Citizen Science as a transformation tool for public policies - The case of Mollet del Valles

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Resumen– En los últimos años, la ciencia ciudadana ha sido discutida en la investigación académica como una herramienta para aumentar la participación de los ciudadanos en las decisiones de la administración pública. En este trabajo investigaremos hasta qué punto la ciencia ciudadana puede contribuir a ese objetivo observando y analizando el proceso participativo en una comunidad de Cataluña. Discutiremos nuestros hallazgos a partir de un caso particular e intentaremos extraer consejos generales para las instituciones públicas con el fin de implementar la ciencia ciudadana con éxito.

Palabras clave– Ciencia Ciudadana, Participación Ciudadana, Innovación Abierta, Investigación e Innovación Responsables (RRI)

Abstract– In the last few years, citizen science has been discussed in academic research as a tool to increase citizens involvement with public administration decisions. In this paper we will investigate how far citizen science can contribute to that goal by observing and analysing the participatory process in a community in Catalonia. We will discuss our findings from this particular case and try to extract general advice for public institutions in order to implement citizens science successfully.

Keywords– Citizen Science, Citizen Participation, Open Innovation, Responsible Research and Innovation (RRI)

✦

1 INTRODUCTION

IN a world with increasingly complex problems, it can be a sensible approach to involve multiple stakeholders that are sharing knowledge and skills in order to find a coherent solutions. Transformative Innovation or Transformative Change is a framework address these societal problems.[1]

In this paper, we describe and analyze the transformative innovation policy strategy based on the concrete example of Mollet del Valles in Catalunya. Firstly, an introduction will be provided concerning the different stakeholders and entities that the Mollet-project is related to. Secondly, the theoretical groundwork on which the project is based - such as citizen science, transformative innovation, social norms theory and theory of change - will be explained. In a third step, the citizen involvement process within the waste

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treatment transformation process in Mollet is analyzed.A very strictly set time frame only allowed the observation of the first steps within the process, however, the planned events will also be taken into account and will be considered in further research.

2 CONTEXTUALISATION

2.1 Mollet del Vallès

Mollet is a spanish city located near Barcelona, with 51.600 inhabitants and a surface of 10,77 square kilometers. The economic activity is concentrated on metallurgical, chemical and real estate industries. The tertiary sector also has an important weight in the economy.[2]

The waste segregation model used in Mollet is the 5-fraction model, the most common in Catalonia, based on five separate waste collection containers: organic matter, glass, paper and cardboard, packaging and other waste. For waste that cannot be disposed of in any of these containers, there are other collection systems. In addition, there is a collection service for commercial paper and cardboard, a collection service for old furniture and a collection service

for clothes in the street.[3]

In 2018 Lavola, a company specialized in sustainability, conducted an analysis called Local Plan for the Prevention of Municipal Waste of Mollet del Vallès, with the aim of planning and implementing a strategy to reduce municipal waste with the participation and awareness of the different economic agents and entities of Mollet, and with the incorporation of values, new habits and attitudes of consumption. The analysis concerning waste generation was carried out from data from the city council.

The plan had 4 objectives: to reduce the generation of waste at source, to reduce the quantity or hazardousness of waste, to promote reuse and to raise awareness and involve citizens and other agents of the municipality. To achieve these objectives, the actions proposed were: actions associated with new consumption habits in favor of responsible purchasing and promoting the reuse of waste, actions to reduce food waste and actions to promote the circular economy. The waste prevention plan was designed for a 3-year period, which began in 2018 and ended on January 1, 2021.[4]

2.2   Framework - Stakeholders

The Catalan Smart Specialisation Strategy (RIS3CAT) is a strategy first elaborated in 2014 with the aim to enhance collaboration between different players in the research and innovation sector, such as universities and technology centers in order to create societal impact.[7] This strategy was modified in 2019, integrating the RRI (Responsible Research and Innovation [7]) and a shared agenda [6] within projects like TRANSFORM [8] and SeeRRI [9]. The shared agenda consists of a bottom up approach for collective experimental projects with a high transformation potential. They include various actors and aim to generate shared knowledge and shared values [9]. Within this framework the cluster B30 is situated, a territory close to Barcelona, including numerous research centers, businesses, industrial parks, the Municipality of Mollet, and also the Universitat Autonoma de Barcelona (in short UAB). The research team for this article consists of 4 students from the UAB that are included in the Challenged Based Learning pilot project within the subject of Open Urban Innovation (REFERENCE). The GENCAT commissioned the SME ScienceforChange (in short SfC) with the task of guiding the citizenry through the process of citizen science aiming to transform the waste treatment system.
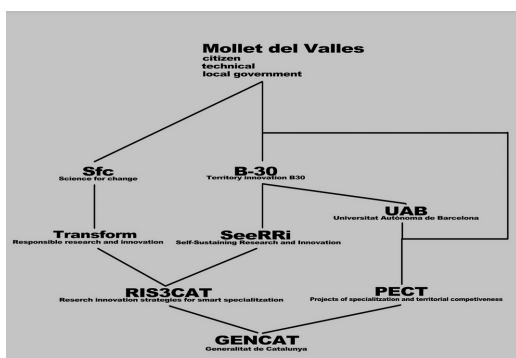

Fig. 1

2.3   Theoretical Concepts

Sustainability Transition

The concept of Sustainability Transition was framed by the European Environment agency in 2019 responding to an ever growing need for feasible solutions to the climate crisis, waste of resources and growing social disequality. Sustainability transitions can be defined as "long-term processes that involve transformations of society as the result of the emergence and dissemination of new forms of innovation that promote new ways of thinking and living (new social practices, new technologies, new business models, etc.)."[5]

Quadruple helix and Open Innovation

Two key concepts that are applied in the Sustainability Transition strategies are the concept of Open Innovation and the Quadruple Helix (also "Multiple Helix") of Innovation. The quadruple helix of innovation is defined by its 4 key entities University, industry, government and the public environment. These key-actors work together to establish a holistic and realistic view on the specific problem, trying to establish effective solutions to societal challenges. According to the European Commission (2020) Open Innovation is the " Outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment". [10] Instead of a closed business-, university or administration environment, all the agents open up to the other entities and collaborate in order to share knowledge and find new solutions for social and environmental challenges.

In the case of the Mollet Project, the different stakeholders are the Local Authorities of Mollet, The Citizens of Mollet, the company Science for Change, the Universities UAB and UB and the government of Catalunya.

Shared agendas

Shared agendas can "help to develop more effective, innovative responses to the challenges facing the territory and to meet the ambitious targets that the European Community has established for the coming years" [11]. They consist of a bottom up approach for collective experimental projects with a high transformation potential. They include various actors and aim to generate shared knowledge and shared values. [11]

The shared agenda established by the government in Catalunya includes the so called PECTs (Projectes d'especialització i competitivitat territorial) which can be translated with " territorial specialisation and competitiveness projects". Both Mollet and the UAB are part of the PECT which have the goal to foster collaborations between institutions such as universities and local authorities. The shared agendas include a zero waste management strategy, [11] in which the UAB as well as the Local Authorities of Mollet are included.

Challenge Based Learning

This paper was written in the context of challenge based learning (hereafter, CBL), which is currently researched at the UAB and various other European Universities in

the framework of the European Consortium of Innovative Universities, in short ECIU.[12] CBL is an innovative approach to learning at universities which aims to advance the students skills by addressing real-life problems. [13] Firstly this leads to new collaborations between external parties - the so-called "challenge providers" - and universities, thus creating social impact. [14]

Secondly, it allows the students to work in a field where they can develop skills such as self-management, social intelligence and reasoning for complexity and see the direct impact of their contribution. [15]

In the Mollet case this means that the university stakeholders can inject their knowledge in various steps of the process, one example being the creation of the digital game by the programmers of the engineering school, implemented through a hackathon. Furthermore, future professionals can gain insight into their work, such as it was the case with the research team in the first phase of the project. Readers interested in the subject can find more information on it in the attachments.

Citizen Science

Citizen science (CS) involves members of the public in active participation in scientific research. It brings together public administration, science and the citizens in order to collaborate on projects and decision-making and aims to democratize scientific processes and produce new relevant knowledge. [16]

It is important to highlight the distinction between citizen participation and citizen science, as the former includes the citizens into the process as passive actors, that contribute their opinion or their data, but are not actively involved in the scientific research or creation of policies, whilst the latter allows the involvement of the citizens into the "meta-level" of decision, where - in the optimal case - they have a say on what to investigate, with which methods and what conclusions should be drawn from it. This is especially true for citizen social science,[30] which adopts approaches from the Participatory Action Research (PAR).

According to Sauermann et. al. (2020), the value of the knowledge created by science depends on the needs and preferences of the broader public. Therefore it is necessary to investigate the citizens needs and wishes in advance to the initiation of a public project.

The points to consider in developing a citizen science project are the:

- Coordination
- Participation (demographic parameters, expertise requirements)
- Community
- Evaluation (How and who decides outcomes?)
- Openness (open data, contribution acknowledgement, public access)
- Entrepreneurship (funding and profits)

Furthermore it is important to consider the 5 citizen engagement principles, as worked out by the Iscape Citizen Manifesto. [17] Those principles help in order to address the complexity of the problems and to make them digestible to the citizens. One of those principles can be called gamification - "make it playful" - which helps to engage with the problems in a fun and inspiring way, encouraging creativity and motivation.

Social Norms Theory

According to the National Social Norms Center at the Michigan University, the social norms are explicit or implicit rules that guide behaviours occurring in a social context. Those norms are transmitted through formal channels like policies or informal channels such as stories. They vary between one social group and another, and an individual may alter their behaviour to adapt in different groups. There are two different but related kinds of social norms:

- Descriptive norms refer to how a majority in a group actually behaves.
- Injunctive norms refer to the beliefs among a majority about how people "ought" to behave.

For example, people living in a residential neighborhood may believe they ought to recycle as much of their waste as possible (injunctive norms). However, they see that only a few houses on their street have recycling bins next to the trash cans on garbage recollection day, leading to the perception that most people do not recycle (descriptive norm).[19]

Theory of Change

Theory of Change (herafter, ToC) refers to a tool to generate a description of events that are expected to lead to a particular long-term outcome. This description is usually captured in a diagram and narrative to provide a guiding framework that shows how the desired goals can be reached. For the development of a theory of change, a discussion between the stakeholders about the context, the long-term outcomes, the sequence of events and the assumptions on how the changes happen should take place [20]. These theories of change are often formulated by entities that want to apply a certain change in their organization/processes. [21] ToCs in sustainability science articulate the relations between sustainability goals, diagnoses, knowledge gaps, context conditions, activities, pathways to impact, and epistemological assumptions (Dhillon and Vaca 2018). One particular type of ToC, the multiple stakeholder- process, includes the supporting co-production of knowledge, social learning, technical cooperation, creation of new actor networks and conflict transformation. [18]

3   CASE STUDY MOLLET

3.1   Context

The Mollet project is embedded into the TRANSFORM, a european project which takes place from 2020-2022 and includes 3 different regions in Europe. [8] The aim is to investigate citizen science as a potential tool to integrate citizen participation within the public policies. Further involved actors are the Generalitat de Catalunya

with the RIS3CAT strategy and the shared agendas,[11] who commissioned the company Science for Change, [26] together with the University of Barcelona with its multidisciplinary Open Systems group to support the Municipality of Mollet in their citizens participation approach.

Within this frame, SfC and the UB are designing a participatory process that the citizens are able to take part in. According to SfC, the project is using a "Extreme citizen Science Approach", which consists of an inclusive model that engages the citizens in every step of the process [24], without limits because of educational, sociocultural, economic, gender or age factors.

The whole project consists of 8 phases including the analysis of the state of art, the selection of interest groups, participatory sessions with the local authorities and the citizens, the development of the interactive game, implementation of such, the analysis of the generated data and finally the return of this data.

Phases of the project:
Phase 1: Background analysis (January-April 2021)
Phase 2: Analysis and selection of groups of interest (February-April 2021)
Phase 3: Participatory dynamics with local government agents (April-May 2021)
Phase 4: Participatory process with key citizen profiles (April-May 2021)
Phase 5: Development of the interactive game with a gamification perspective (April - July 2021)
Phase 6: Implementation of the game in public schools in Mollet del Vallès (October-December 2021
Phase 7: Data analysis (January - February 2022)
Phase 8: Return (March 2022)

3.2   Methodology

In the project's first phase, which was conducted from April to May 2021, first contacts between the different stakeholders were established and a first "game" was developed and from the sessions that were taking place in Mollet with the citizens.There was a first reunion with the technicians and deputies from the cities' council with Science for Change in the moderator and guiding role. To this reunion, the "indirect" actors were also invited, including the waste treatment workers, the policemen that are responsible for fines in case of wrong garbage separation and others. In that meeting, the technicians developed a Pro- and Con- list of the current garbage collection system, thinking about possible arguments that the citizens could develop. Just after this first reunion of the technicians and other actors, the research team for this paper was introduced to the project. A first preparatory session took place in which the UAB research team were introduced into short-term plans and the role they had to play.

The next session was conducted with a "sample" of citizens from Mollet del Vallès, who were directly contacted by the City Hall (*Ayuntamiento*), thus including mostly citizens already acquainted with the city hall. It took 2 hours and consisted of a brief introduction into the different systems

(ca. 5 mins each) with a consequent active task carried out by the citizens (aprox. 30 min each). This included the notation of Pros and Cons onto Post-its. This was done also with the two prospect models (intelligent containers, door-to-door).

In between the first and second "citizen"-session there was another one held with the UAB research team in order to "test" the method that was going to be used in the second session. Each student adopted the role of a fictitious person, with some distinctive characteristics (age; work, family and economic situation; perception of the current environmental situation) provided by SfC. The students then had to add advantages and disadvantages to each model (selective collection, smart containers, door-to-door). Then (without adopting the role of a fictitious person), pros and cons of each model were elaborated and possible concrete situations for the specific character were described.

The second session with citizens, like the first, was held at the "Mercat Vell" in Mollet del Vallès for 2 hours. The team of SfC, the UB and UAB guided through the session. This session was more focused on the representations of scenarios: Instead of the citizens commenting their own opinions, they were faced with different characters and had to imagine **scenarios** that these characters could encounter with the different models of garbage recollection.

3.3   Results

Concerning the first session that was led by the technicians, it was reported that the different departments of the city hall were happy to be brought together at the same table, as they did not usually exchange information in their everyday work.

First session

The first session was conducted in the "Mercat Vell" in the heart of the city and took 2 hours. 12 citizens showed up, who were mostly of an "older" age category (over 35), including many retired people. The participation of the present citizens was high, they were motivated to contribute their opinions and open to understand the mechanisms of each model. However, the conscience about WHAT they were doing (namely citizen science), was missing, or rather, was never addressed by the guiding entity (SfC). Interestingly, the majority of the citizens declared to already recycle and separate their waste, while at the meantime they complained about other people not doing so. Many of them were in favour of more control (they did not care so much about being supervised by the government), in exchange to cleaner streets and less noise. Some of them also addressed topics that were not "intended" to be part of the discussion, such as the financial situation of the government, and possible debts it had with private cleaning companies. While it was intended to find the advantages and disadvantages of this model, noting it down on a paper, the citizens preferred to enter in a vivid discussion, including their opinions rather than a set articulation of Pros and Cons. The discussions of the first session were rather free, therefore it made the impression as if the citizens were

not really conscient about a specific goal.

Fig. 2: Citizens at the table in the Mercat Vell

Second session

The second session was attended by 8 citizens with an average age around 40-50 years. Although some of the citizens did not like the characters they were exposed to, no one rejected the game and all of them came up with several scenarios. This time, the groups consisted of 2 people and the work was more effective in the sense that there was less space to talk and a more concentrated atmosphere. In the end the citizens presented their findings for the characters considering the two future models door-to-door and intelligent containers.
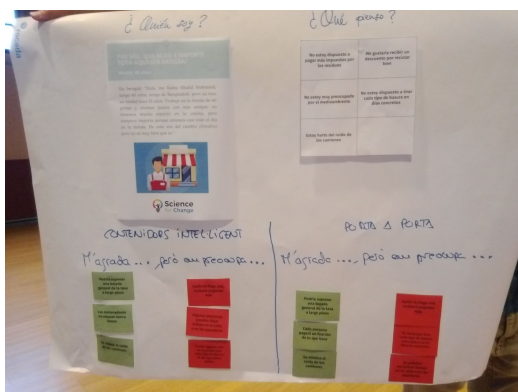

Fig. 3: Citizens discussing the Scenarios

Fig. 4: Poster with Character scenario and findings

3.4   Discussion

3.4.1   The citizens perspective

From the two sessions that the research team was able to participate physically, the impression was created that the citizenry invited was a rather homogenous group with assimilated opinions. The majority claimed to recycle their waste and complained about others not doing so. The general opinion that could be observed in many citizens was that they felt a lack of education and respect regarding the separation system. It can be thus stated that from the citizens point of view, what is needed is not necessarily a change of the technical system itself, but rather a change in the attitude towards the system OR a fiercer regulation from the public administration.

However, one has to consider that the group is not representative of the whole of citizenship, of whom some might be more in favour of a system change, and others might not be concerned at all. This might also be due to the fact that of the 20 citizens of different age groups that were expected, only 8 showed up. Possibly, the engagement of different social groups could be enhanced by making more publicity and incentivising them to come to the meetings with rewards, which could be discounts on f. Ex. the garbage fee.

Another point that was observed by the team was that there was a lack of conscience about the "meta-layer" of this meeting, namely the participation in a Citizen-Science project. The team gained the impression that the theoretical framework on which the project is based was not communicated well enough to the citizens: It seemed not clear that these meetings were thought to be the preparatory sessions in order to be able to create the digital game introduced in October 2021 at various schools in order to gain more relevant and diverse data. This might be prevented by handing out information beforehand or by underlining the introduction of the session with a visual presentation, introducing the purpose of the session and the methodology used.

Furthermore, In several situations the team was confronted with citizens that had relevant stories to tell or knowledge that the administration did not know of: One example was a friend who worked at the recycling plant and found himself with the difficulties of the flawed recycling habits of the citizens. Another was a story about a hired external waste recollection company that did not pursue its work as the local authorities stopped their payments.

This type of information confronts the scientist with a difficult situation: the veracity of the content might not be given, but anyways it has high potential on influencing the citizens opinions and also behaviour.

One approach here might be to listen to the stories and research their origin and extract the relevant information together with the citizens. This has the positive outcome that the subject will be clarified, the citizens can actively participate and a real dialogue is created, instead of just imposing concepts on the citizens.

3.4.2   The administration perspective

From the administration's perspective, we have observed that the quadruple helix has been correctly implemented,

including the citizenry in the participatory process.

In addition it was found that regular communication between different entities is important in order to understand each other's problems, as shown by the first reunion of the technicians and other entities of Mollet. In addition , we miss more information about how citizens have been selected.

Even so, the established participation games worked well in order to make the citizens enter into a discussion, but did not leave so much space for free thinking, as the framework for the Pros and Cons was already given.

Firstly, it was found that regular communication between different entities within the Government of Mollet is important in order to understand each other's problems, as shown by the first reunion of the technicians of Mollet. Thus, a first pillar of the project consists in good coordination and communication within the administration entities.

Secondly, as already mentioned in the State of Art, there had already been a Local Municipal Waste Prevention Plan of Mollet running from 2018 to 2021, which also had the objective to reduce waste and include the citizens into the process. The question was left unanswered whether this plan (and its outcomes) are and will be considered in the further development of the process.

Concerning the participation of the citizens, the established participation games worked well in order to make the citizens enter into a discussion, but did not leave so much space for free thinking, as the framework for the Pros and Cons was already given.

Regarding the community, it is very likely that only a special "kind" of citizen comes to the reunions - namely the engaged "model" - citizen with a lot of free time and rather rule-compliant attitudes - if there is no preestablished selection process for the citizens.

3.4.3   Dimension Challenge Based Learning

From the students' perspective it has been a positive process that has allowed contact with the public administration and cooperation in a real project. It has also established a communication channel through which theoretical concepts and knowledge have been received, always with the support and accompaniment of the teaching staff.

There have also been other not so positive aspects that have hindered the work and created some problems. First of all, the late incorporation of the project in the academic calendar. The collaboration started in the middle of the semester, when the students already had a work started and a state of the art done. This implied rethinking the work several times until finally deciding to completely redo the state of the art, with obviously a very limited amount of time.

Another aspect is the low participation of the students in the process of designing the activities, understandable due to the late incorporation, but contrary to the principles of challenge based learning, since the skills that would allow organising a similar process are not created if one does not participate in the organisation, see the different options and understand the reason for choosing one or another. Finally, the students felt that they did not receive enough feedback on how the theoretical concepts received from business and management were applied in the concrete case study.

4   CONCLUSIONS

In order to extract significant conclusions that can be applied to other cases of citizen participation, it is necessary to observe the process as a whole and not only look at the early stage. However, already in the first sessions one can observe certain tendencies that lead us to the following preliminary conclusions:

- In order to empower the citizens more, it seems necessary to not only create awareness about the topic itself (garbage recollection), but also about the process (citizen science). THis could be done by actively inviting the citizens to bring stories, listen and start discussions in their environment, and bring these findings to the sessions. THis material could then be included into the scenarios, to make them more vivid and closely related to the people.

- Furthermore it can be stated that measures need to be taken to include more diverse voices,on the one hand from citizens that do not have the possibility to come to the reunions, and on the other from citizens that might not be so closely related with the local administration. For the latter, one possibility could be an incentive in waste-fee-reduction or "boni" that the actively participating citizens can receive

- Regarding the case of Mollet we can observe that a change of the current system might not be necessary, but instead introduce small changes in the actual system. These small changes could consist of educating the people that throw waste besides containers or don't recycle or recollect certain fractions more often (plastic and paper).

- Challenge based learning is a powerful tool for for improving universities education, by giving students the opportunity to get useful skills and experience. However, it's recommended to adapt the participation periods to the scholar calendars, and to do it beforehand. Another key aspect would be the involvement, even passively as spectators, of the students in the internal meetings and decision making processes.

5   FURTHER STEPS

The further procedure consists of the development of a digital game, including several scenarios similar to the ones presented during the sessions. This digital game will be introduced in several secondary schools in the Municipality of Mollet. With the help of this practice, the researchers want to guarantee a more diverse spectrum of people, as in schools, many different social classes are represented. The research will be continued, accompanying the project and will be documented in further papers.

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