Transdisciplinary Methodological Option for Initial Research Process: Training of Researchers

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A methodological option that could be applied in the training of transdisciplinary researchers is presented, fulfilling the characteristic features of the perspective transdisciplinary. The proposed contemplates four phases: 1). Contextual, documentary and field research, 2). Self-research, 3). Experimental research and 4). Research of impacts. The literature indicates that transdisciplinary research address real-world problems, contextualized, focused on space and place and evidenced scientifically, knowing general and specific contexts, addressing the problems and the solutions with actors that live them. The researcher subject should comply with scientific profile, creative, systemic and transdisciplinary, with attitudes of patience, tolerance, rigor, conscience, etc. The research is focused from the beginning, collaborative and participatory, integrating disciplines and not disciplines, integrating tools in general methodological, systemic and non-systemic, etc. Finally, in relation to impact: the proposed solution must be tested and evaluated in real world, as well as contemplated the communicating results to scientists and non-scientists, etc.

Keywords: Research process, transdisciplinarity, methodology, training of researchers.

1 Introduction

The transdisciplinary research process (TD-RP) has been carried out in different places of the world (Klein et al., 2001; Klein, 2001; 2008; Wallner and Wiesmann, 2009; Pohl et al., 2012; Harris and Lyon, 2013; Zscheischler and Rogga, 2015; Schnenberg et al., 2017) [1-8]. Successful results have been confirmed when applied in urban research projects, sustainable development, climate change, environmental projects, health, wastewater, energy, architecture, education, etc. (Sholz et al., 2000a; 2017; Goebel et al., 2010; Stokols, 2011; Enengel et al., 2012; Siew and Döll, 2012; Fam et al., 2014; Serrao-Neuman et

al., 2015; Miah et al., 2015; Nascimento and Pólvora, 2016; Hoffmann et al., 2017; McGregor, 2017a) [9-20].

In this sense, from the introduction of the term and later as an approach on the practice during the research process has gained experience, overcoming challenges and obstacles. Several researchers have communicated their experiencies in the practice of this vision to generate knowledge. Thus enabling that other researchers to learn to cover most characteristic features. Thereby, according to the sociocultural, political contexts, etc. some researchers from around the world are applying this perspective as a way of investigating, covering an increasing number of characteristic features necessary, according to what has been reflected over time by different authors that should fulfill a transdisciplinary research process (Klein, 2001; Pohl and Hadorn, 2007; Hadorn et al., 2008; Wiesmann et al., 2016) [2, 21-23].

Future and current researchers, research groups, research networks, etc., is necessary to be aware of this vision to identify and propose solutions to the complex and challenging problems of the world. Which, some of them are for survival as a species. For this reason, having methodological options that support the development of the transdisciplinary research process is relevant. Since they could be incorporated into the practical life of scientific research processes. Which should be oriented to address the diverse problems of our societies, according to the physical, social, cultural, educational, ecological, economic, political contexts, etc. In this sense, the aim of this document is to share the characteristic features of the transdisciplinary vision. In addition to propose a methodological option for a scientific research process under this vision.

2 Research Process

Etymologically, process comes from Latin *processus*, that comes from the verb procedere which is composed of pro – (forwards) and the Latin verb cedere (to walk, to march, to retire, etc.). According to the Oxford dictionary [24] and the Royal Spanish Academy (REA) (2017) [25], the term process is understood as 11the set of operations to which a thing is subjected to elaborate or transform it" and "action to go forward", "passage of time and set of successive phases of a natural phenomenon or an artificial operation". On the other hand, the term research is "action to investigate" (Oxford Dictionary). Where "Investigate", comes from the Lat. *Investigāre* whose meaning is "to investigate to discover something" and to carry out experimental or intellectual activities in a systematic way with the purpose of increasing knowledge about a certain subject (REA). Thus, the research process could be said is the set of operations that are carried out in the performance of experimental or intellectual activities, in a systematic way. These activities have the purpose of increasing knowledge. Next, the related to the transdisciplinary research process, its characteristic features will be addressed and it will be finalized with a useful methodological option in the training of transdisciplinary researchers.

2.1 Transdisciplinary Research Process

The fundamental features of the transdisciplinary research process, according to the literature reviewed could be related according to: a) the problem being addressed b) subjects that investigate, c) Research process, and d) Impacts of research.

2.1.1 Problem Addressed

One of the first characteristic features related to the problem that is addressed is that it has to do with a relevant problem in the real world (world of life). So, the transdisciplinary (TD) perspective, would be located in a way to generate knowledge for the benefit of society. It is worth mentioning that the desire to do science for the benefit of society is from before the introduction of the term at 1970 (Klein et al., 2001; Ramadier, 2004; Bernstein, 2015; Sholz et al., 2017; McGregor, 2007). Greats scientific like: Bacon (1561-1626), Einstein (1879-1955) and Niels Bohr (1885-1962), For example, they had in their lives the desire to serve society. Likewise, Claude Bernard said that the phenomena of life should be studied in the context in which they develop (De Romo, 2007). In 1994, Gibbons et al. [27] indicated characteristics of the transdisciplinarity related to the problem, it must be contextualized, it must exist first and then be investigated. Being necessary to focus on space and place with a defined target population (i.e., those affected by the problem), establishing the importance of contextualizing the problem. Meanwhile, in the World Congress of Transdisciplinarity, the Charter of Transdisciplinarity is elaborated. Indicating in the article 11 that: An authentic education

cannot privilege abstraction in knowledge. It must be taught to contextualize, concretize and globalize (Anes et al., 1994) [28]. Understanding that the problems that transdisciplinarity addresses may change over time (Gibbons et al., 1994) [27] and they are complex.

Pohl (2005) [29] mentioned that the research TD, must take into account the complexity of the problem -*i.e.* the complex system of factors that together explain the current state and its dynamics. Approach the diverse perceptions of science and society on a topic, and separate the idealized context of science to produce practically relevant knowledge. Galvani (2008) [30] indicated that the perspective TD, could address environmental issues, intercultural, poverty, health, etc., transcending the specialization.

According to the aforementioned, transdisciplinarity *per se* is challenging, Lawrence and Després (2004) [31] mentioned that the TD address the complexity of science and challenge the fragmentation of knowledge, but also it is focus on socially relevant problems. Transdisciplinary research for Pohl and Hadorn (2007) [21] refers to: (a) consider socially relevant problems as drivers of the posing of scientific research questions and (b) address complex problems involving a variety of scientific and social actors considering the diversity of participants among other characteristic features of TD. On this basis, methodologically; future researchers in the initial processes of research, must also contemplate the definition of a heterogeneous specific group. These groups will be made up of diverse specialists from the same discipline or another discipline, as well as members of the population affected for the problem. Ideally, decision makers should also be involved in order to influence the necessary changes in the real world. In cases of transdisciplinary research with the industry, members of the academy are considered from the beginning, on the one hand and on the other hand, participants of the industry (Miah et al., 2015) [17]. In cases of collaboration with ethnic groups, also the different participants are defined at the beginning of the research according to the proposal by Berger et al. (2016) [32].

Among other characteristic features of transdisciplinary research generates knowledge of interest to the scientific community (Stokols, 2003) [33]. This implies carrying out research activities with scientific rigor. For example, when you get evidence of the research problem existing in the real world. It must know, characterize, describe, to later analyze, evaluate and diagnose. In such a way that these activities allow to obtain scientific evidence of the problem. It is necessary to establish the research questions that can led to the appropriate experimental tests. For this, the participation of diverse disciplines and actors of the problem will be necessary in their definition and obtaining evidence of it.

Overall, the transdisciplinarity is based on several theories as systems and complexity that to propose a way of thinking. Being, this evolution of thinking different to from the disciplinary thinking. It requires a type of contextualizing thinking, beginning with the assumption that any system is understood in terms of the environment and its larger relationships, and connections. Showing how to gather information from separate disciplines so that it can be useful and allow to act wisely (Flyvbjerg, 2001; see Montouri, 2013) [34-35]. Sensitizing the participants and sharing the findings with them, as well as when they obtain findings to be published and shared with the scientific community, carry out.

It is also done, since it should not be forgotten that the knowledge generated fulfills a function towards the real world, but also it covers the intellectual concerns of scientists (Stokols, 2003) [33]. The transdisciplinary research process (TD-RP) is a process of scientific research that fulfills important features such as integrating disciplinary knowledge. It is a vision focusing on solving real-world problems, covering the scientific rigor required in each research activity conducted. Beginning with that basic scientific rigor to subsequently reach the transdisciplinary rigor (rigor that contemplates the other, the others and the other), according to (Basarab, 1996) [36]. The TD-RP is distinguished for being collaborative, from the definition of the problem itself. In relation to this collaboration process, Hall et al. (2008) [37], distinguish three aspects that would be influencing: environmental (contextual), intrapersonal and interpersonal. These authors, posing a model to evaluate collaboration based on results and products obtained among other indicators.

It is necessary to highlight the importance of using methodologies, tools, etc. to integrate the knowledge of the extra-scientific and scientific. Also, communicate, reconcile interests, establish consensus and agreements, etc. being indispensably the self-observation (Carrizo, 2004) [38]. A deep inner work

of the subject that investigates (Basarb, 1996) [36], is a challenge to carry out. Since it is necessary to cultivate a transdisciplinary attitude (Klein, 2004) [39], which could be a virtuous attitude. In order to comply the desirable requirements that, among others, Ausburg (2014) [40] points out must have a transdisciplinary investigator.

2.1.2 Subject that Investigates.

Characteristic features that are identified as necessary to develop in a transdisciplinary researcher are among others: scientific, systemic and creative thinking, and trans-disciplinary attitudes. In the article 14 of the transdisciplinarity letter it is indicated to develop: Rigor, aperture and tolerance (Anes et al., 1994) [28]. The same that Nicolescu approaches in the document that he elaborates, entitled: "The manifesto of transdisciplinarity" (Basarab, 1996) [36], where he mentions that these attitudes should be in the practice of TD-RP. Although one could say that they are these, among some, required to fulfill the characteristic features of a research process of this type. According to Ausburg (2014) [40], among the characteristics of a person who wants to carry out transdisciplinary research are: 1). abilities to think in a complex and interrelated way, 2) abandonment of the intellectual comfort zone, 3) working outside the discipline itself, 4) participating in new ways of thinking, 5) "Freeing yourself from reductionist assumptions about how things relate, how systems operate and the expectation that science offers a "better" solution or final answers", 6) joy that comes from seeing things in a new way, 7) need and mutual trust, 8) having a modest position, 9) ability to build networks outside the familiar, etc.

In general, it is necessary to develop virtue, which leads to actions aimed at integration, collaboration and a desire to serve the other, the others or the other (the next, the distant, the environment). Our young researchers on formation, it is important to take that awareness of working on the development of virtue. That leads to self-transformation, to the environment and finally transform another. Even, Basarab (1996) [36] discuss the transgression of individuals. He defines transdisciplinarity as: "A generalized transgression that opens an unlimited space of freedom, knowledge, tolerance and love". On the other hand, transdisciplinarity is defined as a methodology. Which, covers three fundamental pillars: 1). Different levels of reality, 2) The third included and

3) The complexity (Basarab 1996; 1997; 2010; 2013; 2014, McGregor, 2013) [36, 41-45].

Basarab (1997) [41] mentioned that transdisciplinarity is open globally, and this process could be invaluable for education. Unesco reported by Jacques Delors (1996) [46] emphasizes four aspects in education: a). Learn to know, b). Learning to do, c) Learning to live together and d). Learn to be (Espinosa, 2014; McGregor, 2015a [47,48]. Hence, educating in the transdisciplinary could have an impact for the sustainable development of nations and societies. Because, it involves training the allows the development of empathy, human values, etc.

In this sense, the education Dieleman and Juárez (2008) [49] indicated it should not be a "rational" of only knowledge transfer activity. Rather, a process of learning various elements such as knowledge, values, stimulation skills, self-reflection, etc. Thus leading the learner to "learning in order to act", this is to act manifesting the transformation, then to provoke as say Kolb (1984) [50], that the observation serves for the transformation through the accumulated experience. According to Espinosa and Galvani (2016) [51], the authors, Maturana and Varela (1998) [52] are among many others, those who approach the knowledge and learning transdisciplinary.

Another relevant feature to develop in the researcher TD is the transdisciplinary language. Roberto Juarroz (1994) [53], says that a common language is required to communicate and dialogue. Paraphrasing him: "First, I will say that any change of vision (because I think we are experiencing a change of vision) presupposes a change of language. It is not possible, with the words of old visions, to continue talking about this inaugural vision. This new vision to which intend to access and to express from the transdisciplinary attitude and language".

The term "transdisciplinary attitude" (TD-A) is recognized by Basarab that it, was introduced by Juarroz (Ramadier, 2004) [54]. It is required by the subject researching (investigator) a transformation, towards this attitude (Basarab, 1997) [41], raises the self-transformation oriented towards the knowledge of the self. The unity of knowledge and the creation of a new art of living. "The universal exchanges of knowledge cannot take place without the emergence of a new tolerance based on the transdisciplinary attitude. Which implies putting into practice the transcultural, transreligious, transpolitical and transnational vision. Hence the direct and

indisputable relationship between peace and transdisciplinarity" (Bermdez, 1998; Camus and Basarab, 1997) [55,56].

Previously, Ramana Maharshi (1879-1950) proposed self-inquiry (Maharshi, 1998) [57]; he said: "You talk about seeing and knowing the world. However, without knowing yourself, the knowing subject (without which there is no knowledge of the object), how can you know the true nature of the world, of the known object?". Highlighting in the same way the importance of self-knowledge. On the other hand, Ivánovich Gurdjeff (1866-1949) who raised a possible spiritual and humanitarian evolution of man and for his side, Ouspensky (1878-1947) proposed self-knowledge as a requirement for interiorization and possible evolution of man (Ouspensky, 1978) [58]. Jiddu Krishnamurti (1895-1986) indicated how could be bring about a positive change in society and proposed that education not only consists of learning, academic subjects, but implies educating oneself (Krishnamurti, 1983a; 1983b) [59,60]. They, among many other philosophers, writers, scientists, spiritual teachers, etc., have felt their world and have dedicated themselves to cultivate a particular attitude. In these poly-critical times, is necessary to cultivate this attitude in the researchers in training, order to feel to the society, understand it and long to serve it. For Goethe (1749-1832), science was both an internal path of spiritual development and a discipline focused on accumulating knowledge of the physical world. Involving faculties of observation and thought, but also, other human faculties related to the spiritual dimension (Max-Neef, 2016) [61]. Claude Bernard (1813-1878) distinguished in the experimental method three fundamental elements: feeling, reason and experience. Thus, rejecting research without feeling because for him it is necessary to be amazed and to be sensitive to what surrounds us and that the imagination awakens to intuition. Another important aspect of Bernard's thought was that the phenomena of life should be studied in the context in which they develop (De Romo, 2007) [62]. In this way, a conscious and in motion investigators are required; that they can go out into the real world and entering the Laboratory and vice versa. It is important highlight; the investigator must be in constant dialogue with the participating group (among them the actors of the problem). Gibbons mentioned that, the investigators from its beginnings of the research process require dialogue with different participants and actors. He suggested that, if you are going to work in transdisciplinary research you need to have a lot of patience (Klein et al., 2001) [1] throughout the entire research process. Developing patience is one of the additional tasks of the researcher. So it is necessary to self-investigate himself to self- know himself.

Morin (1988) [63], notes that "the knowledge operator must become at the same time in the object of knowledge". In this way the researcher becomes in subject to investigate. Through this process of self-research that produces self-transformation, one would expect the researcher in transdisciplinary training (RiT-TD) to learn to work and dialogue with others. McGregor (2004) [64], highlights the importance of people continually working on how to be with others. In addition, they must that work on finding their own potential, striving to develop creativity and sharing instead of selfish retention of "my" knowledge. Where the person opens up to permanent questions and reflexive dialogues within different Reality levels.

In such a way that the research process is outward and inward, it is self-investigating and investigating outside. The process of inward investigation that entails self-transformation must be a constant work to be transdisciplinary investigators. Klein (2004) [39], notes that the attitude TD should to be cultivated by the researcher. In this way, the investigator subject and his self-research for self-transformation is the basis of the entire transdisciplinary research process. It would be the cornerstone of this research perspective since there can be no transdisciplinary process without researchers working on their attitude and development of virtues. Then and only then can you work in the transdisciplinary research process, especially when you are the leader of a research process of this type.

2.1.3 The Research Process (RP)

The research process under transdisciplinary perspective would be with and for the real world. In this way, it has another characteristic feature is that the various actors of the problem, people who pose the problems, those who are involved, etc. participate in a mutual learning process (Sholz, 2000a; Pohl and Hadorn, 2008) [9, 21]. Term recognized by Roland Sholz and colleagues at the Zurich Conference (2000), as a basic principle in the transdisciplinary research process (Klein et al., 2001a; Sholz, 2000b; Vilsmaier

et al., 2015) [1, 66-67], being Sholz who introduced the term according to his own experience in the research process, years ago when sharing results with the actors of the problem. In general, you could say, "we are all sometimes teachers and all sometimes, students", always with the attitude to receive learning as to share. The participation of the target group (i.e., those affected by the problem) is an indispensable characteristic. It is better, as long as there are more participants (Enengel et al. 2014) [68], involved and committed.

Some authors are convinced that user participation is often perceived as reinforcing the interdisciplinary nature of research projects and can be considered a way to "expand the mind". The strong interdisciplinary proposals are considered to be those that are designed in close collaboration with potential users (Bruce et al. 2004) [69]. In this way, the researcher TD, when interacting with users and for them, could discover the learning in practice, and in this way allow enrich ideas, experiences, etc. to carry out the research process. Taking advantage of the experiences known by the participants who have experienced the problems in the real life. Pineau (2009) [70], points out that non-scientific knowledge is as important as scientific theory.

Another characteristic feature of TD, is to make connections not only across the boundaries between disciplines, but also between academic research and the sphere of tacit and experiential knowledge. Where it is required to do a "border work" for this activity, reflecting an awareness of the difficulties of crossing what are, in fact, controlled limits (Horlick and Sime, 2004) [71] of both parties.

In this sense, the scientist would have to expand the formal methods used in traditional science with a way of producing hermeneutical knowledge (Dieleman, 2015a) [72], *i.e.* generates knowledge based on experience and reflection (Gadamar, 1975) [73]. Reflection that according to Arboleda (2015) [74], lead more to understanding than to attack, more to contribute than to disfigure, more of a criticism (Kantian), without judgment, to criticism (agon). It is very important, accept throughout the process (stages of dialogue, decisions, proposals, etc.). that there are different levels of reality interacting with each other as indicated Torkar y McGregor (2012) [75]. Thus, it must be understood that there are different perceptions and the points of view must be integrated. It requires a close and constant collab-

oration among researchers, at all phases of the RP (Després et al., 2004) [76]

Likewise, other characteristic features are distinguished in the research process, e.g. Gibbons et al. (1994) [27] note between other characteristics of transdisciplinarity: 1) the solution to the problem integrates disciplinary and empirical knowledge, and 2) The results should be communicated to those who participate in the research process; *i.e.* the results will be communicated to the scientific and non-scientific community. According to Lawrence and Després (2004) [31], the representatives of the different disciplines would have to be participating in the whole research process, as many times as necessary with the actors of the problem, co-producing knowledge and collaborating. In case there are several disciplines collaborating and sometimes one of them is interested in addressing the problem and sometimes the other may be not (leading). Zandvoort (1995) [77] suggested how two programs could cooperate in the research. Based to the organize among them, with possibilities of being a guide (when a program initiates research) and being a provider (the program or invited discipline), being relevant the organization in the transdisciplinary research. Always with the desire to co-participate in solutions to problems of the real world and society. Pohl and Hadorn (2007) [21] mention that transdisciplinary research refers to: (c) generating knowledge that is oriented towards a socially robust and transferable solution to both scientific practice and society.

In this way, during the research process, it is necessary generate knowledge of interest to the scientific community and also the affected population, involving to decision makers. This characteristic of the research process TD, it coincides with Hoffmann et al. (2017) [78]; who indicate that it is necessary to involve decision makers as in the case of the application of a transdisciplinary approach between scientific-technological sciences and the economic ones as pointed out Zscheischler et al. (2017) [79]. In the review elaborated by Wickson et al. (2006) [80] the transdisciplinary approach is approached from the problem, the collaboration and the methodology. They emphasize that in the transdisciplinary perspective, it is possible to use several methodologies and focuses on real-world, complex and multidimensional problems that affect society, where the dimensions philosophical or theoretical are not the starting point, is the problem as experienced in society and

its environment. In relation to effective collaboration in transdisciplinary science initiatives, Stokols et al. (2008) [81], identify four main areas that could facilitate such collaboration: 1. social psychology and organizational behavior, 2. cybernetic infrastructure for remote collaboration, 3. community coalitions between scientists and practitioners, and 4. evaluation studies of transdisciplinary research centers and training programs.

Some authors in the Congress on trasdisciplinarity (Klein et al., 2001) [1], celebrated in Zurich, it was reported several reflections related to the research process. Waldkirch (2000) noted: We must move from an "information society" to a "cooperative society". This will require, curiosity, as well as the ability to interact with other Disciplines and a willingness to Cooperate and find partners that fit together. Sholz and Marks in this same event mention that a research process TD, in general, includes Epistemologies, Methodologies and Organization. Hurni-Hans and Pohl indicated that through mutual learning, the knowledge of all participants is improved, including local knowledge, scientific knowledge and knowledge of interested industries, companies and non-governmental organizations, these authors, among others, add characteristic features to the Transdisciplinary research process. The fulfillment of these characteristics during the research process, among others, could strengthen the scientific contributions that can contribute to the improvement of the quality of life of the society.

2.1.4 Research Impacts

Transdisciplinary research is characterized by being carried out "with" and "for" the community. The main challenges of this type of research could be working together for an objective and the common good, although there are different features: levels of reality, knowledge, level of individual interior work, disciplinary training, worldviews, interests, ages and sex, social positions, religion and beliefs, physical and mental health, decision makers, etc. In addition to maintaining the longing to positively impact to the society, this helps to improve the quality of life for everyone. Then, it is an important point, communicate results to society, thus impacting the different holistic levels when the results are provided to the real world.

An effort different from what has sometimes been done in science, in hyperspecialization where academics and researchers are sometimes hermetically isolated (Montouri, 2016) [82] and do not leave the laboratories. Here is a work that impacts to different holistic levels of the real world. This impact could be in periods almost immediate, as the research progress or when is communicate results to the society at levels different: local, state, national, regional dimensions, etc.

This allows a cybernetic process, where can be feedback loops throughout the entire research process. Researchers are disseminating results to the target population, but also to the scientific community. Gibbons (2000) (See, Klein et al., 2001) [1] mentions that the research results must be written in such a way that it can be understood by his colleagues. However, it must also be taught to the public, in this way scientists need to assume responsibilities to develop focused research. Once the research is done, according to Richard Ernst- Technological Institute of Switzerland and Nobel Prize in chemistry, 2000, see Klein et al. (2001) [1], it is very important teach the public and speak in the media and other forums.

In fact, it is said from the beginning of the investigation it would have to be impacting in some way in the specific community. Some authors point out the importance of transmitting the knowledge and feed it back with the target population starting to work from the beginning of the research with them. Allowing yourself in this way, to know the specific problems and jointly to define the problems and what is known, and done about it. Likewise, to propose solutions and demonstrate that they could be. In such a way that Transdisciplinary Research has to serve society (Perrig-Chiello et al., see Klein et al., 2001) [1], obviously impacting on it.

It should be noted and emphasized, that research from transdisciplinany perspective, must maintain a scientific basis and the process must follow those scientific rules (Balsiger, 2004) [83].

Thus, Sholz and Marks (Klein et al., 2001) [1] mention that "Transdisciplinarity is an activity that produces, integrates and manages knowledge in technological, scientific and, social areas" as the prefix "trans" indicates, goes beyond the disciplines, implying the social, health and environmental impact, educational, economic, political, etc. at different holistic levels. Another characteristic feature of the research process under transdisciplinary perspective is to pretend to generate socially robust knowledge (Gibbons, 1999) [84] establishing a contract of science

with society, generating knowledge that corresponds to the diverse social demands of the epoch (Cupani, 2012) [85], within what is called mode "2" to produce knowledge (Gibbons, 1994;1997; Nowotny, 2000) [27, 86-87].

In this reflection of impacts on society when you research process is carried out under vision TD, Adler et al. (2017) indicated [88] it is necessary considerate the transfer of knowledge. Thus, research TD, contemplates the transfer of knowledge, *i.e.* through of the the RP-TD it is obtained a solution, demonstrated for a specific case and specific context. So, it must be considered, how to apply it to another context with the necessary adaptations to be able to transfer to other contextual situations (Adler et al., 2017; Wiesmann et al., 2016) [88, 23], in such a way that the knowledge generated can serve to different contexts.

Before evaluating the impact of the research, the research group will have to implement the solution in the real world. They must integrate and synthesize the results found to evaluate the impact in present and future. It can be said: In general, at the end of the research under traditional vision, they are distinguished the activities of conclusions, presentation of results, innovation or new knowledge and communication of results (Crespo-Moreno, 2006; Hernández-Sampieri, 2005; Pedraz, 2003; Gray and Malins, 2004) [89-92]. The case of the participatory action research process, it is proposed to hold workshops in the final phase (Mart, 2000) [93].

In the TD-RP, the results could be presented as the research progresses, sensitizing the participants and sharing the findings. When the findings are available to be published and shared with the scientific community, submit to arbitration respective of journals and give follow up for publication. It should not be forgotten that the knowledge generated fulfills a function towards the real world. However, also covers the intellectual concerns of scientists as it is clearly noted by Stokols (2003) [33].

The process of transdisciplinary research is a process of scientific research. This type of process is relevant that fulfills important features such as integrating disciplinary knowledge and not and also focuses on solving the real world problem. In addition, the entire process meets the scientific rigor plus that rigor that contemplates the other, the others and the other. Among other problems of the transdisciplinarity are distinguished: the institutional aspects

and that the decision makers, can gain credibility of their national scientific community. Also, that the researchers approach the problems according to the needs of the country. Where the actors of the government could get involved. Notably, in the first congress of trandisciplinarity celebrated in Portugal they were present: president, government, civil society, industry and academics according to McGregor (2015a) [48]. Involving the government and decision makers of high rank is relevant to produce the necessary changes in society.

It is important to be aware that for the desirable positive impact to exist in the target population, their participation is also important. So, the target population must also allow yourself to go through the changes and the respective evolutionary processes for the incorporation of the respective solutions in their lives when necessary. Also, developing the awareness of being citizens of the world (Lazlo, 2010) [94]. In transdisciplinarity, humans have the potential to reconcile differences and contradictions, leading to a higher state of existence (McGregor, 2015b) [95], this, could allow integration and peace.

Of this way, the training of new transdisciplinary researchers requires trainers who are also convinced of the challenges they face, e.g. in continuing this vision TD for research, despite the obstacles and the sometimes cultural resistance to which it faces.

Also, it is required, develop resilience in oneself and share it with the group before the situations, etc. it's about re-educating. According to D'Ambrosio (1996) to educate, is the strategy of society to facilitate everyone to reach their creative potential and develop their capacity to collaborate with others in common actions, seeking the common good. So, this approach to educate in TD would be rescued. So that, all those involved would be in a process of re-educating themselves. Impacting continuously with this re-education in the quality of life of society.

For a researcher to reach positive impact on society; in principle, in its stages of formation, the student must develop minimally the attitudes of rigor, aperture and tolerance as enunciated in the transdisciplinarity letter (1994) [28] and considered by Basarab (1996) [36]. According to Espinosa (2011) [97], rigor is related to the inscription of the researcher to a discipline. Tolerance is included in the levels of reality and the opening is manifested by the dialogue.

These attitudes in practice is a challenge to live

them, being considered the cornerstone for the development of a PI-TD. The investigator should do constant tasks for the development of qualities and virtues, sense of responsibility, etc. For this reason, education in the transdisciplinarity of researchers is relevant. Espinosa and Galvani (2014) [98], point out a basic triad in university education: transdisciplinarity, complexity and eco-training.

There is no doubt that the changes in society today, could start with individual changes. Young researchers in training, must go through these individual changes, in order can influence on society by proposing systemic solutions to problems to the world.

Young researchers in training face a great wave of distractions. they live the information age with their respective positive and negative consequences. With regard to the negative, it could produce mental noise that could impede their evolution. Its necessary become aware of it and decide to walk towards wisdom. D'Ambrosio (2009) [99], indicated that trainers and students should be led towards good sense, prudence, moderation in the way of acting, temperance (not getting carried away by the anger that is felt) and reflection. Also, the ability to consider all the factors implicit in a situation, be holistic and transdisciplinary.

The training of a profile of transdisciplinary researcher implies the training in aspects holistic and human (Hernandez-Aguilar et al., 2013) [100]. Humanization processes of all researchers and society are necessary. Among the many research questions posed by researchers, they should also consider: Do my research and work make life more human? Do they make life more valuable for men? What good do I do with what I do? etc.

A methodological option that could support the training of young researchers, covering the characteristic features of a transdisciplinary perspective, is addressed in the following paragraphs.

3 Methodological Option for an Initial Research Process

A methodology that could be used in an initial research process under a transdisciplinary perspective in the formation of students consists of four phases: I) Contextual, documentary and field research, II) Self-research, III) Experimental research and IV) Impact research, each of the phases proposes to have

six sub-activities proposed to be developed.

3.1 Phase I. Contextual, Documentary and Field Research

The first phase of the methodology is related to the problem to be addressed. In this phase, the researcher in training could develop the following activities: 3.1.1 Knowledge, choice and contextualization of the problem - knowing and observing the world - documentary research, 3.1.2. Field research in the real world and analysis, evaluation and diagnosis (AEaD) through field research in the real world, 3.1.3 Definition of specific problem in a collaborative way (disciplines and interest groups), 3.1.4 Research of scientific literature (A Review) of the proposed of solutions to the problem to be addressed, and the solutions to the problem in the real world (in practice), 3.1.5 Learning of theories, methods, tests, tools in general, etc., and 3.1.6 Determination of the alternative of solution or research proposal to be developed.

3.1.1 Knowledge, Choice and Contextualization of the problem

In this activity, the researcher establishes the general context (Cx) of problems; observing the several problems of the world (climate change, environmental degradation, energy, water supply, poverty, inequalities, diseases, malnutrition, natural disasters, mobility of people, transport, unemployment, wars, food, etc.) and begin to know them to decide the problem in which you will participate. From there, he will begin to learn to contextualize the problem at a global (G), regional (R), State (S) and local (L) level, to then concrete it at a specific level, going through activities of decomposition of the same, as many times as necessary and activities that allow to specify, exactly in what of the whole of the problem will participate. In this way, he will first locate the existing problem in the real world and then investigate it, fulfilling the characteristic features of transdisciplinarity when the problem is approached. So, the researchers in training could: a). Conduct a review of scientific literature and of reliable statistical sources, b) selecting and identifying of the problem in the real world (RW), c) Decomposition of the problem leading to its targeting, d) Apply diverse systemic and non systemic tools and methodologies to represent the problem and e) From the

selected problem, depen knowledge of it identifying its greatest empathy (conecction with phase two). Moreover, the RiT-TD, have to: a) Do the determination of the system and its interelations (sub and supra-systems), b) Selection of variables in the specific context and its interelations (sub and supra-systems), regulations, etc., c) Behavior of problem variables over time (past, Pre: present and F: Future), d) do the Representation of variables using software (Maps G, N, etc.), e) Prediction of future behavior of the variables (mathematical analysis Amv: Apply various methods), f) Correlation or interconnection of problem with other problem, g) Determination of possible causes of the problem and its impact and the future behavior of the system (causal diagrams and forecast of variables). So, specify the problem and begin to analyze systemically for this could make use of methodologies, models and / or various systemic tools and no. It is proposed to choose variables that represent the behavior of the system and contextualize these in time Past, present y future, correlating the variables with the specific problem and analyzing the possible causes of it, make the representation of the problem and possible causes. Subsequently, the researcher could assess the relevance of the problem through the evaluation of the impact in different dimensions: social, environmental, political, educational, economic, etc. at the national (N) and / or local (L) level- Also, could analyze the quality of life of the population, and determine with which sector of the country, the problem is related. in this way, the RiT-TD can define the relevance of the problem, and to visualize what will be the specific problem within the specific context, like so, the respective target population.

In this stage, the researcher will gather contextual data of the specific study system and the environment considering the dimensions: social, environmental, educational, technological, economic, physical, geographical, political, scientific, etc. In this way, it is necessary to resort to sources of statistical information worldwide and at a national level depending on the country in which the research is carried out, It would be possible to go to governmental instances or not (e.g. in Mexico, we use information sources such as the World Bank, National Institute of Statistic and Geography, National Aeronautics and Space Administration, National Administration of Aeronautics and Space, Agrifood and Fisheries Information Service, Secretary of Agricul-

ture, Livestock, Rural Development, Fisheries and Food, International Maize and Wheat Improvement Center, Federal Attorney's Office of the Consumer, Mexican Social Security Institute, Official Journal of the Federation, Conapo: National Population Council, Pan American Health Organization, Globocan , International Agency for Cancer Research, World Trade Organization, you could even resort to statistical data available on the internet in real time). The choice of sources of data information will depend on each research project and the interest to contextualize the problem over time and based on the type of information available. It is important to highlight that within the proposed methodology; it is indicated to perform scientific activity report. The preparation of the documentary research report, following recommendations of style and format scientific IMRaD (Introduction, Materials and Methods, Results and Discussion) is very important. The researcher in entraining could a) know the rules and style of scientific writing, b) prepare the report of the field investigation and / or of the characterization of the object and / or subject of study (clear, concise, accurate, objective, congruent (CCAOC), c) read, debug, re-reading, writing envolve and assess contribution, and d) communicate results (Cdr): (scientific community: congresses, symposia, journals, books, manuals, etc.) and / or dissiminate knowledge to communities, preparation of manuals, web pages, various media, disclosures, etc.), decision making towards where to communicate results.

The process of scientific activity report carried out is important in the training of the RiT-TD since it allows him to arrive at the communication of results in order to submit himself to the criticism of the research peers. It also allows you to systematize the research and engage in daily activities of the researcher, ask research questions, find answers, decide on the research to be carried out after, plan it, establish it, follow it up, analyze it, interpret it, assess it, report it and decide where the communication will be realizated to Seminars, workshops, congresses, conferences, scientific note, original article, etc.

3.1.2 Field Research in the Real World and Analysis, Evaluation and Diagnosis (AEaD)

Once the problem is focused on space and place, the RiT-TD, will obtain evidence of it, through studies of the population's perception or through physi-

cal evidence. demonstrating scientifically that the problem is located in the real world and affecting a certain target population by carrying out field research or characterization of objects and / or study subjects. From the beginning of the development of the activities of this phase, it is proposed to adopt the systematicity to investigate. In this way, the RiT-TD could: a) Analyze system, specifying area of study and specific case to investigate, b) AEaD based on Perception study (a) see phase III, AEaD based on physical evidence (see phase III), c) Investigate similar reports in the literature, identifying what they have done, how have they done it? What have they found? and what could be done?, d) Define and characterize the object of study (biological, agricultural material, subjects, communities, target population, liquids, solids, etc.), type of tests, etc., e) Establish objective and hypothesis of the research, f) Research planning (help with planning tools), g) Definition of experimental design or research design and statistical analysis, h) Establish experiment or field research and rigorously monitor the investigation (obtaining and recording data); to later analyze the results found. In this way once the activity is carried out, it will proceed to the report of the scientific research activity until it is communicated. Thus the researcher will have to: a) Prepare a report on scientific research activity (style IMRaD), b) Prepare section of the introduction (suggestion: prepare prior to the realization of the activity of research), In general, to describe the importance of the research activity (AdI): why is it done? for what is it done? Who serves? etc. Review the literature (RoSL) of studies related to what is intended to be done, establishing objective and hypothesis, c) Writing the section materials and methods (M) according to the rules of scientific style in accordance to the sequence in which the investigation was carried out, d) Writing the results and / or findings starting with statistical analysis and description of the relevant results found by evaluated variable, e) Discuss the results found when counteracting what has been reported with others, f) Elaborate conclusions, clear, concise precise objective CCPO, etc. related exactly to what was demonstrated or found in the investigation, Cdr., g) Diagnose the problem with evidence of it and determine the causal factors and implications of the problem and h) Report the diagnosis: What happens? How does it happen? Why it happens? Who does it affect? etc. to proceed to solve *i.e.*

know for transform, Cdr.

The scientific evidences found are added to the experiences lived by the "problem actors" and adding visions could establish a diagnosis with a wider vision of the problem. It is important to note the possibility of using diagnostic methodologies, systemic or not (e.g. soft systems methodology), as well as multitribute techniques that help to prioritize problems, identify causes, (e.g. Analytical hierarchy), as well as make network representations of social problems, etc. Altogether, in this methodological step we could have evidence and a transdisciplinary systemic view of the problem. It should be clarified that, in case of studies of perception, it should be known the total population chosen to study, and it defines the sample size to be evaluated, defining a specific target population. If you choose to apply a survey, it must be designed and validated, using methodologies for its preparation and validation. Record data, organize them, process them, analyze them statistically, interpret them and report results of the research activity, and then, like any research activity carried out, communicate results. Recalling that in the research, under the transdisciplinary perspective, the results of the research could be communicated, to the scientific community, to the collaborating group of interest and / or to society.

In the case of analyzing and evaluating samples collected from the real world, as evidence of problem, through a specific object of study that can be achieved, it is necessary to remember that various specific disciplinary tests could be used to evaluate it.

3.1.3 Definition of Specific Problem in a Collaborative Way (Disciplines and Interest Groups)

In the present activity, the researcher will integrate the heterogeneous group of participants and, together with them, define the specific problem to be addressed collaboratively (disciplines and interest groups). The specific problem of the investigation, could be considered collaboratively. This is importante point out that in the course of time different disciplines are integrated, and also actors of the problem. In this step, it is very important to reflect: How is integrated a working group: to discipline and not? What attitudes do you need to have to remain integrated in a work group? how to reconcile interests? how to solve conflicts? define, what it is that could

allow union, collaboration, commitment, respect, etc. by the members of the working group? Integrate disciplines and diverse actors with different characteristics, cultures, religions, etc. it's a challenge for when you work in a transdisciplinary way.

The RiT-TD, must reflecting on the language that employs, since have to be careful in communicating, in dialogue, etc. It is important develop simple language as part of this methodological step. In this way, in this activity the researcher has to: a) Integration of heterogeneous group of participants (disciplines and stakeholders), b) Identify empirical actors that are involved in the problem (organizations, societies, community partners, other public or private research groups, etc., c) Definition of the various participating disciplines or no - promote relations intra-inter- and trans institutionales, etc., d) Define the problem and its border, without losing sight of the interconnections, as well as the level of intervention to be carried out, e) Determine if the problem is related to any economic sector of the country, among others. Even, it is possible to opt for learning and applying methods or tools that support group work, when it become necessary.

3.1.4 Research of Scientific Literature - (A Review), and the Research of the Solutions to the Problem in the Real World (in Practice)

Once the specific problem to be addressed is located, 1) The researcher must make an exhaustive review of scientific literature to know the several solutions to the specific problem what different authors have reported and 2) Investigate the solutions established by the actors of the problem in everyday life.

In relation to the activity of review of scientific literature (RoSL), the researcher could do it systematically. In this stage, the researcher in entraining will have to develop diverse habits (connected to phase 2, formation of a scientific thought and continue to strengthen its scientific rigor). It is important to define the planning of RoSL, for this the researcher could pose the questions: What is the relevant problem in which the topic to be developed impact? What is the specific topic to address? Why am I going to do it? What am I going to do? Who does it serve? What do you mean? What would you like to transmit and to whom? What are the search keywords according to the specific topic to be addressed? What are the electronic search engines

to use? What are the documentary sources to use? What are the search methods? etc. In this way, the researcher in training could order his ideas and thoughts and proceed to the respective activities related to RoSL: Planning, carrying out, reporting and communicating.

In planning of the RoSL, the researcher could consider, defining the sources of information and decide the digital platforms to be used for the electronic search. (e.g. Ebsco, Science Direct, Google Scholar, deGruyter Open, Edp Sciences Journals, Science AAAS, APS Phisics, Frontiers, Hindawi, Springer-nature, ElSevier, Scielo, Redalyc, etc.). As well as, the researcher must choose the keywords for the bibliographic review during the search process, the frequency of search, the software used for classification and or writing of work, the type of review that will develop, etc., even the work schedule. Subsequently to the planning, continue with the carrying out of the activity of literature research. So, initiate the search and the organization of the information, analyzing and integrating it. To group and classify it. Once classified, you read, you begin to criticize, describe, write, re-read, synthesize, debug, etc. and so on.

It is even possible to adopt the IMRaD (Introduction, Materials and method, Results and Discussion) format, or free format for the realization of the literature research report under a type of article review. What is known about the topic? What has been investigated? What aspects remain unknown and could be investigated? What is the frontier of knowledge of the subject? To be clear about their problem solution proposal, focusing more and more on what will be their object of study and where their scientific contribution will be directed.

It is worth mentioning, on the other hand, the solutions that are given to the problem in the real world will also be investigated with the actors of the problem. Then, it is possible, have elements to decide the level of intervention that will take place, e.g. Atomic, molecular, cellular level, at the level of tissues, organs, organisms, groups, Habitat, Community, Ecosystem, Society, Nation, etc. Criticism is made to what exists, and the proposal of solution or improvement begins to be propose.

3.1.5 Learning of Theories, Methods, Tests, Tools in General

The researcher will need certain learning to carry out the research in each of the research activities and start to go deeper into them. In this manner, could choose what theories, methods, tests, tools in general, etc. it is required learn. In the research process at the beginning, there may be knowledge not yet learned by the researcher, which little by little will learn it.

The learning can be given from any of the researchers to others, or from the actors of the problem to others, or from within the same discipline or from one discipline to another, etc. *i.e* learning and teaching can take place in any direction. It may be necessary to take new courses, workshops, etc., even the need to go to other laboratories. Of this way, the researcher needs a) Identify and learn the theory and concepts necessary to use them in the research process, b) Identify and learn the tools, methodologies, etc., systemic or non-systemic necessary for area of knowledge (formal or empirical), and c) Promote if it is necessary to attend to other laboratories to learn and practice methods, techniques and necessary instrumentation, also interact with the target population (practice of mutual learning for common learning). This stage is also linked to the evolutionary level that the researcher (Phase II), since transdisciplinary, systemic and scientific attitudes must be developed by the researcher.

3.1.6 Determination of Solution Alternative or Research Proposal to Develop

This phase will finish with the determination of alternative of solution or research proposal to be developed, according to feasibility, viability, limitations and scope. In this manner, it is recommended that the researcher can: a) Choose the alternative of solution or research proposal that to will develop, b) Assess the feasibility and viability of research, c) generate research questions, specific objectives and hypotheses, d) Evaluate the scope and limitations of research, e) Use multi-attribute techniques for decision making.

The choice of specific problem to be addressed and the choice of solution to be developed, is linked and connected to the empathy that the researcher may have and knowledge and talent. In general, your life experiences that make you go maybe to a certain path of research. Decisions must be analyzed and evaluated by supporting multi-attribute techniques so that in that way acting in the present and visualizing the future. In general, this phase is linked to phase II, which will be considered below as a methodological step within this methodology proposal to be followed in a research process with a transdisciplinary perspective.

3.2 Phase II. Self-research

The researcher in training (RiT) will be an agent of change, he observes the world and in his critical thinking he proposes new solutions to problems that are experienced. It proposes possible transformations in general, recommending outward changes, starting by by proposing of self-changes in your interior. Among other tasks in the research process are: characterize, know, describe, etc. to "transform". In this sense, the activity that has been proposed in this phase of the research is self-research. If the researcher, knows the problems, describes them, contextualizes them, evidence, etc. It is for the transformation of the system, since it intervenes systems with its new solution proposals. In the same way, in this phase of the research process, the subject that investigates will self-observe, contextualize, show their own and others' problems, as well as their decisions and behaviors, to detect areas of opportunity that could be improved defining the intervention levels of the system itself, for self-transformation and begin practicing scientific thinking, systemic and trans-disciplinary attitudes. This phase is carried out during the entire investigation process and it is linked to the entire investigation process since it is the one who investigates. Among the proposed activities are: 3.2.1 Contextualization in place and time to the "subject" who investigates, 3.2.2 Analysis, evaluation and diagnosis (self-research), 3.2.3 Practice of creative, systemic and scientific thinking, 3.2.4 Develop transdisciplinary attitudes, 3.2.5 Link up with other disciplines and actors of the problem (add in each opportunity disciplines or actors of the problem) and 3.2.6 Link with decision makers, organizations and individuals - raise awareness and to sensitize.

3.2.1 Contextualization in place and time to the "Subject" who Investigates

In the first activity of this phase, it is proposed to contextualize the researcher in time and in different areas of his life: psychological, family, economic, social, etc. It could pose reflection questions: how have you made the decisions over time? Do you remember leaps of consciousness in your life? Which have they been? How do you represent your leaps of consciousness? For what you have these leaps of consciousness served? Etc.

In transdisciplinary research is important the management of emotions, then, it is within the methodology in this phase of self-research considered, the identification of emotions from events that have taken place throughout life: anguish, resentment, frustrations, love, fear, anger, sadness, integration and / or disintegration, etc. It is important, in order to achieve dialogue, to overcome those aspects that may have remained unsurpassed. It's time to rescue the learning of life's experiences and manifest conscious changes in the attitudinal If necessary, the researcher could go to external support treatments. Then, it is advisable to the RiT-TD can check if there is any life experience linked to your decision on the choice of the problem to be addressed. Moreover, any life experiences prior linked to the time that can devote to the research. Know more about self; what has governed your life? What are the values that you manage in the different dimensions of your life? What has been your policy, creativity, virtues, talents, frustrations, successes, failures? Etc. The researcher could establish the context over time, using any support tool for self-knowledge or simply could elaborate an analysis SWOT (strengths opportunities weaknesses threats) at different stages of his life. It is advisable that the RiT-TD, analyze the problems own or of those with whom they have lived together, ask questions about them, reflect on and locate problems or relevant life experiences that have transformed it.

Thus the RiT-TD could a) Elaborate a self-context: historical, physical, psychological, economic, social, etc., b) Become aware of one's decisions over time, c) Representation of the system (self) (and environment) (Application of various methods (Avm) systemic or not) and Locate leaps of consciousness (Avm), d) Study the system and environment, relationship with other sub and supra-systems, regulations, etc., e) Determine its behavior in time: P,

Pre and F, f) Evaluate the impact of their actions on the quality of life in their environment (home, family, neighbors, co-workers, classmates, work organization, school, etc.) g) Propose alternatives to integrate higher holistic levels for current and future decision making based on past experience. Even these activities of your self auto-contextualization, are proposed to report them in the style of research activity, but for oneself, unless there is something that they want to share because it coul be useful to others.

3.2.2 Analysis, Evaluation and Diagnosis (Self-Research)

In this activity of the phase II is contemplated a self-analysis, self-evaluation and self-diagnosis of the current state of the RiE-TD. It is possible use SWOT, multi-attribute techniques, such as analytical hierarchy, etc. for carry out a a current self-investigation of the RiE-TD. In this sense, it is possible realize: a) analyze the system and current location, b) investigate in the literature about self-knowledge, c) define aspects to self-investigate that are relevant (biological dimension, health, emotional, mind, body, potential, tastes, feelings, abilities, preferences, profile as a researcher, etc.), c) planning of self-research (use several tools), Definition of criteria, objetive, hipothesis, etc. for the specific self-research to be carried out, d) establish the methods, tools, techniques, experiments, type of evaluation instruments, etc. to be used, e) Follow rigorously the investigation and register data of variables, Interpretation of results found, etc. f) prepare the report of the self-research activity (for yourself). Through self-research, the RiE-TD, could self-diagnose their current state related to their transdisciplinary attitude. Carry out self-criticism and detect the areas of opportunity to change. Of this way, the RiE-TD, could: a) Develop Reflective activities and of self-transformation, b) Self-criticism, c) Define recommendations to overcome weaknesses, d) Choose tools to apply e) Overcoming weaknesses - exercises and tasks to be done, f) Determine abilities, strengths, preferences, knowledge in general and performing various tasks towards the improvement of their transdisciplinary attitude.

3.2.3 Practice of Creative, Systemic and Scientific Thinking

Based on its self-diagnosis prior, the RiT-TD will develop activities and tasks to strengthen scientific and systemic thinking. Developing creative critical thinking, as well as developing the exercises in yourself to make it evolve thinking, is part of this methodological activity. Paraphrasing Einstein: "You cannot solve a problem at the same level of thought in which it was created", hence the importance of evolving thought as researcher. The RiT-TD could a) Know historical context of science and of scientific thought, b) Develop abilities of observation, analysis, synthesis, criticism reasoning, posing questions and seeking answers, etc., c) Develop capacities to integrate with other disciplines and actors and Detect the main intolerance, d) Realization of integration exercises with different and even opposites e) work in the systemic decisions f) Self-assess the own decisions g) Visualize the past, present and future, also at the macro and micro levels and the possible interconnection of all g) Learn and apply different decision techniques such as multi-attribute, etc. h) increase the Reflection, development of conscience, self-criticism and self-transformation constant , i) contextualization and conceptualization of current own system, j) Contemplating methods of analyzing variables over time and their prognosis k) Learning and Avm systemic or not, useful in the process of research l) Choose the methodology to represent and / or diagnose self-system m) Avm to represent the auto-system, n) Apply various tools for continuous improvement, o) performing various exercises, developing the necessary discipline

3.2.4 Develop Transdisciplinary Attitudes

It is contemplated to develop transdisciplinary attitudes, minimally attitudes of rigor, openness, tolerance, patience, etc. In this sense, for such development of thought and necessary attitudes of a RiT-TD, it is possible use the tools, methods, tests, treatments, etc that choose according to your needs . whatever is necessary to strengthen its scientific, systemic and transdisciplinary attitudes to continue walking in the Transdisciplinary perspective in evolutionary moments, knowing outside and transforming towards its interior.

Several tasks must be performed by the RiT-TD, e.g. a) Work in the virtues of patience, tolerance, etc., b) Moderating of behavior to achieve inter-relationships: practice of prudence, c) Development of transdisciplinary rigor, d) Development of desires to serve and improve their environment, e) Continuous practice of transdisciplinary rigor (including the scientist), f) Do the task of various activities TDs, such as mutual learning, mutual interdependencies, border work, etc., g) Reflective activities for self-transformation and decision-making of the type systemic, feedback and return to any activity according to the need of the researcher in training, etc.

3.2.5 Link up with Other Disciplines and Actors of the Problem (Add in each Opportunity Disciplines or Actors of the Problem)

It is proposed that the research subject be aware of the need to link with actors of different problems and disciplines. In addition, is important link with the decision makers, respectively, understanding that linking is have mutual correspondence. It is necessary that the RiT-TD: a) Know the actors of the problem, b) Collaborate with disciplines ethically-respect and add Ideas, proposals, be inclusive, etc. c) Practice in the research process: mutual learning, mutual inter-dependencies, border work, etc. d) Contribute to their environment by participating in relevant problems -Continuous work, e) Continue developing habits, reflection and awareness- ask questions and searching for answers Why do you research? For whom do you investigate? What do you feel for your world? Etc.

3.2.6 Link with Decision Makers, Organizations and Individuals - Raise Awareness and to Sensitize

In the training of researchers it is important to create awareness, in the transdisciplinary researchers who should work on reflection, introspection, have periods of quiet, seek mental health, etc. because they must propose solutions and make decisions to improve the environment. So, that the most appropriate and for a common good arise, they must be proposed by a researcher in harmony with others and their universe. It should be mentioned that this activity is carried out from the beginning of the research until the finish. Among other activities the researcher could a) Approach organizations, actors, etc. to propose

solutions and collaborate together in the research process, b) Promote the link c) Give information to promote better decision making in the population-divulge results in the mass media, re-educate, linked with step, d) Feedback to any activity or phase. It is important to highlight, the phase II is the cornerstone for that the research process under the transdisciplinary perspective.

3.3 Experimental research (Development of possible problem solution - Design of new proposal for the real world)

The experimental research phase refers to the development of the possible solution to the problem, the demonstration that it was so in the laboratory conditions. Then, must be done the designs of the solutions to be implemented in the real world, as well as the necessary adaptations. In this phase of the research process, characteristic features of transdisciplinarity are used in relation to: 1) the methodologies, tests, tools, etc. that are applied, systemic or non-systemic methodologies and also disciplinary methods, tests, tools, etc.; 2) in relation to the participants: could be disciplinary and not disciplinary (civil society, empirical, decision makers, institutions, target population, etc.; 3) In relation to the research process that is carry out with a systemic vision: it is necessary visualize the problem and its interrelations, also the behavior past, present and future, 4) to a scientific process, from it begins, since the proposed activities must comply with the scientific rigor since the beginning to evolve and reach transdisciplinary rigor; and 5) in relation to transdisciplinary attitudes: the RiE-TD must have the TD attitude that allows to interact with others during the research process to achieve ends with a common benefit. This phase will obviously lead us to the demonstration of the solution that is really intended to be a solution and after "n" stages of experimentation, the design of the new proposal will be considered for real world

Figure 1 shows the activities that the RiT-TD, can realize in the phase III such as: 3.3.1 Definition of specific problem and research questions, 3.3.2 Preliminary experience in research and learning, consultation with specialists, 3.3.3 Planning, establishment, monitoring and reporting of experimental research activity (ERA), 3.3.4 Dialogue between disciplines and actors of empirical problems (interested parties), 3.3.5 Communication of results (CoR) to the scientific community and / or disclosure to society, etc. and 3.3.6 Dialogue and presentation of new research questions and / or design and / or development of proposals, products, models, services, innovations, etc. in an iterative process. Likewise, each activity of this phase is divided into several other sub-activities that can also be seen in the figure.

3.3.1 Definition of Specific Problem

It is intended that the researcher TDs, make the approach of the specific research questions, based on the previous collaborations. According to the definition prior of the problem, which carried out with the conformed heterogeneous group (including disciplinary and empirical). On the one hand, the researchers could propose the specific research questions and work, on the other hand, the empirical ones in relation to what they know about it. Thus, the researchers look for the scientific literature, what is known? And what has been done about it? They could Define Specific issues to develop, placing the frontier of knowledge. Also, identifying that the precise and achievable activity to develop is original.

3.3.2 Preliminary Experience in Research and Learning, Consultation with Specialists

In case the researcher does not have preliminary experience in the experimental research activity that will be carried out; the methodology contemplate activities related to obtaining preliminary experience in the research. In this way, obtaining the respective learning and consultations with specialists (n times). To be able to pose later state the specific objectives, hypotheses, know the theory, methods, techniques and / or specific tests necessary for the realization of the activity and the selection of the specific experiment. When the tests are expensive, it could be assisted by simulation programs or the RiT-TD, can attend with the specialists to learn, when the tests are performed by them

In this methodological step, then, it is proposed to establish a preliminary experience in the research. Either real or simulated, with the objective that the RiT-TD gain experience in that activity and have more elements and arguments for the approach of the respective activity experimental, as well as dimension the activity. By then, we can establish objectives and hypotheses. On the other hand, the researcher will have to learn the knowledge, theory,
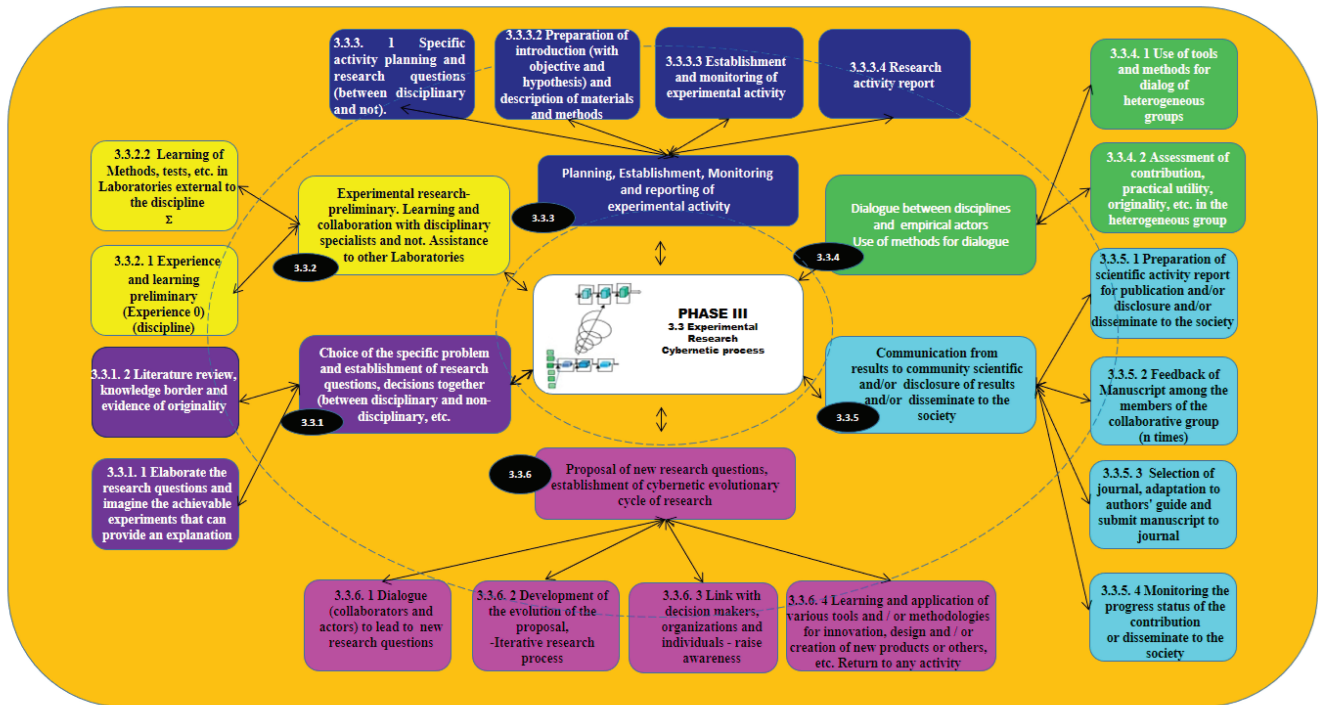
Figure 1: Research process under a transdisciplinary perspective: PHASE III.

methods, techniques, various tools, software, etc. that are necessary in general, to be able to carry out the activity. In such a way that you can choose the most suitable experiment that could answer the research questions posed. If it is necessary, the RiT-TD can create some links with specialists from other disciplines.

3.3.3 Planning, Establishment, Monitoring and Reporting of Experimental Research Activity

Since in both cases elements must be gathered and the necessary learning to be able to plan the research activity to develop. In the proposed activity will be the planning, establishment, monitoring and reporting of the specific experimental research activity.

Based on the experience gained and the research questions posed, the activity will be planned. Some basic questions to plan an experimental activity would be: How is the activity that going to be done? What material is required to be used? What methods and / or tests will be used? What are the standards, recommendations or standards required in the research activity? What will be the experimental design and statistical analysis to be used? What variables will be evaluated? When will they

be measured? What instrumentation will be used? What are the experimental conditions to use, are there some preference or not? Is there space in your own time and place to perform the experiment? Is there anything else that you need to learn? What are the disciplines directly linked to the activity? What is the specific theory that supports this activity? What are the administrative resources required? What are the expected contingencies? What are the variables that characterize the objects of study? Etc.

Subsequently, it is necessary to carry it out starting with some characterization defined to the object of study. Later perform properly the formal research activity, give the rigorous monitoring of the activity, record data, for later analyze them, interpret them, assess the level of results and communicate them.

It is important to highlight the importance of systematize the scientific report under the style IMRaD (Introduction, Material and Methods and Discussion) scientific style format since before starting the activity. In this way, before initiating the experimental research activity, it is possible to elaborate the introduction that answers the why of the research. Contextualize and justify the activity and make a brief review of literature that explains what other authors have done. Indicate the objectives of the activity and the hypothesis.

3.3.4 Dialogue between Disciplines and Empirical

Once the research activity is finished, conclude with the report of the same. Previous to the communication of results, dialogue activities between disciplines and empirical (stakeholders) are proposed, where the results obtained with the research will be reflected. What could be useful for a practical application? What would be the contribution to knowledge? In such a way that the results obtained with the advances of the research in the heterogeneous workgroup are valued.

3.3.5 Communication of Results

In the present activity corresponding to the communication of results results to the scientific community and / or divulgation to society y/o disseminating results to the target population is contemplated. Selecting the most important to communicate to target population. Of this way, the RiT-TD continues to strengthen his profile as a transdisciplinary researcher, by submitting to both the scientific community and/o empirical, to criticism in order to continue improving. In the disseminating results to the target, it is advisable to schedule meetings with them. Depending on the objective you have with the results obtained, you would propose the strategies if you need to train something, create awareness for change of decisions, etc.

This phase complies with a cybernetic process, which allows the improvement of the proposal of solution. Various activities are carried out until it is achieved to comply with what is required, and can be adopted and adapted to the target population.

3.3.6 Dialogue and Presentation of New Research Questions and / or Design and / or Development of Proposals, Products, Models, Services, Innovations in an Iterative Process

For this, they also go through continuous stages of dialogue, posing new research questions, etc. In addition, the design and development of the proposals, products, models, services, innovations, etc. Through iterative processes to meet the needs and conditions of the target population. In this activity, dialogue is contemplated, but it is also proposed to learn how to do it, through the use of Methods to di-

alogue, to agree on ideas, etc. using multi-attribute techniques, among others, to prioritize priorities to continue making decisions and to evolve research activities.

It is important to highlight, the constant revision of scientific literature, as well as the constant feedback with the actors of the problem are activities. In the research process is very important use conceptual maps, mental maps, causes diagrams, digital tools, software, etc. that allow to organize ideas and information, classify it and give a better vision and use. Employ different academic searchers, databases, etc. employ snowball methods to search for information and arrays to accommodate it. Read and write, and then debug and continue writing, reading and debugging. Analyzing the information with critical thinking, etc. The advances of the research are valued and decisions are made if it is necessary to return to some activity within the methodological process or if it is necessary to link with decision makers or transmit the knowledge obtained to the target population, etc. In case you achieve basic knowledge to develop something close to the need of the target population, use design methods necessary to achieve the design of new products, prototype, services, models, etc. This development should be done in constant communication with the target population to provide feedback and improve it until it is implemented, making meetings of the heterogeneous work group as many times as necessary. If it is necessary to continue carrying out new research activities, they will continue to return to the initial point of phase III, or in case it is necessary to return to another phase, the same could be returned. But in case it can be implemented, now it would continue to implement it and test it in phase IV.

3.4 Impact investigation

This phase investigates the impacts of the proposed solution in the real world. This phase includes, among others, the following activities: 3.4.1 Implement and test the real-world solution proposal, 3.4.2 Contextualize in the real world the impacts in different holistic dimensions for analysis of impacts in different levels and dimensions and selecting the most critical ones, 3.4.3 Field research (Real World) of the impacts of the solution proposal obtained, 3.4.4 Evaluation of results and / or feedback, laboratory adjustments and possible return to experimental activities, 3.4.5 Analysis and collaborative

synthesis of improved proposal and programming of workshops, training, awareness, awareness, etc. towards the population and 3.4.6 new research questions and return to any of the specific phases or activities or finalize the investigation.

This phase would begin testing the solution proposal in the real world, establishing previous agreements with the target population (the users of the proposal). Consider the conditions of the users, the regulations, etc. and plan the establishment of the proposal with the real conditions and establish it after all the necessary tests and previous simulations (3.4.1). To follow up on the operationalization of the proposal and start-up. Provide the necessary training to the users and give performance monitoring and record of experiences for possible improvement. Once the proposal is working, it is recommended in the methodology, carry out the contextualization in the real world the impact in different holistic dimensions. The analysis of impacts could be in different levels and dimensions and selecting the most critical ones (activity 3.4.2). In activity (3.4.3), the impact in the real world will be analyzed, evaluated and diagnosed at the immediate nearby selected level where the proposed solution was implemented and tested. It is requerired described above, specify the respective research questions, choose the research to be carried out, plan it, establish it, follow up and report it. Activity 3.4.4 proposes the evaluation of obtained results, reflecting on the following questions: What has been achieved? What do you know today that you did not know at the beginning of the research? What is NEW and USEFUL for others? What are the important results of the research? What is the contribution to knowledge? What do you want to communicate? Where or to whom to communicate results? Etc. Decide if you return to Lab activities to adjust for possible changes and if it is necessary to return to perform phase III or other activities. If it is decided to communicate results, must be chosen to communicate results, planning and encouraging towards the target population or for the scientific community. It is continued as in the whole process having meetings and constant collaborations with group formed of investigation. It is necessary to analyze and synthesize the acquired knowledge to share it mutually between academic group and problem actors. Carry out workshop programming for and with the population to share knowledge. Provide training, raise awareness and raise awareness among

the populations, these aspects are addressed. Finally, in the activity 3.4.6 the research groups define the new research questions and return to any of the phases or specific activities of the phases.

Figure 2 summarizes the four proposed phases to carry out a transdisciplinary research process. Phase II can be observed on the base since it is considered the cornerstone of a transdisciplinary research process. Where the need for self-research is represented, for self-transformation in a continuous cybernetic process that allows the researcher in training to walk towards a scientific, creative, systemic thinking and towards transdisciplinary attitudes. Reflection and self-change are essential in the entire research process. In the following positions it is possible to observe three additional levels, which represent phase I, III and IV. Phase I highlights some necessary activities when the transdisciplinary researcher initiates the research process. Starting with the observation and knowledge of the relevant problems, then the selection of some of them, contextualizing it in time and at different holistic levels. Up to the decomposition of the problem and choice of a specific problem to investigate in the real world through field research, in order to obtain scientific evidence of it. To later analyze the impact, it has through the network of interconnections that it has. Evaluating its past, present impact and possible future impact. in the third level, there is phase III, of the transdisciplinary research process. This phase is located in the specific problem and the specific questions posed by the researcher and the group of collaborators. The RiT-TD must propose the necessary experiments to answer the questions. For this he would have to have a preliminary experience, as well as the knowledge previous methods or tests that allow you to develop research in laboratories of the same discipline or any other with which the collaboration has been established. In each activity carried out the researcher must make the scientific report of the same. If possible, the researcher could reach a new design, product, model, etc. Depending on the scope you have had in your research process. In the design and construction of proposals as finished products, researchers can use design methodologies, choosing the one that is favorable for their objectives. For this, the researchers must be in close contact with the potential users of the proposal. In the fourth level, phase IV is located, where the researcher is expected to establish and test the functioning of the

solution proposal in the real world. Establish the various research activities to evaluate the impact of it. In this way the researcher could return to any of the activities of each of the phases of the research process, depending of what is required. Assessing the impact over time of the proposal solution is indispensable in this phase of the investigation.

4 Conclusions

The proposed transdisciplinary methodology could be applied in the training process of transdisciplinary researchers, since it covers the characteristic features of Transdisciplinarity. The main features that a research process must fulfill are focused on the self-transformation of the subject that investigates.

Acknowledgments

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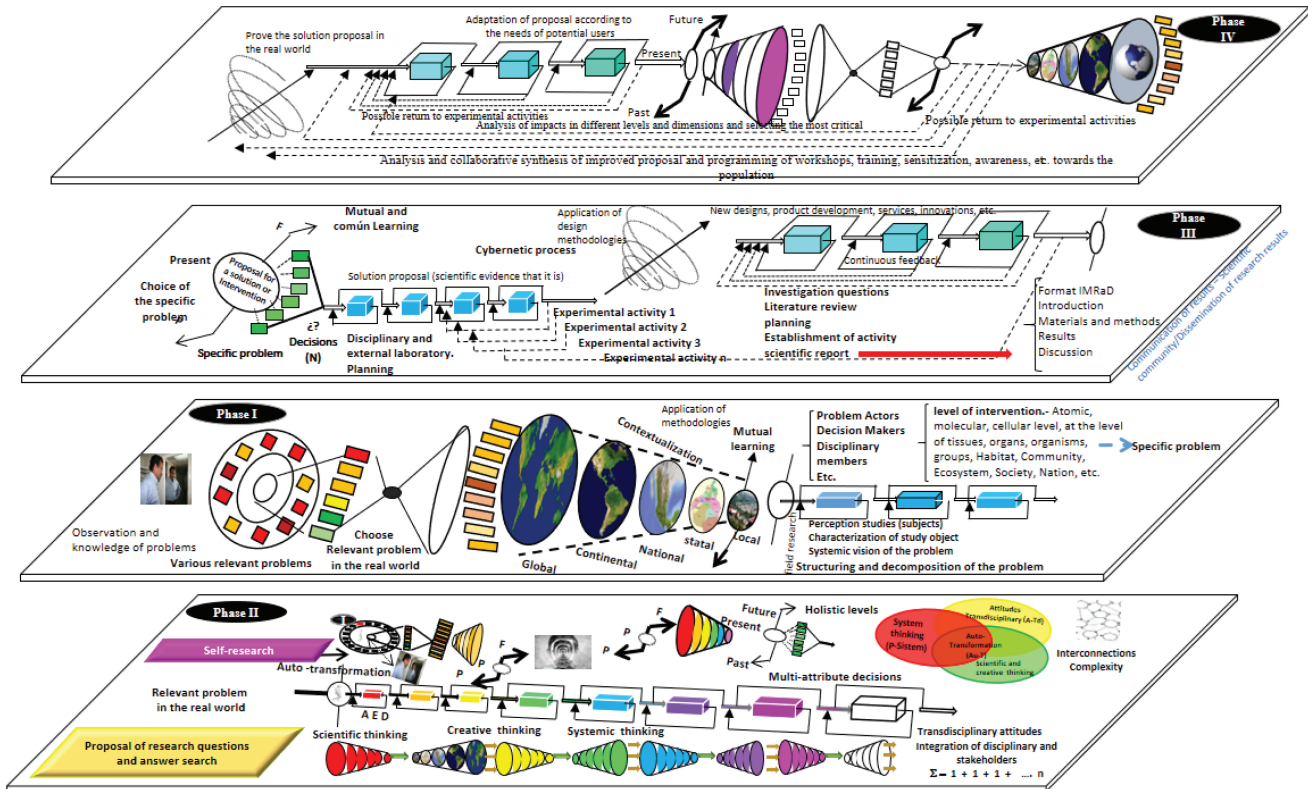
Figure 2: Initial methodological process by a transdisciplinary perspective: a) PHASE I.- Contextual, documentary and field research, b) PHASE II.- Self-research, c) PHASE III.- Experimental and d) PHASE IV.- impact research.

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