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Raising Public Awareness of Water Scarcity Through Science Mediation.

An Analysis of APRH's Project ECH2O-Água.

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Abstract

This Master thesis situates in the field of Social Studies of Science integrated by the European Inter-University Association on Society, Science and Technology, ESST. It followed and analyses the activities of the non-governmental awareness-raising project about water scarcity and water uses, ECH2O-Água, from March to June 2019 in the Lisbon area. Seeking to understand the independent expert association APRH's approach in communicating their knowledge to different groups of lay persons (retired people, school children, people in their workplace, etc.) so as to strengthen their sense of responsibility towards the environment and society.

The study of this science mediation project consisted of an ethnographic observational approach completed by qualitative interviews. It was conducted in cooperation with two groups of fellow investigators from ISEG's Master Science, Technology and Innovation Management.

The related STS-concepts used here are the mediation of scientific knowledge, citizen science and the Actor-Network Theory.

The analysis is supposed to lead to suggestions for the improvement of the project ECH2O-Água's impact on public awareness of water scarcity and determine generalised conclusions for the success of public awareness-rising projects initiated by scientists and engineers in the sustainability sector.

Keywords

Water scarcity, IWRM, science mediation, ethnography, ANT, public awareness, knowledge transfer.

Preface

The underlying work is the result of four months of intense cooperation. Hereby, I would like to express my gratitude to everyone who showed interest and participated in it. Special thanks to Sofia Bento, my supervisor here in Lisbon, for introducing me to the executive team of ECH2O-Água as well as to her class in ISEG, and actually making this research project possible. Thank you Patrícia, Caroline, Isabella, Ines and Larissa, Maria-Eliza, Evelyn for your time and great efforts, but especially for the warm exchanges throughout our fieldwork phase and your positive attitudes. I really enjoyed working together with you. It is the same for the entire executive ECH2O-Água project team. Thank you, Susana Neto, Ana Estêvão and Leandro Muller for introducing me to your purpose-loaden work, for your open-mindedness, availability, (technical) explanations and feedback on my work. I would also like to thank Catherine Allamel-Raffin for spontaneously accepting the supervision of this thesis and directly contributing to its improvement through constructive feedback, which completed Sofia's and Susana's in the final writing phase, when I needed help to structure my thoughts. Special thanks also go to my lovely friends who helped me to stay focused and not give up.

I hope I'm doing justice to the project ECH2O-Água and to all of your intense efforts.

Kerima-Nada Weller, Lisbon in June 2019.

Abbreviations in Text and Annexes

AN	Actor Network
ANT	Actor Network Theory
APRH	Associação Portuguesa dos Recursos Hídricos (Portuguese professional Water Resources Association)
CCT	Centro Comunitário de Telheiras
CIM	Centro de Interpretação de Monsanto
CSPB	Centro Social e Paroquial do Barreiro
DHA	Departamento de Hidráulica e Ambiente
EC	Experimental Community
ESSA	Escola Secundário de Santo André
EU WFD	European Water Framework Directive of 2000
EBL	Escola Basica de Lumiar Alto da Faia
FCG	Calouste Gulbenkian Foundation
IWRM	Integrated Water Resources Management
LNCE	Laboratório Nacional de Engenharia Civil
MSTI	Master Science, Technology and Innovation Management at ISEG, ISEG
D	Director of APRH
K	Kerima Weller, author of this work
PM	Project Manager
P, C	members of the research team involved at ESB
L, M-E	members of the research team involved at CCT
T	Technician of ECH2O-Água

Declaration of Authorship

I hereby declare that the thesis submitted is my own unaided work. All direct or indirect sources used are acknowledged as references. I am aware that the thesis in digital form can be examined for the use of unauthorized aid and in order to determine whether the thesis as a whole or parts incorporated in it may be deemed as plagiarism. For the comparison of my work with existing sources I agree that it shall be entered in a database where it shall also remain after examination, to enable comparison with future theses submitted. Further rights of reproduction and usage, however, are not granted here.

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Kerima-Nada Weller, Lisbon, June 27th 2019

Table of Contents

1 Water Scarcity is a Social Issue	1
1.1 The Social Studies Interest in the Science Mediation Project ECH2O-Água	9
1.2 Research Question of this Thesis	10
1.3 Conceptual Frameworks mobilised to tackle this question	11
2 Water Stress in Portugal and Measures taken to prevent and soothe it	15
2.1 Government's approach	17
2.2 Associação Portuguesa dos Recursos Hídricos (APRH)	20
2.3 The project ECH2O-Água	21
2.4 Other Portuguese Initiatives About Water Awareness (a non-exhaustive list)	25
3 Methodology and Organisation of this study	27
4 A Close Look at the Project ECH2O-Água	32
4.1 Communication Strategy of the project ECH2O-Água	32
4.2 Participating Institutions followed within this thesis' project	38
4.3 Activated Actor Networks in the project dynamics	41
4.4 Attended sessions of ECH2O-Água	45
4.5 ECH2O-Água, A citizen science project?	60
5 Suggestions for further editions of ECH2O-Água	64
6 Conclusion: How can science mediation projects influence on lay peoples' awareness of ecological issues and make them participate in the strive against them?	73
7 References	76

1 Water Scarcity is a Social Issue

The urgent need for Integrated Water Resources Management. Ecosystems, industries, infrastructures, agriculture, living beings, and among them humans, need clean freshwater to exist. It is indispensable to all forms of life on our planet. We all are highly vulnerable to the lack of water, which makes every person, animal, plant or watercourse, be it surface— or groundwater, a stakeholder of their own to appropriate Integrated Water Resources Management (IWRM)¹ (OECD, 2003; WWAP, 2009; UNDESA, 2005). “Appropriate” equals sustainably balancing the use and the protection of available fresh water resources in a long-term perspective, while ensuring the satisfaction of current existential and social needs (FAO, 2019). As scientists, farmers, environmental observers state, and organizations such as the United Nations, the European Union or the International Water Management Institute decided to fight², water scarcity will be and is already a major problem of this century (M. Catley-Carlson (02/18-19/1999)).

Causes of water scarcity. The 2019 UN World Water Development Report (WWDR) bears the title “Leaving no one behind” and illuminates the already known but still alarming fact that since the 1980’s, water use has been increasing worldwide by about 1% per year (Aquastat, n.d. in UNWWDR, 2019). According to Burek *et al.* (2016) it is expected to grow at a similar rate until 2050, whereas the OECD (2012a) estimates an increase of 55% over the next 40 years, summing up for an estimated global human population of 9.8 billion people by 2050 (UNDESA, 2017a). The WWDR stresses that mainly the rising demand in developing countries and emerging economies account for current and future water stress situations, whereas agriculture was, is and will be the thirstiest consumer, outpacing by large industrial and domestic use (UN, 2019). Moreover, inconsequent and insufficient wastewater treatment keep on negatively influencing on water quality as it is released into the natural circle after anthropic use (see UN, 2007). The slow but steady trend towards a “western” lifestyle with a

¹ WWAP’s definition of IWRM: “IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.”, (WWAP, 2009)

² e.g. through international conferences and projects like the International Conference on Water and Environment (Dublin, 1992), the regular World Water Forums (8 between 1997 and 2018) organised by the World Water Council, the EU Water Framework Directive of 2000 (EU, 2000b), just to name a few. These mainly voluntary commitments and not mandatory policy suggestion (except for the EWF) against the risks implied by water scarcity are unfortunately often not coherent with one another, or built on international social equality. (Rahman & Kajander, n.d, pp. 8-9).

generally high demand for energy, agricultural and manufactured products, as well as denser settlements and increase of touristic activity in coastal or arid areas, multiplies these destructive effects by generalising overexploitation (H. Ingram *et al.*, 2008; C. Gopalakrishnan *et al.*, 2005). In the context of climate change and ever more extreme hydrologic and meteorological conditions competition between users increases steadily. In many traditionally arid regions suffering from regular droughts, water stress³ levels are getting more urgent, intensifying local populations' vulnerability and exposition towards water-related risks. Water stress is expected to turn into the most pressing challenges of the 21st century (Gulbenkian Think Tank on Water and the Future of Humanity, 2012).

How to face the risks of water scarcity. Concerning human exposition to environmental and self-created risks, our vulnerability and capacities to improve our resilience against them, the works of Ulrich Beck and his disciples in sociology are evidently worth a read, starting with his book of 1986 “Risikogesellschaft”. The shorter and more recent (2019) article of Vincent Gitz and Alexandre Meybeck “Risks, vulnerabilities and resilience in a context of climate change” focuses on the exposure of agricultural systems, their direct link to society and the implementation of policy tools to increase understanding of risk and therefore resilience. We will come back to the notion of decisional empowerment and resilience through awareness based on knowledge about the water scarcity problem, characterizing it as not exclusively an environmental, existential problem but concerning actions taken to prevent a crisis, as a social issue.

Our focus in this thesis lies on the social aspects of IWRM, especially in the situation where experts try to transfer their knowledge about why exactly it is crucial, in order to maintain decent living conditions on this planet. The knowledge transfer is expected to open lay peoples' eyes to the issue, i.e. raise their awareness and trigger change in their behaviour, including their private use and demanding appropriate political action. Broadly this can be interpreted as both, an action to protect the resource, and increase resilience against environmental pressure, also through lay people's increased willingness to participate in political actions advocating IWRM. According to the Hyogo Framework for Action 2005–2015, socio-economic disasters originated by natural catastrophes can be “substantially reduced if people are well informed and motivated towards a culture of disaster prevention and

³ On page 2 of the UN WWDR 2019 facts and figures summary, water stress is defined as “the ratio of water withdrawn annually by all major sectors [from the allocated water available through precipitation in surface– and groundwater stocks], including environmental water requirements, to the total amount of renewable freshwater resources, expressed as a percentage”.

resilience. This requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities'' (UNISDR, 2005, p. 9). Action 3 of the framework makes clear that knowledge, innovation and education are the main pillars of human resilience since they provide people with skills and comprehension. Both, formal and non-formal education should be used to increase resilience against extreme weather and climate conditions through capacity-building at all social levels. Considering the hydro-social cycle as described by Linton and Budds in 2014, society's involvement needs to be encouraged by public institutions and expert groups in order to facilitate comprehension of the impact that human activity has on water, of different stakeholders' interests and needs, and to trigger adapted behaviour (UNISDR, 2005; UNDP, 2013; Venckute, M. et al., 2017; Stern, 2000; Linton, J., Budds, J., 2014). However, a concrete analysis of technical aspects of water conflicts and resilience-building, adaptive behaviour to periods of water scarcity will be left to others (we suggest A. Cominola et al., 2015).

Amongst public interest defending institutions, the call for effective, efficient and truly engaged integrated water management and governance is clear: governance can contribute to define clear sustainable water policy goals and targets at all levels of government. Multi-level governance can help implementing them and maximise the benefits of sustainable water management and welfare at the least cost to society in a context of public confidence through inclusiveness of stakeholders through democratic legitimacy and fairness for society at large (L. Nunes et al., 2006; S. Bento et al., 2012; OECD, 2015; T.Y. Stigter et al., 2015; Huntjens P. et al., 2016; Neto (2019) presentation).

Water legislation. Other than only stating the scientific facts, the 2019 UN World Water Development Report (WWDR) bears the title "Leaving no one behind". It perpetuates the UN's 2010 official recognition of the human right to water which entitles everyone, without discrimination, to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use. This includes water for drinking, personal sanitation, washing of clothes, food preparation, and personal and household hygiene purposes, as these are identified as essential for a person's full enjoyment of life and all human rights in dignity (UN OHCHR, 2010). Mentioning this human right to water, the social dimension of water scarcity explains itself. Fulfilling this promise of secured access and quality is a central point of the UN's 2030 Agenda for Sustainable Development, saying that for its progress to be real, everyone must benefit from socio-economic development in the short and long term.

This human right must not be confounded with water rights, mostly handled under national laws and regulation since they focus on property issues and national water course

management responsibilities (UN, 2019). Undoubtedly, as they address different types of stakeholders, one needs to be aware of the existence of those two unlike categories of rights when reflecting on integrated water resources management. For the first one the stakeholders are human beings in the need of water to exist. For the second one they are corporate and private landowners, administrative communities, and investors, who each have their particular, or for some even contrasting perception and interests in the resource and its exploitation. Discussing the legitimacy of every group's interest is difficult and quickly turns into a broader critical view of the capitalist system, as the recent controversy about the privatisation of water and sewer systems sources proved (Food and Water Watch, 08/31/2015; IWA, n.d.). For now, we leave this fundamental legal debate to legislative entities, public interest and environment defending organisations.

Need for public awareness and action. Yet, our readers will notice throughout the following chapters that our concern about raising public awareness about water scarcity or water stress and sustainable use of the resource is very closely linked to these framing aspects, as water directly interferes with food and energy supply (T. Gunda et al., 2019; Parceria Portuguesa Para a Água, 2010). E. Mostert et al. (2008) remind us that our understanding of ecological systems itself is not problematic, the real difficulty is to transform and embed this knowledge in society, in order to integrate all social agents in the sustainable management of natural resources through adequate policy, informed by scientific experts. This requests general capacity to understand one's individual role in the processes (the authors call this "sustainability learning"), to relate them to the enveloping systems and therefore take educated decisions and adapt one's behaviour according the co-constructed policy measures.

Citizens' choices are often motivated by individual economic interests. R.C. Griffin (2012) gives us insight in the economic point of view on the water issue and calls upon evening out what he entitles the "future forces"; continued population growth, economic growth, environmental demands, pollution, groundwater depletion, climate change, infrastructural decay, reservoir sedimentation, and energy scarcity. They are acting in unison and promising to raise water scarcity everywhere, albeit weighing unevenly heavy on the scale (R.C. Griffin, 2012: 427). According to him, facing the pressure means making use of all possible influences: new tools, policies, projects, and ways of thinking, considering harmonizing (or at least non-conflictual) options such as reuse, non-rivalry and jointness on a large scale, as water is a constantly flowing good. Opposing to the point that we are about to make with this thesis, Griffin believes that reducing one's individual hydrologic footprint as aimed by the here

followed project ECH2O-Água, increased water conservation or the idea of keeping water cheap, are deficient in economic terms (R.C. Griffin, 2012: 429).⁴

Water conflicts. Trying to adopt a more integrative approach of the issue, we would like to draw our reader's attention here to the fact that many researchers in social science argue that the water-energy-food security nexus debate is not exclusively about ensuring sufficient clean water delivery, sanitation and hygiene (short "WASH") services to people. IWRM must also respect the socio-cultural aspects of the resource water, ensuring its supply and use to be sustainable, socially acceptable and empowering in the sense of enabling people to develop their personal capabilities (W. Jepson et al., 2017; N. Newhouse, 1990; T. Gunda et al., 2019). Curiously, even though the title seems to point out the soft aspects of water scarcity and security, this year's WWDR still only focuses on the physical access to appropriate retail water services as demanded by the human right to water. The report does not even consider a relational framework of the hydro-sociocultural cycle, which we now know is not restricted to merely utilitarian water needs but includes identity, spirituality, cultural reproduction, collective values and the sense of responsibility to other beings (see: WWDR 2019). It is the same with the Water Blueprint Project, part of the European Union's Horizon 2020 Strategy and 2011 Resource Efficiency Roadmap on sustainable development (EC, 2012). We argue that, while seeking to further balancing inequalities by globally promoting the utilitarian water-energy-food security nexus (Parceria Portuguesa Para a Água, 2010) and in the same time responding to the diverse dimensions of culturally diverting perceptions of sufficient water quantity and quality, societies now need to choose if they are willing to reorganize their consumption habits so as to avoid any further undesirable and unsustainable situation and rather ensure real water (and other resource) security, including for future generations. To do so, withdrawals need to be reduced and whenever possible be balanced through a supply with completely renewable resources as to limit their impact on the environment and competition between users (FAO, 2019). Alternative, at first-sight sustainable solutions permitting to hang on to a "western" lifestyle, such as alternative bio-fuels have to be carefully analysed concerning their overall influence on the environment, including their demand on already

⁴ To better understand his point and discover a purely economic discussion of the water issue, we suggest reading his book *Water resource economics: the analysis of scarcity, policies, and projects* (second edition of 2016). Notably chapters 4 to 6 about risk and reliability, social and legal institutions, and policy analysis, and chapter 13 about the author's perception of "the water challenge" appeared to be very helpful for us to understand the different management strategies (e.g. pricing, technology restrictions, water use regulations, supply enhancements, etc.) for the, by nature physically established, water budget.

overexploited water supplies, threatening water quality, the environment and therefore ourselves.

Water as a social factor. Unfortunately, it seems utopian that humankind as a global solidary community manage to quickly understand these complex interferences and all act appropriately to them. In the light of the mentioned prognostics concerning the future rise in water demand and therefore rising water stress, conflict connected to access to enough water of decent quality seems inevitable, and already menacing, as the outbreak of the civil war in Syria in 2011 sadly proves (P.H. Gleick, 2014). To illustrate that it doesn't even need a severe drought as experienced in the Middle East to have conflicts break out, we would once again like to remind the very astute criticism of W. Jepson *et al.* (2017) concerning the exclusive physical dimension of the above mentioned declared right to water (H₂O) as a basic need to secure human existence. As developed by the authors, water is much more than what we drink or use: It is also related to values and social structures as the latest UN World Water Development Report illustrates, even if restricted to the single context of gender equality (UN, 2019b). Not only in indigenous communities does it bear cultural and social specificities, clarify roles and structure habits. In their article "Expanding Perspectives on Transboundary Water", J. Blatter *et al.* (2001) also emphasize the perspectives on water other than the utilitarian one (need for domestic use, economic sectors, environmental protection).

Need to face reality and change it. Social scientists seem to agree on the urge to be aware and respect other values and meanings of water which depend on ways of knowing about it, varying relationships of water to territory and the state, material and symbolic attachments and other facets or elements (S.R. Davies, 2011a). Each of these meanings can be originary to claims to legitimacy or fairness. However, this is not yet achieved and action needs to be undertaken to install a sort of "covenant", i.e. a society-wide consciousness and responsibility to save natural resources and avoid conflicts especially between human stakeholders to water. We unbalance systems and, for our own safety as a species, need to act responsibly for us and our surrounding environment now. This is the main message of entitling the post-industrial-revolution-era "Anthropocene": showing that humankind is influencing on the environment through our presence and activity on this planet in a deteriorating way and need to undertake concrete changes if we want to maintain a liveable environment for everyone. Uncountable newspaper articles, documentaries, podcasts, governmental and NGO publications as well as eco-friendly initiatives and education programs communicate on this issue and invite people to get involved and reduce their personal impact, often illustrated through the image of CO₂-/H₂O/etc. footprints.

How can science mediation help? This translation of scientific knowledge to public is necessary, since, as the environmental consultant Nancy Newhouse already suggested in 1990, awareness can alter people's behaviour. Therefore, it is crucial to positively influence on public awareness of ecological issues in order to trigger their internal locus of control, meaning a sense of responsibility, thanks to solid understanding of problems and action strategies and make them act consciously according to this positive motivational attitude (J. Heinström, 2010; Y.-T. Chiang *et al.*, 2019). Achieving this is easier when the developers of education programs are (1) geared to the audience's level of knowledge, attitude, and moral development; when they are prepared to (2) explain both sides of the issue, being comfort, status and habits on the one and preservation on the other hand; as well as to (3) encourage more direct contact with the natural environment; since these are factors that (4) highly stimulate a sense of responsibility and personal control (N. Newhouse, 1990; J. Heinström, 2010).

Changing consumer habits is thus not only about informing them about the current and future critical states of the environment but also about developing a strategy to achieve widespread social acceptance and understanding of those scientifically agreed-on problems and eventually technological devices that help achieve the sustainability goals, so as to trigger change is citizen's awareness and behaviour in a more sustainable way (A. Kollmuss & J. Agyeman, 2002; M. Chetty *et al.*, 2008).

Actions are directly linked to values, which is why any project working on social awareness of environmental issues needs to make sure it activates positive frames of human responsibility to Mother Nature and all living beings, including other human societies. Interactions between connected (eco-) systems need to be explained as they sculpt how we perceive the world we live in, which then influences to what extent we are willing to take care of it, as emotional involvement is proved to shape awareness and attitude, even though they can always be covered up by more immediate and selective individual motives (A. Kollmuss & J. Agyeman, 2002).

This indicates that sustainability is a concept for environmental protection related to economic scale and cost for societies and individuals. Moreover, it includes connected issues like energy use, technical maintenance, finances and political support. Thus, in order to cover up for the entire complex interconnectedness, awareness-raising projects for sustainable development should not only address environmental protection out of good intentions, but also admit that this might include changes in people's habits and oppose their usual way of living.

Inclusion of the public. Regarding sustainable politics, we would therefore like to emphasize the importance of appropriate and complete information of the public about societal

problems and menaces, as well as the open hearing of their specific knowledge. Public awareness is mandatory for participatory governance which has been proved to resolve or even avoid conflicts of water use (T. Gundaa et al., 2019; S. Neto et al., 2019). In Social Studies of Science, the underlying exchange is called public participation. It can either exist through information and education, as a one-way communication situation in which experts are providing knowledge to laypersons; or as an opportunity for two-way communication, meaning exchange between experts and the public through dialogue; or even as a mechanism of participation in decision making (Parry et al., 2012). However, any of these measures needs to be prepared, be it in science, technology or environmental policy: citizens and their capacity to understand need to be taken seriously so as to motivate them to participate in preservation processes, be open-minded to mutual learning and to engage for changes, if necessary, exploring different perspectives rather than defending entrenched positions.

The underlying case-study. Within the disciplinary boundaries of Social Studies of Science, this Master thesis is dedicated to have a close look at the project ECH2O-Água, a public awareness-raising initiative in the field of sustainable water use. Merging climate change and water scarcity, it focuses on one of the highest-ranking research topics of the 21st century. It was launched by the Portuguese professional Water Resources Association APRH, who has been working on water security for more than 40 years now.

We choose to follow through intense observation the project ECH2O-Água applied in the Lisbon area, Portugal from March to June 2019. It was conceptualized by APRH to get in contact with the most diverse groups of people about the water scarcity issue, framing it as a problem that is going to affect each and every one in multiple ways, referring to multi-disciplinary international consensus expert knowledge. Within a future-oriented vision, the project invites its participants to embrace an eco-systemic view of the planet and to reflect on their singular positioning within this structure, when advancing easy ways of positively changing it in their everyday life to reduce every one's negative effect on the water cycle. Its purpose is to sensitise people about their own impact on the environment and to empower them through this knowledge. It also includes introducing the public to easy technological devices (faucet aerators) that help saving water. Furthermore, the team encourages participants to communicate openly on the problem of water scarcity, freshwater supply and the urgent need of its sustainable management in their personal and professional surroundings. Through their action, the organisation aims to reach around 6000 people with their message. Thanks to an analysis of our observations of the project's activities, regular exchanges with the executive

team and short qualitative interviews with participants, we aim to find out how the concept of ECH2O-Água can be further improved, respecting an inclusive knowledge approach. This example then gives us more general hints about how an awareness-raising project can trigger behavioural changes by activating participant's emotional involvement

Organisation of this work. Before introducing our readers to the water stress situation in Portugal as well as to the related communication and actions undertaken to fight it (Chapter II), we quickly outline the Social Studies Interest in Science Mediation Projects like the one investigated on here and the theoretical frameworks that will be mobilized for it. Chapter III displays how we obtained our data. A fourth chapter comments on exactly this investigation, undertaken between March and June 2019 in the Lisbon area. In Chapter V, suggestions for ECH2O-Água's optimisation concerning its success in raising public awareness on environmental issues in a range of different target groups will be made based on our findings. Our conclusion will drive us back to our more general research question of how to effectively approach different profiles of lay people in order to make them care about scientifically proven environmental threats and adapt their behaviour appropriately.

1.1 The Social Studies Interest in the Science Mediation Project ECH2O-Água

Future water security is a social concern. The protection of water is everyone's serious business. Consequently, it is indispensable that all stakeholders, this is: every person as an individual and within their social and/or professional involvement; understand the urgency so as to manage and use the resource efficiently. Broad awareness of governments, institutions, farmers, industries and citizens must be achieved quickly, as water stress observably becomes more intense and will endanger the well-being and existence of ecosystems and human populations in the near future. Together with institutional authorities, scientific water experts now bear the responsibility to spread their knowledge as to increase the visibility and tangibility of the problem immediately. Solidifying public's perception of the issue is the base needed to create their emotional involvement, making them care about water and its protection. Through instructive proposals and technological help, it will then be possible to turn this abstract willingness to act environment-friendly based on values into a concrete change in habitual actions (S. Preuss, 1991; W. Kempton *et al.*, 1995; U. Schneidewind *et al.*, 2016).

Public empowerment through awareness. Projects like ECH2O-Água seek to activate exactly this profound understanding of the need for IWRM and to trigger a desire to

consume consciously and avoid wasting water. Relevant and useful information about the current and future situation, the water cycle and about a range of (in-) direct water uses are only the common knowledge base that needs to be provided to relieve this positive energy of motivation to do better for the sake of the planet and humanity. Real life situations and experienced learning are motivation factors for this kind of instructed change (R.D. Saveland, 1976). The created concern through reference to participant's personal lives (APRH calls this the "learning cycle") invites them to become actors of the knowledge transmission process themselves, assuming their responsibility as citizens in a society, who collectively and individually bear an important role in achieving global sustainability goals on a local level (S. Neto et al., 2019; J. Blatter et al., 2001).

Scientists engage in social activity. ECH2O-Água is of high interest to a social studies analysis. Conceived, developed and realized by scientists, civil and technological engineers, it is by definition a project of science mediation for the lay public. It includes the participation of several different target groups in terms of age, personal and professional situation, and initial state of knowledge. Thanks to APRH's regular activities, the involved experts are used to interdisciplinary work and therefore know that highly specified information needs to be simplified and adapted to a non-specialised public, to make them understand the main message of one's argument. The aim of our study is to understand how scientists undertake this contextualizing demonstration of the links between global water scarcity and personal water uses, addressing non-experts. During the project phase, different social realities and communication patterns meet and we want to find out how the message flows between them and how receptive different target groups are.

1.2 Research Question of this Thesis

With this study based on the case of ECH2O-Água, we seek to understand how a public awareness-raising project can achieve its main intention of turning passive consumers of water into active, eco- and socio-responsible citizens who participate in the strive for generalised water security. Therefore, we need to concentrate on the project's strategy of spreading awareness through knowledge transfer and exchange (Chapter 4):

How do experts on water-related issues translate the need for an urgent change of individual and collective attitude for improving water preservation?

Do they effectively adapt their proposals to the different audiences and social realities they address to, taking into account how different groups of people conceive the water issue, feel about water and use it?

Are they successful with the observed approach?

This will help us respond to the practical solicitation made by the association APRH which is to help evaluating and eventually improving the project ECH2O-Água concerning the best ways to approach different target groups (Chapter 5).

Then, we should be able to perceive how an expert-group can achieve a certain rise in public awareness, indicating how participatory citizen science and engineering lead to more profound understanding in different profiles of lay people and thanks to it, trigger their concern and appropriate actions, resulting in individual and collective preservation of the resource and the environment in general.

1.3 Conceptual Frameworks mobilised to tackle this question

Frameworks for guidance. Focusing on the educational and co-creational dimension of sustainable resource use and management provided by ECH2O-Água, but also on citizen mobilisation in IWRM, we assume the project to be an object of interest to the field of Social Studies of Science, Technology and Innovation. For its analysis we decided to mobilise different concepts based in the STS field, meant **to deepen** the answers to our just exposed research questions. These concepts are the mediation of scientific content, citizen science and the actor network theory. The reasons of this choice are presented **below; concomitantly we will develop the relevant content related with our research questions.**

Mediation of multi-disciplinary scientific content. As suggested by M. Venckute et al. (2017), we assume that education can be used as a tool to reduce the water footprint of young people, but also of adults and retired people. Contextualisation of one's actions in a global system by learning about facts and best practices is a first step to change. But the scientific content needs to be adapted to the respective target group's initial state of knowledge and capacities to understand. Only relatable frames of reference and direct experience should be used in science mediation so as to meaningfully influence on laypeople's cognition, e.g. interpretation of reality. In a next step, this knowledge transfer through interaction can be used to create awareness and emotional involvement leading to decisional empowerment concerning individual and collective actions (J. Vinke-de Kruijf, 2014).

In the sense of P. Vare and W. Scott (2007)'s analysis, ECH2O-Água is both: ESD 1 and ESD 2, as it (1) intends to promote awareness and informed ways of thinking about water that are meant to positively influence on participants' behaviour, and in the same time (2) helps building capacity to exchange with experts, build their own opinion through deep understanding, test ideas and face contradictions between convenience choices and sustainable living. In total, adopting Vare & Scott (2007)'s terminology, it wants to create a knowing, empowered yes (we know and care)— and (act appropriately and share our knowledge)— debate in participants, which then shapes their behaviour.

With an interdisciplinary approach to the analysis of science mediation in the fields of environmental studies, civil engineering, sociology and ethics, we seek to participate in its improvement (suggestions can be found in chapter 5).

Citizen Science. This leads us to the concept of citizen science which is all about empowering people to act responsibly thanks to integrated knowledge (F. Serrano Sanz et al., 2014; E. Lewandowski et al., 2017). The concept is part of the Science with and for Society's approaches intended by the EU's Horizon 2020 (EC, 2013). Defining ECH2O-Água as a citizen science project may help promoting its value for further funding or expansion in this spirit.

Although not even the European White Paper on Citizen Science (F. Serrano Sanz et al., 2014) delivers a single and clear definition of the concept, we will now try to sum up its main ideas, so as to be able to check if ECH2O-Água fits into it: Citizen Science projects engage non-scientific experts in research and scientists in the mediation of their expert knowledge so as to make it tangible for the entire society, enabling all members of a community to actively participate in democratic processes shaping the organisation of scientific activities and related decision-making (ibidem, 9, 14). Characterised by continuously evolving relations between the diversified stakeholders with at least partly common objectives, the "open, networked and transdisciplinary scenario" citizen science includes "a wide range of models and outcomes and a[n ever] growing number of actors" in its collaborative activities (ibid, p. 9, p. 27). Through the generated common knowledge base "science-society-policy interactions are improved, leading in turn to a more democratic research based on evidence and informed decision-making" (ibid. p.9).

Collective learning. Clearly inspired by John Dewey's reflections on education and learning,⁵ Sarah R. Davies is the author who inspires us with her perception of different ways of knowing by dialoguing, by experience and the concept of learning by doing, indicating that participation leads to citizens' deliberation (S.R. Davies et al., 2011a). Chapter 2.3 will show that through ECH2O-Água, APRH has the intention to act as a science mediator and create a critical lens concerning water governance and domestic use through three different phases of their interventions: (1) knowledge through dialogue, (2) knowledge through experience, and (3) learning by doing. As a result, the association hopes for more civil mobilisation to save resources, and to make governance more participatory and democratic. This relates very well to the just outlined objectives of citizen science. Our observation and analysis of APRH's approach and material, used to visualise (virtual) water needs and promoting best practices fitting into everyone's daily routines, are supposed to discover how exactly ECH2O-Água's three phases correspond to these three elements of participation for deliberation.

Actor Network Theory. The Actor-Network Theory (further "ANT") mainly developed by Michel Callon (1986) and Bruno Latour (2005) helps us see, understand and explain relationships between actors and important moments of the project. We chose to apply it loosely because it guides us in structuring our ethnographic study's observation, insisting on the interactions and dynamics of the events. With the intention of determining the crucial moments and elements in the process of raising public awareness and triggering change in user habits, we will try to determine what Bruno Latour entitles "translation" of knowledge from one Actor-Network (AN) to another. Translation corresponds to creating new ANs. We will see if ECH2O-Água can merge with its participant groups and form a new entity. This is what we earlier called an "awareness-raising" action because by sharing their expertise one actor influences on another actor's perception of the underlying subject. This action relies on specific translation tools called "immutable mobiles". These can be metaphors, referential frames or

⁵ The American philosopher John Dewey already developed the importance of experience in learning processes in his essays on education and teaching in the late 19th and early 20th century. He argued that knowledge prepares pupils to their active participation in life in society thanks to an autonomous reflective attitude concerning their individual and communal existence. After him, knowledge is transferred only by experience, as doing (trying and undergoing) something creates a relatable, subsisting impression. This is why learning processes meant to result in critically reflected positions must be integrated in real-life situations instead of being abstractly structured and theorised (J. Dewey, 1899, 1916).

Concerning our intended focus on the immutable mobiles of science mediation projects, we would like to remind Dewey's insistence on those: "if knowledge comes from the impressions made upon us by natural objects, it is impossible to procure knowledge without the use of objects which impress the mind" (J. Dewey, 1916/2009, pp. 217–18). His argumentation was focused on (young) children, but we believe that in a context of decisional empowerment and deliberation, the principles can be enlarged to citizens of all ages.

objects. We will see which kind of immutable mobiles ECH2O-Água activates to achieve its intentions. Once determined we may decide on their usefulness for the purpose of a participatory project leading to change in daily practices and involvement in the transmission of the project's core message.

2 Water Stress in Portugal and Measures taken to prevent and soothe it

Threat: Water Stress. Water supply crises are among the top five risks identified in the WEF Global Risks 2013 survey (by both likelihood and impact) (OECD, 2013). In the entire European Union, water security is menaced by the pressuring problem of quantitative over exploitation and qualitative degradation of water courses and aquifers through non-sustainable, excessive use, contamination with agricultural derivatives like nitrates or non-treated urban wastewater, and industrial emissions or leakages of poisonous substances, only to name a few factors (EC (11/14/2014a)). Especially the south of Europe, including Portugal, is affected by a threat to water. Through this threat food, energy and social security are menaced locally. The country needs to counter the negative effects of population growth, land use and economic activity, especially tourism, on the resource, and prepare for more intense consequences of climate change on various regions. Especially coastal erosion and on-boarder-surface water quality are big issues to be dealt with through a convenient water scarcity and droughts policy, including multiple diverse and adapted economic and socio-educational instruments to reframe perception and use of the liquid resource by closing knowledge gaps (EC (12/13/2012)). Regardless of their importance in protecting the already stressed water resources, none of the measures proposed by the European Commission are compulsory for EU member states. They are solely voluntary, as are the commitments of OECD members who stated already in 2003 their willingness to reduce per capita and even total water use, partially despite rising incomes and populations (OECD, 2003). As we know, water rights and regulations are mostly a matter of national policy. Thus, we will now have a look at the current and estimated future Portuguese water stress situation and IWRM engagement in the strive against environmental degradation and water scarcity on the Portuguese territory.

Sustainability in Portugal. The OECD's latest environmental performance review for Portugal of 2011 recognizes the country's willingness to invest in environmentally effective and economically efficient eco-system protection, especially its efforts to fight coastal erosion through the 2009 National Coastal Zone Management Strategy (establishing a 20-year vision and 20 strategic measures to protect the integrity of coastal areas through better co-ordination of housing and infrastructure development, protection against natural pressures such as coastal erosion and floods, and protection of environmental and landscape values (OECD, 2011a) and reduce greenhouse emissions. But renewable energy plants and reservoirs for domestic and industrial use in the south of the country bear a degrading influence on surface water quality,

already menaced by agricultural contamination through pesticides and industrial derivatives. More than half of Portugal's surface water risked failing the environmental objectives of the EU Water Framework Directive in 2005, "with the highest risks in the basins of the Sado, Mira and Guadiana, whereas only 7% of groundwater was classified as at risk" (OECD, 2011a). Water used for hydroelectricity generation regularly doesn't appear in any water withdrawal figures as it doesn't consume it in a traditional way, even though the stagnation leads to eutrophic states, which can also be found within the Tagus, Sado and Mira river basins (OECD, 2011a).

Current intensification. Anyhow, total water abstraction in Portugal is constantly increasing, as is the OECD average, weighing heavily on ecosystem balances (OECD, 2011a; S. Bento *et al.*, 2012). The country's economy has lately been suffering from relatively high trade deficits and unemployment rates, their dependence on the thirsty tourism, agriculture, and paper production sectors are worsening factors to the water stress situation in the partly already arid country. Precipitation being extremely irregular in time and space compared to other European countries and over 50% of river water coming to Portugal from Spain, already exploited and rejected, water quality and quantity are insecure. Severe droughts and increasing multi-sectoral demand cannot only be overcome through punctually more intense groundwater extraction as this endangers its quality and its sustainability. Construction of regulatory reservoir sites with their negative cost- and environmental impact has become a vital necessity to fight scarcity from affecting essential drinking water, domestic and agricultural needs (EU, 2000a).

Especially in Portugal's southern coast and inland, periodic droughts are becoming longer and more intense because of climatic changes, as do extreme weather events such as fires (mostly in eucalyptus cultures of the paper industry). Sea-level rise and intensified population in the coastal areas lead to threats through coastal erosion and consequential ecological imbalances. Altogether, these factors intensify the country's ecological, economic and social vulnerability to water stress.

Nevertheless, the UN World Water Development Report indicates "only" 10-25% of physical water stress for Portugal, which equals the Water Stress Indicator table per country of the IWMI Research Data Water Data Portal indicating a value of 0,561 for Portugal. This ranks Portugal amongst the European middle-class (Spain 1,5) (IWMI, 2019).

The Portuguese socio-political context of water scarcity. Since 1974, the Portuguese republic's constitution is built upon the basic principles of economic and social justice. As a

logical consequence, one of the main tasks of the state is to create an environment favourable to social justice and equality throughout the entire territory and social structure by promoting sustainable economic development and giving access to social insurance to every citizen (P. Pellegrino *et al.*, 1986). However, inequality and poverty remain contemporary issues and will probably get worse in the future as urbanization, climate change and economic performance will accentuate the pressure on already stressed water resources. Furthermore, in respect to the population's needs, the government has the intention of implementing an identical, generally low price for water across the country. Unfortunately, this led to water being mainly considered a "low price product" throughout the population (EU, 2000a; resume of conversation with AllAqua employee of 06/05/2019). Even though, water being the most needed element for all forms of life, it is questionable if this low pricing strategy can advocate for sustainable water use. Fiscal incitements for domestic eco-responsible behaviour are focused on energy efficiency, whereas the 2008 water resource levy on water abstraction and discharges is meant to cover resource management costs, improve water use efficiency and positively impact water quality. But, paid by licensed operators and calculated per cubic metre of water withdrawn, the levy only affects end consumers in an opaque way as it is only a small, inexplicit part of their total water bill. However, it partly finances the Water Resource Protection Fund's, the Water Institute's (INAG) and the River Basin District Administrations' actions (OECD, 2011a). The 2005 National Plan for the Efficient Use of Water's (PNUEA and its two consecutive Strategic Plans for Water Supply and Sanitation (PEAASAR I and PEAASAR II)) goal was to reduce water scarcity risks by promoting efficient water use in the urban, agricultural and industrial sectors, making high-quality water supply and sanitation services reliable and, through this, protect the environment (OECD, 2011a). In total, local researchers recognised "a general improvement in environmental indicators and the integration of the various actors in the [water management related] planning process" thanks to the EU Water Framework Directive (F. da Silva Costa, 2018).

2.1 Government's approach

Ministry. The main institutions in charge of water observation and management in Portugal are the National Environment and Sustainability Council, National Water Council, National Consumer Council, and evidently the Ministry of Environment (EU, 2000a). This "Ministério do Ambiente e da Transição Energética" is currently run by João Pedro Matos Fernandes and divided into four subgroups: Adjunto e da Mobilidade, Ambiente, Ordenamento

do Território e da Conservação da Natureza, and Energia⁶. Together, they are in charge of the National Environmental Policy Plan, Consumer Policy, Citizen's and institution's participation in initiatives to environmental protection, support of science and technology research related to environmental and natural resources.

Water legislation. The legal framework for water preservation was founded in 1919 with a ban on pollution of water resources. Article 18 of decree law 46/94 identifies human consumption as the first priority within cases of conflict between water uses (EU, 2000a). In 2005 the country transposed the EU Water Framework Directive (EU WFD) into national law n° 58/2005 (New Water Law). Before this, regularly revised (8-years rhythm) Water Plans on the national and regional level were prepared in the late 1990s by INEG and Decree laws 45-47/94 are parts of it. Unfortunately, this work done by INAG (analysis mainly focused on the agricultural sector, the problems of coastal erosion, wastewater treatment, and industrial contamination) was not considered when implementing the EU WFD which caused a lot of repeated workload. The more recent Decree-Laws n.º 226-A/2007⁷ and 97/2008⁸ clarify legitimate water uses through a licensing process, and the adapted pricing strategy for different uses, corresponding to the EU WFD (EU, 2000a).

Yet, according to the analysis of local researchers in social sciences of environmental issues media coverage and political engagement concerning water scarcity and quality concerns is relatively low and judged not dedicated enough regarding the national challenges. These are repeated droughts and ongoing excessive exploitation of the country's available resources, unreliable in time as climate change negatively influences on precipitation reliability and therefore water management attempts. The researchers call upon more actual governmental activity to counter these instead of simply promoting sustainable production and consumption policy and subscribing to non-mandatory principles (L. Schmidt, 2016; A. Horta et al., 2017).

The government's communication on their commitment to sustainability and water security is indeed of a surprisingly positive character, regardless of the mentioned national struggles. It can easily be observed on the government's website:

⁶ Assistance and Mobility, Environment, Spatial Planning/Urbanism and Nature Conservation, Energy.

⁷ Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento regional (05/31/2007) Decreto-Lei n.º 226-A/2007, *Diário da República*, 1.ª série, N.º 10, retrieved 06/11/2019 from <https://dre.pt/application/dir/pdf1s/2007/05/10502/00240049.pdf>

⁸ Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento regional (06/11/2008) Decreto-Lei n.º 97/2008, *Diário da República*, 1.ª série, N.º 111, retrieved 06/11/2019 from <https://dre.pt/application/dir/pdf1s/2008/06/11100/0339503403.pdf>

“Water” addressed by governmental communication. The keyword and tag “água”-search for the last five years (01/01/2014-03/31/2019; without videos and images) comes up with 11 pages of 8 hits each. These cover up for communication on national water management plans and strategies, visits of environmental ministers from abroad, Portuguese help interventions in areas hit by extreme weather events such as the current one in Mozambique (Republica Portuguesa, 04/16/2019). Another example of this positive communication are public speeches. At the occasion of this year’s World Water Day on March, 22nd, the Minister gave one at the University of Lisbon’s Civil Engineering Department LNEC (J. P. Matos Fernandes, 03/22/2019). This speech was very optimistic concerning the Portuguese achievements, for example in water quality improvement which helped to reduce water-related health issues to a negligible minimum or efficient water management allowing to not cut on retail water delivery during the severe drought periods experienced in the summers of 2016 and 2018. The speech calls for national pride concerning these noteworthy measures. But the minister also addressed future water scarcity challenges related to climate change, in the last years repeatedly experienced through ravaging fires, that remind how rare and precious water is. He mentioned the need to save water wherever possible and to use it as efficiently as possible (“O uso da água tem de ser parcimonioso”⁹, p. 5/16) especially in agriculture, and by considering circular reuse on all levels and in all sectors. Concerning the more efficient use in the domestic sphere, the minister promoted a new governmental public awareness raising program launched by the public company Águas de Portugal in autumn 2018, focusing on the value of water, its efficient use and the importance of abandoning wasteful habits. “Água com um Pingo de Consciência” arose out of a National Study on Portuguese Attitudes and Behaviours towards Water, held in April 2018, which identified the existence of dissonances between attitudes and behaviours of the Portuguese society (1660 online answers to the survey) towards water. The study found out that the Portuguese consider water as the most important resource, but do not value it accordingly. Neither do they recognize they are constantly wasting it, which is why an awareness campaign seems most appropriate to fight water scarcity through efficient use. Supervised by the Ministry of the Environment, the campaign includes diffusing knowledge through press, radio, television and digital media, and via public workshops and event in schools. Other than that it teaches municipal agents in urban areas about efficient irrigation of green spaces and street washing (Aguas de Portugal, n.d.).

⁹ “Economies in water use must be made.”

Influence of public institutions on public opinions. The speech and search hits reveal the EU-inspired public communication strategy on environmental and water-related issues, characterized by its confident tone, pretended eco-consciousness and pursuing future-vision, while not concretely admitting common damaging practices (e.g. monocultures) and taking responsibility for it. This lack of self-criticism within the ministry might be responsible for the already mentioned inadequately low public awareness concerning national water security (Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional (2007); Público (05/22/2019); Expresso (02/01/2018)).

2.2 Associação Portuguesa dos Recursos Hídricos (APRH)

Description. Founded in 1977, the professional association APRH unites hydrologists, hydrogeologists, civil engineers and more recently many environmental engineers, biologists, some social scientists, economists and sociologists; around questions on water management, supply, use, and quality. It grew to around 1000 members of multiple academic disciplines and the water industry. The members have a common professional interest but supposedly it is their personal conviction of being more efficient together that made them join the network.

Today, three fully employed coordinators organize the activities of the forum, meant to share knowledge through interdisciplinary solution-seeking exchanges about water-related issues. The association constitutes an ideal network that enables and simplifies interdisciplinary cooperation. The joint presence strengthens their position in favour of sustainable resource management within public or private advisory or deliberative committees. The meetings, seminars, field trips and other expertise-merging activities are organised by APRH on a national and international level, the most important event being the bi-annual Portuguese Water Congress. Internally, special committees and working groups study key issues within the water resource sector.

Scientific and technical achievements as well as important information are promoted through the organisation's journal *Recursos Hídricos*, website, and newsletter. In addition, APRH promotes training and their members' scientific and technologic updating events.

Through its existence and activities, the association campaigns for resource protection in Portugal, based on scientifically solid arguments meant to inspire the national water policy and turn it into effective and transparent IWRM governance thanks to ameliorated territorial and interdisciplinary coordination and capacity building.

Idea for ECH2O-Água. Even though the trend is slightly turning around lately, the association has been facing difficulties recruiting new members and raising appropriate funds to cover for its activities for a long time already. Consequently, in 2018 they decided on extending their activities from exclusively intra-expert-exchanges to addressing broad public through an awareness-raising project about the value of water and the need to protect it. With ECH2O-Água, APRH takes responsibility in public education and thus opens up to the social dimension of their field. The current director judges this turn towards even more interdisciplinarity and overtake of social responsibility more valuable than a professionalisation of the association into a company with public interest, another option to diversify activities and income possibilities. She hopes for a sustainable organisational learning process to be initiated within APRH by ECH2O-Água.

2.3 The project ECH2O-Água

Idea and funding. ECH2O-Água is initiated by the professional association APRH and co-financed by the European Union through their DEAR (Development Education and Awareness Raising) programme¹⁰ and by the Camões I.P. that regularly focuses on projects within the lusophone world and culture¹¹. It is also a partner of the project NoPlanetB-AMI¹² and clearly positions itself in the sustainability sector. It is a public awareness-raising project translating scientific knowledge into the societal concerns related to it, conceptualized in order to get in contact with a variety of citizens about water security and domestic water use, throughout two sessions incorporating three phases.

Organisation of the project. In phase one, an introductory presentation of the water scarcity issue, illustrated through a PowerPoint Presentation (PPP), APRH invites its participants to embrace an ecosystemic view of the planet and to reflect on their singular positioning within this structure. For this, the World Bank's video "Water's Promise" is shown

¹⁰ European Commission. (unknown). *Development Education and Awareness Raising Programme*, <https://europa.eu/capacity4dev/dear>, consulted on retrieved 05/20/2019

¹¹ Camões Instituto da Cooperação e da Língua Portugal (n.d.) <https://www.instituto-camoes.pt/en/>, consulted on 06/21/2019.

¹² "The project "There isn't a PLANet B! Win-win strategies and small actions for big impacts on climate change" aims to contribute to the development of knowledge and critical understanding of European citizens, regarding the interdependent world of their role, responsibility and lifestyles towards a globalized society.", retrieved 06/21/2019 from <https://ami.org.pt/en/missao/no-planet-b/>.

to some groups.¹³ Proposing ways to reduce one's negative effect on this system, ECH2O-Água triggers both : (1) reflection on a subject that might seem far in distance and time (climate sceptic opinions such as “There is no proof for Climate Change and how it will affect Portugal precisely.”, “There have always been periodic changes in weather and climate trends”, “Portugal has enough water that is turning in a circular system, thus droughts will never be a substantial problem”, “Droughts and floods are only menacing poor countries of what once was called the ‘third world’”), and (2) a reflection on which values are related to water without us being actively aware of it. These values include eco- and social responsibility, safety, comfort, freedom, spiritual, aesthetic and environmental dimensions, and are implied in water needs for religious and recreational purposes, the maintenance of biodiversity, etc. Understanding of urban and natural water cycles is supposed to raise participant's awareness, make them adopt a more eco-conscious behaviour and transfer the willingness to get politically active and demand sustainable IWRM and governance. Videos made by the association show best and worst practices of domestic water use. Based on this, the association wishes to discuss these, and other options participants can think of to reduce one's individual impact on resources. Participant groups shall link the project's intention to their personal reality and feel emotionally involved in the process through it.

Phase two, the demonstration of how to install a faucet aerator device on a tap, is still part of the first session and implies the project's core message: To protect themselves, society and the environment from water scarcity, it is every single person's duty to rethink and adapt user habits, i.e. reduce their personal water footprint. Technology can help us doing this, but even though the project includes the introduction of their audiences to water pressure-increasing on-tap advices for sinks and showers as well as water-saving devices for toilets (the term “faucet aerator will be used as a synonym for those), APRH does not want to give the impression that technology can actually save society from water scarcity. These water-consumption reducing appliances and illustration of their effectiveness are only part of the project since they are perfect mediation tools by visualising the abstract problem (see chapter 4.3 and 4.4). In Europe, communicating on water scarcity is generally difficult since people have the impression of retail water being inexhaustible as it is always immediately available. In some experimental communities, equivalent flow reducers are installed in showers, and

¹³ World Bank High Level Panel of Water (2017) Water's Promise, retrieved 06/21/2019 from <https://www.youtube.com/watch?v=UnHjBheHPGA>.

discharge reducers in toilet cisterns. The devices demonstrate that sustainable solutions can be easily integrated in everyone's daily-life, which is motivating.

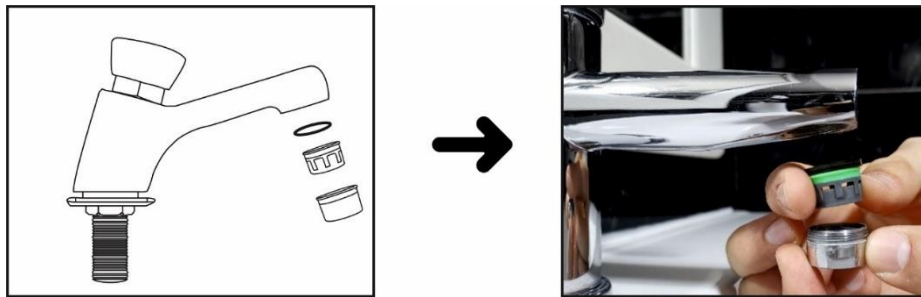


Figure 1 – Installing a flow reducer on a tap (source: S. Neto et.al., 2019, p. 7).

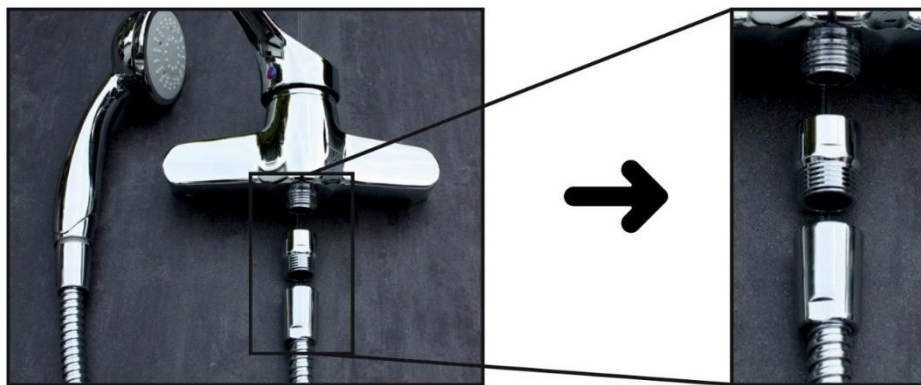


Figure 2 – Installing a flow reducer on a shower (source: S. Neto et.al., 2019, p. 7).



Figure 3 – Installing a discharge reducer on a cistern (source: S. Neto et.al., 2019, p. 7).

Besides installing the devices, APRH does not restrict ECH2O-Água to diffusing information about water scarcity or promoting good, sustainable practices, but it initiates a concrete participative learning process by inviting the groups to undertake measurements of the actual water use within the participating institutions in phase 3, setting up session 2, taking place roughly one month after session 1. Here, participants monitor the actual water use since the devices have been installed on the day of session 1, and calculate the water saved since then thanks to the faucet aerators and the more conscious use triggered by the presentation of phase

1. ECH2O-Água's social dimension is then further developed as "measurement witnesses" (a small group of participants who are shown how to install the device, take the measurements, and monitor the actual use) are invited to communicate their new or refreshed knowledge about how to save water in the institution or at home to their fellow participants and their personal entourage.

Outreach. APRH seeks to find a strategy to achieve widespread social acceptance and understanding of scientifically agreed-on problems and technological devices in daily life, so as to trigger change in citizen's awareness and behaviour. Through ECH2O-Água, the association expects to directly reach an estimated 500-600 people within the experimental communities (children, youth, adults and elderly), where they are taught about water scarcity and best practices to save water. In the following we will refer to them as "participants". During the project development period, an estimated number of 5000-6000 people (colleagues, teachers, staff and families of all participants in the experimental communities) are expected to be made aware of the need to act immediately against high-quality fresh water scarcity through individual action. Counting on dynamic knowledge transfer, APRH anticipates that these numbers of indirect impact will grow significantly in the metropolitan region of Lisbon and in the country, as the project continues and triggers awareness in direct participants. As S. Neto et al. (2019) indicate, this process has already started, and the project's results as well as the interest showed in it exceed expectations.

Participants in experimental communities. The project covers a diversity of target groups through actions in experimental communities including schools, community centres, companies and foundations (Town Councils of Lumiar, Olivais and Alvalade, Community Centre of Telheiras, Barreiro City Hall and Calouste Gulbenkian Foundation). An expansion of the circle of experimental communities is already happening, ensuring a diversified outreach and impact: The Câmara Municipal de Lisboa (a new important institutional partner) is willing to take over the concept and conduct the sessions in other schools and community centres. Employees of Centro de Interpretação de Monsanto (a new experimental community) will be charged with this from autumn 2019 on. Moreover, the range of societal groups is enlarged by the recent join of Centro Porta Amiga da Olaias, another partner of ECH2O's co-funding institution NoPLANetB-AMI, initiated in June 2019. Here, a, compared to the initial experimental communities, less wealthy and more troubled neighbourhood will be approached.

For a more detailed description of the experimental communities and involved institutions we followed for this work please go to chapter V.1.

Local partners. Institutional partners of the project dispose of multidisciplinary technical and scientific experience and expertise. They range from the private company AllAqua providing the faucet aerator devices; over the educational and labelling non-profit organisation ANQIP (National Association for Quality in Installations,) which has made the link between APRH and other institutional and private actors in the water sector to merge forces and increase impact; to the academic partners of the Engineering Institute at University of Algarve who develop a mobile application to calculate one's water footprint. Other than that, one master's student cooperates with APRH as the project's technician (T) who installs and explains the devices in the experimental communities. Visibility is ensured by the partnership with Calouste Gulbenkian Foundation (FCG), already involved in the water question through their Sustainability Programme and the house-internal Think Tank on Water and the Future of Humanity. Even though EPAL, a Portuguese water supply company, hosts and realises a similar project at the moment, it is also an institutional partner to ECH2O-Água. The common interest in water-focused environmental public education lead also to the just mentioned, firstly unexpected but very positive, partnership with the Câmara municipal de Lisboa, who will take over the project's concept and use it to pass on the information about water scarcity to other social institutions in Lisbon. This is part of the city's actions accounting for the title of Capital Verde Europeia in 2020.

Communication about the project. ECH2O-Água has an online portal on APRH's website that provides direct access to relevant information about the project. On social networks APRH shares information about the proceedings of the project throughout its three phases described above and separated into two activity days at every participating institution (first day: 1 - Information, 2 - Observation and Experimentation; second day, one to two months later: 3 - Analysis and Dissemination of Results through repeated measurement). The project disposes of a range of communicational materials. Detailed descriptions and information about these can be found in Chapter 4.1 of this work.

2.4 Other Portuguese Initiatives About Water Awareness (a non-exhaustive list)

Sustainability in commerce. In 2017, the International Year of Sustainable Tourism, EPAL and the hotel association of Portugal have teamed up to contributing towards the promotion of tap water consumption as an environmentally sustainable and economically accessible practice able to enhance both social wellbeing and economic development (Águas de Portugal, 2017).

Academic and UN supported actions. Framed by the UN World Water Day 2019, there have been activities concerning public and expert's awareness concerning the water issue all over Portugal. In university circles, the social character of water issues has been highlighted with a conference at the Instituto Ciências Sociais in Lisbon (see program [here](#)). However, this memorial of the World Water Day does not occur directly on the UN Website. The ones officially referenced there are the following four:

- at an [international school in Faro](#) pupils were made aware of differing water in-/security situations throughout the world through watching a video and doing a vocabulary activity related to the water issue. Then they carried out a web quest and did a survey on water usage in order to make them aware of their personal responsibility in the issue,
- at [Parque Natural Água Jovem](#), Aguas do Algarve, APA e Zoomarine, young school children from the area were introduced to the water circle and the influences of climate change on local water resources,
- at the the [Department of Biology of the University of Aveiro](#), young researchers organised a one-day symposium bringing together academic researchers and local entrepreneurs of the water management sector. The symposium was open to the general public, and pupils from local high schools were specially invited to actively participate. Communication about the event was shared in municipal agendas and local newspaper.

Young entrepreneurialism. Independently from the UN-related actions, Lisbon's international, innovative community of business starters concerned with environmental issues and associative organizations informed about the current and future problems regarding clean water supply, treatment and social equity, gathered at a [conference about sustainable and resource-protecting freelancing, organised by the Lisbon-based team of the international community "Creative Mornings"](#) on World Water Day 2019. The conference was at NOW_Beato coworking space in rua do Grilo, 1950-144 Lisbon. Here we discovered the work of the interdisciplinary awareness-raising platform "Give a Shit". Their focus lies on an experience-based approach, advocating technological innovation and social reorganisation in urban sustainable water and sanitation management throughout insisting on the anthropic impact on the water cycle. In the named co-working space, Give a Shit transformed the toilets into an informative and awareness-raising space about water waste, careless pollution through unreasonable (mis-)use of sanitation and the weaknesses of the water treatment cycle (for more information we suggest to go to : <http://giveashitnow.org/>).

3 Methodology and Organisation of this study

Our ethnographic study is qualitative in its approach, cooperative in its realisation, and consists of

- [1] analysing the project's discourse through documents, objects online publications, and constantly being in contact with the executive project team;
- [2] attending ECH2O-Água's first (phase 1 and 2) and second sessions (phase 3), as well as other meetings of the executive team with eventual target groups, throughout April to mid-June 2019 in six different institutions; four in Lisbon and two in Barreiro (observation);
- [3] conducting eleven qualitative interviews with the experimental communities' directors, staff and participants; and
- [4] linking the obtained data to the concepts of science mediation and citizen science along six criteria¹⁴, and undertaking an ANT analysis of its dynamic; so as to be able to
- [5] make reasonable suggestions, again along the six criteria, to adapt the concept and realisation of ECH2O-Água's activities to intensify its social impact.

These steps within the case study about ECH2O-Água's reach can then help us answering our research question of how a science mediation project can influence on different lay public's perception and awareness of ecological problems, impact their behaviour, and eventually social relations?

Cooperative research project. The main parts of our fieldwork were realized in cooperation with an extended research group. In March 2019, two groups of three (CCT) and four (EBL) students in their first year of their Master program in Science, Technology and Innovation Management (MSTI) at the University of Lisbon's business school ISEG joined the research project. Firstly, this happened to overcome the language barrier we were first confronted to, caused by the main author not being fluent in Portuguese. Secondly, the two teams with different disciplinary profiles benefited from a fieldwork introduction through a more experienced student in Social Studies of Science. The link was supervised by Sofia Bento, our common teacher. When attending a meeting or activity, every present member of our research group took notes, photos and got in contact with the APRH team and participants. Though evidently inspired by our discussions, the analysis of chapter 4, suggestions of chapter 5 and conclusions of this thesis are an individual work. The two groups used our common data

¹⁴ Perceptions of the project, Project-internal coordination and learning processes, Participants' initial state of knowledge, Mobilisation of immutable mobiles in this science mediation project, Knowledge transfer and translation, Emotional involvement

for other analysis, more focused on how to do research in Social Studies. Together we discussed different theories, concepts and practices eventually adapted to the analysis of the project. Mainly, these are citizen science (F. Serrano Sanz et al., 2014; and S. Davies et al., 2011a), transformative science (U. Schneidewind et al., 2016), public capacity building through participation (G. Özerol & J. Newig, 2007; S.R. Davies et al., 2009, 2011), target group adapted approaches in science communication (E. Jensen & R. Hollimann, 2009; specific for children: A Delicado et al., 2017; and for seniors: E.A. Wolters, 2013), the use of Actor-Network Theory (R. Dankert, 2011), fieldwork practices in social sciences (J. Mason, 2002, S. Kvale, 1996), and transcription guidelines (Utah Education Network, n.d.).

Access to the field. The hereafter exposed data was gathered through an ethnographic approach. This is a qualitative research design studying the culture and dynamics of a distinct group within society. Even though, according to the ESST-programme's timetable, the underlying work is restricted to a very short time span, meaning that we are not able to follow the entire project until April 2020, this analysis approach seems to be most suitable. Thanks to ECH2O-Água's already advanced stage when we joined the project, access to the participant groups in the experimental communities is immediate. Intersubjectivity bias from our research team's presence is expected to be neglectable because participants will consider us to be part of the ECH2O-Água team. Thus, our research group's presence will not influence the target group's behaviour any further, as their participation in the project is already an irregular, special event to them. Later, during the sessions we assisted, our position as investigators from social sciences was unclear to participants, because they considered us to be part of the executive team. In theory, on the one hand this allows us to collect non-biased data, on the other hand it reduces our distance to the happenings. Moreover, our objectivity is relative, as we sympathised with the executive team and sometimes even got involved in helping out with minor assistance when need be during the sessions (e.g. in the first session at EBL: preparation of and handing over the kits, help with demonstration). In a few sessions (second presentation at EBL, 05/30/2019; session at CIM, 06/05/2019) D or PM introduced us to the participants as Master students interested by the project's social dimensions. Participants did not question this any further and figured we must be assistants, especially because of the just mentioned occasional lending-a-hand. Given this comfortable close to "in-cognito" position (Everett C. H., 1996), where participants did not feel observed, ethnography helps us focus on their reactions to the best-practices promoting presentation and demonstration, as well as follow-up activities. That way we can figure out specific communication and action needs for these distinct groups. With this work we seek to contribute to the critical analysis of ECH2O-Água,

which will later help evaluate and then improve its original concept. Suggestions concerning its realisation might also be made. Finally, we should be able to discuss how this knowledge-spreading project influences on laypeople's perception of the results of scientific research and how this impacts participant's awareness, behaviour, and eventually social relations.

Data analysis approach. Relating our findings through an Actor-Network Theory (ANT) analysis should help us see, understand and explain relationships between actors and non-human actants. In this thesis it is supposed to structure our observations, focusing on the interactions and dynamics of the events and determining the main actors, actants and immutable mobiles that lead to the desired change in public perception and water uses. We are only going to apply ANT to the cases of Centro Comunitário de Telheiras and Escolá Basica de Lumiar, as, thanks to our collaborators, we were able to complete our observations with qualitative interviews in these institutions.

Realisation, documentation and theoretical contextualisation of the ethnographic study. Our eleven interviews followed individual scripts elaborated specifically for each session with our respective groups. In all cases, they addressed interviewees' perception and appreciation of the project, their personal perception of the water issue, and their saving habits in the domestic sphere. The interviews were carried out at the institutions either directly or up to three weeks after the first awareness raising session took place. They lasted an average of 10 minutes for participants, 5-10 minutes for staff members and 15-30 minutes for institutional coordinators. Interviews from CCT were fully transcribed in Portuguese by our collaborators. At EBL we were explicitly asked not to record our interviews, that's why we can only provide a summary based on our notes. The joint fieldwork diary of our research group (Annex 1) was then subjected to qualitative content analysis.

Summarizing Latour's, Callon's and Rawl's views of ANT and its application, R. Dankert's online guide to "Using Actor-Network Theory (ANT) doing research" (2011) helped us with determining our research question: How can an expert group effectively approach different lay publics and initiate their awareness of an ecological problem and make them participate in the strive against it? The indicators we want to develop through our observation and interviewing efforts within and around ECH2O-Água must focus on the "immutable mobiles" launched by APRH through the project. These are links between the Actor Networks involved in the project. Chapter 4 is going to discuss them.

Realisation, organisation. The following table shows our schedule throughout the four months the project took us (March to June 2019) including the activities we attended and the exceptional internal research team-meetings (other than our weekly updates in class):

Institution	Date	Type of session	Comment
C.Gulbenkian Foundation	Friday, March, 1st, 2-5pm	Launch session	First contact with APRH and introduction to the project.
ISEG	Thursday, March, 7th, 12am-1pm	Skype-meeting with APRH director and this thesis's supervisor	Definition of common interests and project idea.
ISEG	Tuesday, March, 12th, 8:30-9pm	First contact with potential collaborators of ISEG's MSTI.	Two groups are interested in participating in the project as social science investigators and interviewers.
Telheiras Elementary School	Tuesday, March 26th, 2pm	Preparatory ECH20-Água meeting	Cancelled one hour before because of some internal quarrels between the school headmaster and teachers about the extra work charge when participating in the project.
EBL	Tuesday, April, 2nd, 10:30-11am	Preparatory ECH20-Água meeting between project manager, the headmaster, and two members of our research group.	Constructive, quick meeting, mutual respect for the other person's field of expertise, introduction to the school and its eco-responsible orientation.
ISEG /CCT	Thursday, April 4th, 5-6pm	Meeting with the research group following the sessions at CCT	Briefing about how to take notes, what to focus on, which position we take as observers.
CCT	Wednesday, April 10th, 10:30-12:30am	Session 1 (phase 1 and 2), Project manager, APRH director and three members of our research group present.	Observation, first interview attempt of one research group-member. Presentation of roughly one hour with videos.
DHA, LNEC	Friday, April 12th, 2:30-4pm	Session 1 (phase 1 and 2), attended alone.	Opportunity to talk to the project direction about the already achieved progress and communicational strategy. Familiar audience.
ISEG /EBL	Thursday, April 25th, 10:30-12:30am	Meeting with the research group following the sessions at EBL.	Methodological preparation of our observation and creation of an interview guide. Definition of their analysis angle : citizen science.
ISEG /CCT	Tuesday, April 30th, 8-9pm	Meeting with the research group following the sessions at CCT.	Preparation of interview guide for interviews with coordinator of the centre, staff and participants.
CIM	Monday, May 6th, 2:30-4:30pm	First preparatory meeting with staff of CIM, who is going to take over ECH20-Água on demand of the Câmara Municipal de Lisboa from autumn 2019 on.	Generally high interest in the project, especially via mediation tool device. Afterwards discussion with the director of AllAqua.
CCT	Tuesday, May 7th, 10:30-12:30am	Interviews with participants and staff at CCT: 5 retired ladies, 2 staff members	Most retired people forgot about session 1. Their main interest in saving water is saving money.
CCT	Thursday, May 16th, 10:30-11am	Interview with the director of CCT	Centre's eco-responsibility, Telheiras festival, her interest and participation in ECH20-Água, results with retired people.
EBL	Thursday, May, 30th, 10:11-15am	Session 2, monitoring and collective drawing of the water cycle. Interview with headmaster and teachers.	Participatory approach observed not to be exploited in depth. Lack of connection between activities.
CCT	Thursday, May, 30th, 12:12-30am	Session 2, monitoring and check up on installed devices.	Main concern with devices is user's comfort.
ESSA	Wednesday, June, 5th, 10-11:15am	Session 2, monitoring and preparation of students in cidadandia-specialisation for knowledge transfer activities	Reflection on possible actions and picking up results of monitoring week for evaluation.
CSPB	Wednesday, June, 5th, 11:30-12:15am	Session 2, monitoring and feedback from technical director.	Positive experience with devices, staff does not feel a loss in user comfort. Overall satisfaction and interest in reduction for communication reasons concerning economies.

Relation with APRH. Mainly, the contact between our research group and APRH was hold between the author of this Master thesis, APRH's director (D), and the organization's secretary and project manager (PM). No specific interviews were conducted with them, however regular conversations gave us an insight in how the co-founders and main drivers of the project auto-evaluate their performance and reflect on it. Discussions with the project's technician (T), a graduate student from the University of Algarve, were completed by email exchanges throughout the month of May for the same purpose. We all were first introduced on March, 1st at the Gulbenkian foundation by Sofia Bento, teacher and researcher at ISEG and the ESST network and supervisor of this work. Information flew mostly via email and personal exchanges throughout the entire research period.

4 A Close Look at the Project ECH2O-Água

In order to be able to draw a conclusion about how scientific experts can efficiently approach non-experts to make them develop a well-reflected eco-consciousness, we will now try to see how our case ECH2O-Água stimulates reflection on, and concern about water quality and quantity in laypersons.

An analysis of the material communication strategy of the project (4.1) will be followed by a presentation of the institutions we included in the underlying study (4.2). Then, using ANT, we will expose how project team and participants in experimental communities connect, and how material immutable mobiles are completed by interactive elements, linking two ANs through translation; initiating the creation process of a new one (4.3). An analysis of their interactions, based on reports of our observations, where we were interested in the way in which APRH's experts on water-related issues adapt their knowledge and discourse to their audience (4.4) will be followed by a remark about ECH2O-Água being a citizen science project (4.5).

4.1 Communication Strategy of the project ECH2O-Água

We received all necessary information and material for the hereafter outlined static analysis of the project's communication strategy when we first met on March, 1st at the launch session. Precise questions were answered by the D and PM throughout other sessions.

The communication material is part of the knowledge exchange between the experts and the public, thus every element is an actant of the AN ECH2O-Água. We are interested in how they phrase content about the water issue and try to trigger self-reflection and change in participant's daily water use.

4.1.1 Logo

The logo consists of a graphic part showing the earth connected to an open water tap, indicating that human exploitation directly influences on natural water occurrence. The slogan “um único planeta para todos”¹⁵ is a call for solidarity with wildlife and other humans. The two drops of water, with one of them fully painted and the other one indicated to be transparent illustrate the core topic: not all uses are directly visible to us and



¹⁵ “One single planet for all.”

even if, technically, we have enough water, we need to make efficient use of it and need to take care of it. The pipeline-network on the leaflet's front page indicates that all uses are connected and rely on the same sources.

4.1.2 The giveaway kit for participants: Leaflet, Bottle, Bag

The giveaway kit includes a backpack with a print of the project's logo, a little (0,3L), blue inox-bottle, also with a logo print and a sticker indicating the three co-funding institutions, and a very informative leaflet.

The backpack is a measure of visibility, carrying the message through the logo. So does the bottle, however its principle purpose, inviting people to drink tap water (translating Portugal's high retail water quality) and reduce plastic waste, assuming that all eco-friendly actions matter and are connected, is even stronger. Moreover, it is a very useful item for the daily use. Its design is both child-friendly but not too childish for adults to carry it around, too.

The leaflet addresses scarcity of freshwater resources, the natural and urban water cycles indicating the various needs and uses of water in nature, for society, production of goods and on an individual, existential and personal comfort level. The need of this virtual water is indicated in Litres and the respective activities are each illustrated by a small drawing. The entire leaflet is held in white, different shades of blue and orange, giving it a pleasant appearance and readability through high contrasts. The text-graphics balance is good and white space sufficient, making the layout very user-friendly and clear. The illustrations are schematic, easy and so is the text: short, synthetic, but still explanatory and rich in symbolic metaphors such as “água fonte de vida”,¹⁶ “à nossa casa: o planeta Terra”.¹⁷ Readability for young children (just literate) and elderly or bad seeing people is slightly affected through a relatively small typo, which on the other hand is the key to the leaflet's content-wise completeness, repeatedly insisting on the fact that water equals life.

Technical terms are illustrated and easily contextualized for their explanation and expressions such as “um bem essencial [...] escasso e indispensável para a vida”¹⁸, “equilíbrio da natureza”¹⁹, etc. illustrate the importance of the resource. In a games section, the readers can determine their own level of daily influence on water resources and test their knowledge of easy water-saving strategies and the elements of the water cycle. These games are highly

¹⁶ “Water, the source of life”

¹⁷ “Our home: planet Earth”

¹⁸ “Water, an essential good [...] scarce and indispensable to life.”

¹⁹ “Balance of nature”

attractive for children as they allow a personal involvement in the learning process incited by the leaflet.

4.1.3 Web presence: Website and Social Media

Website. Information about the project is available on APRH's website since autumn 2018. The link leading to the page actually containing information about it can be found twice on the starting page, stimulating both visually through a version of the logo, and with the main slogan "ECH2O-Água. Um único planeta para todos".

It runs as a dark-blue image through a series of up to six news-hits on top of the page in the news-banner, also mentioning the three main funders, and as the first hit of the first section "Notícias" beneath the banner in its more purist, mostly white and blue project identity colours.

The actual project's site uses the exact same web design logic as the organisation's main page but for the colour policy: in contrast to the dark blue one can find on APRH's website, ECH2O-Água's page is mostly held in white and light blue. On top of the page, again the funding partners are listed with their logos and a link leads back to the main page of the organisation.

The three elements of the banner here run through in the same speed but contain more information to be read about the project's purpose, organisation and outreach to society through the CEs. Visitors are invited to participate in the web survey to calculate their water footprint (research tool of the technician) and are informed about the members of the executive team. The paragraphs come with extracts of the illustrations of the leaflet in the project's identity colours, reminding the major slogan.

The menu is also in banner form, guiding the visitor through the following six sections:

Project	Relocates the visitor on the banner with the resume.
Activities and Documentation	Information on past events with links to their schedule or pictures, Power-Point presentation used and a link to AMI's video about environment-friendly behaviour.
Water Footprint (a concept developed by Hoekstra (2002) and adopted by UNESCO describing the amount of water	Instituto Superior de Engenharia of University of Algarve's implication in the project is to determine the evolution of the ECs' water footprint throughout the different project phases by gathering data on the

contained in consumable goods, including through their production)	difference in water use. The section also sends to two online surveys about daily water use determining one's footprint and virtual/indirect water consumption: T uses this data for his Master's thesis.
Experimental Communities	Five of them are named, pictures show the respective buildings or views from the inside. This visual information does not connect to the project neither to the participant groups.
Partners	Listed through logos and excluded from any obligation to promote either the project or its results. However, they indicate the orientation of ECH2O-Água and translate that it is well supported.
Contact of the project manager	Possibilities to get in contact with the team are important for it to evolve and to make communication with eventually interested people direct.

We need to note that the Activities and Documentation section is not always consequently updated, we believe that it could be useful to pay more attention to it as it shows how dynamic the project is. The selection of pictures of the events is unclear to us, we suggest uploading only expressive pictures, showing the operative team in action and indicating the participants' positive reception. In order to transfer content, the leaflet could be made available for download. Generally, a website traffic analysis might be interesting for the team to understand how this channel of diffusion is used and if internet users are receptive to the design and information delivered.

Facebook. There is no special Facebook page promoting the project, communication about it on the social network is released through [APRH's regular page](#). There, information about ECH2O-Água and other activities of the association appear on the newsfeed in between automatic publications of articles of their media partner [ambientemagazine.com](#), related to the keywords environment, energy, water, climate change and ecology. Other than that, APRH uses the social network to diffuse the content of their newsletter.

[On January, 21st APRH shared a slide of the project's Power Point Presentation](#) indicating partners and purpose of it. The text accompanying this image repeats these and emphasizes the long-term orientation of its positive influence on user habits in urban areas, explaining that achieving those is a never-seen challenge to the organisation that wants to

incorporate their position of active experts on an issue in the Portuguese society in a more interactive way, benefitting from the entire team's differing states of knowledge and capability to evolve in their activities; especially referring to the organisation's secretary who took the project management lead. On [May, 30th a resume of the follow-up activity in EBL](#), a collective drawing of the water cycle and the initiation of a common water use measurement strategy, was posted under the hashtags #europaid #Institutocamoes and #ami referring to the positive repercussions of the kids' and teachers' perception of the first session four weeks earlier.

So far, fourteen other Facebook pages communicated on the project between October 2018 and May 2019 (see: Annex 2 - Facebook [search hits of 05/03/19](#)). All of them were noticeably inspired by official ECH2O-Água communication, using APRH's texts and images.

General web presence. Summarising, we can notice that web-presence of ECH2O-Água is active and coherent in its visual appearance and repeated proposals. Thanks to the mobilised networks, broad dissemination of the referenced information is achieved, reaching out to people interested in APRH, Facebook page followers, but also readers of journal articles. So far, in most cases, information is restricted to the concept. Updates about the current activities are less common and, depending on the team's workload, not put online immediately. Here, an important channel of keeping people interested in the project is underexploited.

We suggest enlarging the focus on a more attractive and immediately accessible update of the activity reports, not only by publishing the summary and photos on the website but also on Facebook, as was recently (May, 30th) done with the article on the collective drawing session in EBL. Additionally, posting a shorter version of the summarizing article should be considered as Facebook users are less likely to open a document than to read a short paragraph. However, the full exploitation of the visuals via Instagram as suggested by the monitoring group of the second session at ESSA (Annex 1, protocol 11 of 06/05/2019), appears complicated to us in order to respect the underlying obligations to always refer to the funding partners.

4.1.4 Directed contacts

Newsletter. The current director of the organisation only created the weekly newsletter in April 2018. Since then it reaches out to more than 2300 people and keeps subscribers up to date on framing information on the organisation's core subjects: water, environment, energy, sustainability. It does not only communicate on member's activities but is always introduced with a news-related edito written by D.

Even though its realisation was approved in September 2018 already, the project is first mentioned in [newsletter n° 36 of January 2019](#), happily announcing the new activity which

also restructures APRH's internal roles, notably of the secretary who becomes the project manager, and of the group's position in, and responsibility to, the Portuguese society. The description of ECH2O in this edito resumes it to their conviction of change in the world's future not only being brought about by technological but mainly social and organizational innovations. The [newsletter n° 40 of February 2019](#) also calls on accepting the organisation's and/or reader's responsibility as social agents for change with technical knowledge and with reach and influence in the political sphere. We highly suggest being more explicit about the project ECH2O-Água in future publications to illustrate the already undertaken steps.

In February 2019 three out of four newsletters announced the launch session at the Gulbenkian foundation and referred to partners and experimental communities, explaining the project ([newsletter n° 38 of February 2019](#), [Newsletter n° 41 of February 2019](#), [Newsletter n° 42 of February 2019](#)). Only [Newsletter N° 51 of May 2019](#) refers to ECH2O-Água again, reporting about a presentation of it on the Festival de Telheiras on May, 21st. This session could have been promoted beforehand to invite readers to come.

A first report on its actual activities in the experimental communities is sent with [Newsletter N° 54 of May 2019](#), diffusing the article written about the collective drawing session at EBL. We suggest sharing these reports more regularly via the newsletter which seems to be a perfectly adapted channel of diffusion for information on the project's progress.

Mailing list. The mailing list reaches about 4000 people (municipalities, companies, participants of APRH's events such as the Water Congress). It is another channel of diffusion through which APRH promotes events of their approximately one thousand members. According to the project manager, the mailing list was only used to invite its readers to ECH2O-Água's public events.

4.1.5 Mobilisation of the described tools

We consider all these objects of high informative value and emotional involvement potential through their symbolism. Linking concept to content and material can turn the latter into immutable mobiles of the activated ANs, because the mediation material allows the crucial information to flow from one actor to another.

The activated channels of diffusion are numerous and dedicated to reach different target groups, which helps diversifying the range of people who get to know about the project and its contents. Unfortunately, we found that besides the website, the discussed materials' and channels' potential to spread word and create awareness of the issue are not exploited to the possible extend: Interesting updates on the sessions could relate concept and realisation and

lead to interest of internet users in making their socio-professional entity an experimental community of ECH2O-Água.

The mediation potential of the imagery and objects is underexploited. The project team would only give the kit to participants after the first part of the first session (presentation). The illustrations are not used in this presentation; neither are the explanations related to the leaflet or logo. Translation in an AN-sense cannot pass through them, even though they appear to be perfect immutable mobiles. We highly regret this, as linking material to discourse would enable participants to transfer the gained knowledge to third parties, a new AN, using appropriate vocabulary and metaphors. This potential can be further developed through a change in the presentation of phase 1.

4.2 Participating Institutions followed within this thesis' project

Engagement. Since this is the first time that APRH is running a project addressed to non-experts, they relied on their personal and professional acquaintances to participate in ECH2O-Água and to promote it within their respective personal and institutional circles. The background information given in this subchapter is taken from APRH's document *Resumo Projeto ECH2O-ÁGUA*, more concretely the section "Perfis dos Parceiros institucionais",²⁰ and from informal conversations with the project management team. The first two institutions, Centro Comunitário de Telheiras (CCT) and Escola Básica de Lumiar Alto da Faia (EBL), were looked at the closest since their analysis is also the subject of our co-researchers from ISEG's 1st year MSTI. The others have only been followed by the author of this thesis.

Centro Comunitário de Telheiras (CCT) was the very first institution to agree on their participation as an experimental community. The community centre's coordinator is a personal friend to one of APRH's leading persons, that's how word about the idea spread. This coordinator liked and promoted the concept among the *Santa Casa de Misericórdia de Lisboa*, within their direct neighbourhood network *Parceria Local de Telheiras*,²¹ and via the online platform "Viver Telheiras". This proves that the Centre and network are already conscious

²⁰ Profiles of the institutional partners.

²¹ *Parceria Local de Telheiras* is a pilot project for municipal transition (Municípios em Transição) which intends to study and implement approaches to link local power to civil society in promoting sustainability and creating change for a more just, responsible and happy world based on positive relationships.

about the need to reduce their ecological footprint. Through a series of informative actions²² the institution wants to raise awareness within their target group of elderly people so as to make them participate in that process actively, via social integration, valorisation and exchange. To the presentation of ECH2O-Água the Centre invited all seniors of the assisted living section, those of their day-care service and the staff. Dedicated to the cause of environmental and social responsibility, the Centre puts a lot of effort in the dissemination of information on the project, for example by inviting the team to present the ECH2O-Água on the Festival de Telheiras (May 2019) and by always having a leaflet ready to be read in the sitting room.

Escola Basica de Lumiar Alto da Faia (EBL), one of the participating entities belonging to ECH2O-Água partner *Junta de Freguesia do Lumiar*, Lisbon, a relatively wealthy area of Lisbon. The neighbourhood council is aware of the importance to teach their residents about sustainable consumption and environment-friendly habits, and so are the headmaster, teachers and parents of EBL's pupils. The school is another experimental community. Through the children's participation in ECH2O-Água, the message about retail water scarcity is supposed to spread within the district and beyond. Here, APRH tested an innovative mediation tool: collective drawings for grounded understanding of the water cycle.

Departamento de Hidráulica e Ambiente (DNA) at Laboratório Nacional de Engenharia Civil (LNEC), is the department APRH is affiliated to within the University of Lisbon. Even though the entire LNEC is a partner of the project, only their department (Hídricas e ambiente) was invited to participate actively in the activities and to be an experimental community. Attending adults are colleagues of the APRH team and experts in the water sector themselves. They will not learn anything new, but concerning the way the project approaches their target groups. The attending kids are from the day-care center ATL LNEC, all sensitive to environmental issues as their family environment is involved in research on hydrologic resources. Here, the monitoring second session (June, 15th, not attended by us) consisted in having the children interview people outside the washrooms about comfort in the use of the installed devices. The participatory dimension was further developed by the children's wish to share their results with the researchers. APRH is planning on including this return on experience into a future intermediate results session conceived for the open public, just like the launch session was.

²² Eco Festival de Telheiras, Meetings with experts on Climate Change and Sustainability, an intergenerational art-exhibition project about over- and misuse of plastics, its harmful consequences for the environment and tips and tricks disposable to everyone to limit the problem in their daily life.

Centro de Interpretação de Monsanto (CIM), is another experimental community concerning the devices. It is run by the project's very important partner Câmara Municipal de Lisboa (CML). It is a science mediation and eco-tourism visitor centre in Lisbon's "green lung", the Monsanto park. Participants here are employees of the centre's different units; thus they are familiar with communicating eco-awareness to heterogeneous groups in a short time. As part of the actions to Lisbon's 2020 Green Capital-nomination, they are supposed to take over the ECH2O-Água concept and expand its reach by running the activities in the centre itself and in schools in other areas of Lisbon in teams of two instructors. This expansion of the project was not planned on beforehand but is very positive for the cause and proves the project's idea and approach to be appreciated and judged important.

For comparison with the monitoring sessions in CCT and EBL, we attended the corresponding sessions at experimental communities **Escola Secundário de Santo André (ESSA)** and **Centro Social e Paroquial do Barreiro (CSPB)**, even though we did not attend the first session there on March, 25th 2019. They are connected through their dependence on Câmara Municipal of Barreiro, which is one of the main partners of ECH2O-Água. The municipality is very concerned with their ecologic footprint, which is why they got involved in the project.

Not representative but still adapted to our cause. In order to understand how APRH can inform different focus groups appropriately about the quantity-quality-society nexus when discussing local, national and international water security, we need to accept that its target groups are not entirely representative for the Portuguese society.

Recently, the range of societal groups approached was extended to a less wealthy and more troubled neighbourhood through the Centro Porta Amiga da Olaias (contact through NoPLANetB-AMI). Here, the team plans on setting the focus on the importance of water savings to lower people's water bills. In order to achieve a real change and ensure their motivation, devices are to be donated to residents in need as part of the giveaway kit. With this action, both the target group range and the initial incentive of the project shift, since the team judges this intervention more goal-oriented within this target group. Even though we cannot comment on this highly interesting expansion of the project, we recognise that ECH2O grows continuously and that target groups are broadly divers.

Our observation will surely lead to interesting findings about existing perceptions of water, social dynamics concerning the physical resource, and the organisation's influence on them. This impact on participants' awareness is what we seek to help evaluating and

optimizing. Evidently, it would be of great value to the executive team to continue this investigation on the social impact, even in more detail and through an extensively structured survey and series of qualitative interviews with participating community members. Unfortunately, our time restrictions do not permit this.

Having exposed who is part of our study and can be found in our protocols in the annex (the executive project team, CTT, EBL, DNA, CIM, ESSA and CSPB), we will now enter the STS-related analysis using an ANT frame. This will then lead us to the analysis of examples from our fieldwork exposed to answer to our underlying main research question of how projects like ECH2O-Água can trigger change within their participant's perception and water use patterns, leading them to individually and collectively preserve the resource through this new awareness?

4.3 Activated Actor Networks in the project dynamics

The constructive suggestions we want to make thanks to our observation and interviewing efforts within and around ECH2O-Água must focus on the “immutable mobiles” launched by APRH through the project. These are links between the Actor Networks involved in ECH2O-Água and observed here. Obviously, the nature of these links is the science mediation material that allows the crucial information to flow from one actor to another. Interesting will be to discover how APRH's experts on water issues adapt their knowledge to their audience so that they turn into multipliers of the public awareness-spreading initiative (new ANs). This process of linking two Actor Networks through translation creates a new one. The following list of involved actor networks may help understand our reasoning:

1. The first Actor-Network is **APRH** which we already know from chapter 2.2. It is composed of human actors (the operational core team and all members) and non-human actants (actions and communications). Together, linked through a common interest in IWRM, an emotionally loaden concern about the planet and the willingness to join forces by collective interdisciplinary learning, they form a common strategy, meaning the network. Interactions between them take place in the offices, in conference rooms, on the congress, via email and the website's portal.
2. Out of urgent need for a new operative strategy, APRH created the second AN of interest to our project: the **executive ECH2O-Água-team** (mainly the project manager, the current director and co-directors of the institution, the technician) whose presentation can be found in chapter 2.3. Dedicated to its science mediation purpose,

the mobilised actants are numerous: faucet aerating devices, measurement equipment (sac and pliers), communicational material (see chapter 4.1). The actions initiated through these immutable mobiles also affect the original AN APRH which follows the project continuously. Eventually this ongoing process has impacts on the latter's internal organisation and positioning in society as outreach and strategy will be recognised and valorised also in the association's traditional activities. But, it is only the AN ECH2O-Água-team, thus only a fraction of the original AN APRH, who get in touch with

3. the **participant groups** in the experimental communities and partner institutions, each forming an independent AN of their own with a specific internal dynamic, since they are composed of a multitude of human actors and non-human actants.
4. We want to understand how a fourth degree of ANs is created through the **common activity of ECH2O-Água and their target groups during the sessions**. Our focus will be set on these temporary entities ("AN-session"), who are per ANT-definition constantly evolving through their ongoing interactions between members, as our observation report of the activity days (Annex 1) illustrate.
5. By transforming the participants into active citizens, ECH2O-Água initiates the creation of a fifth level of AN, which in case of the project's success will be numerous: the **spread of originally APRH's knowledge to broad public through the project's participants who tell their entourage** about their experience and/or show them ECH2O-Água's communicational material (this indirect, extended influence is expected to reach between 5000 and 6000 people).

Links between ANs. The entire process of what Bruno Latour entitles "translation" of knowledge from one AN to another and creating new ones is what we earlier called "awareness-raising" action. As just indicated, this action relies on immutable mobiles conceptualized by ANs one and two, APRH and ECH2O-Água. For our more general research question, the creational process of AN-levels 4 and 5 are crucial.

Evidently, there are other Actor Networks existing within and around the water issue than those mentioned here (remember the "surrounding" ANs of APRH we mentioned when pointing to the special relation between the project launch and the first participating CEs), including various actors e.g. human beings as individuals, aquifers, surface water streams, living beings depending on water, ecosystems, economic sectors depending on water such as agriculture, diverse industries, tourism, governments that need to maintain inner political peace

and defend their national interests against other countries, associations for environmental protection, etc., just to name a few.

Initially known internal dynamics in AN. A first general remark to frame the project ECH2O-Água's activities would be to notice that among themselves, all ANs; the executive team on the one hand and the participants within each group on the other hand; are known to each other. In the case of the CTT and CSPB elderly people and staff (all individual actors, related to one another through bonds of friendship or other emotions, their work position and hierarchy) are even very familiar, since they spend a lot of time together. It is the same for the school children and teachers of EBL and ESSA who attend class together every day. The cases of DHA and CIM are slightly different since the participant groups are more heterogeneous and spend less time together even though they belong to the same institution. Their work is more individual but they relate through likewise activities and a shared professional centre of interest, exactly like the AN APRH which relates through common emotional involvement in the field of IWRM. What could be interesting to us in the analysis of these AN is that they are expected to be already familiar with the topic and scientific facts, therefore their interest is focused on the project's approach to diffuse this information with the goal of promoting best practices among lay persons, whereas the ECs give us insight in how effective this approach actually is.

Restriction of this analysis/atmosphere in sessions and AN. For reasons of simplicity and coherence with our data collection, this work will mainly focus on the cases of EBL and CCT, and only be completed with comments comparing to CIM, DHA, ESSA and CSPB: During the sessions, the rooms are part of the respective actant-networks, and so is the equipment they provide: seat options, surrounding objects, the projection screen, and the room's brightness, all influence on the participants. Being in the activity room of CCT or the library of EBL together with people they know creates a feeling of trust and prepares the participants to speak openly, which could be interpreted as very productive for the cause. On the other hand, the familiar environment may not comfort every human actor: already existing hierarchies or social dynamics and (dis-) agreements may influence the individuals' participation (a comment on this aspect can be found in the paragraph "Session's frames" on p. 59).

Already identified immutable mobiles. The PowerPoint Presentation and videos are definitely the main translating elements of this first phase thanks to their materiality compared to the presenter's verbal explanations. Still, used metaphors and imagery speech are also effective in creating a link between abstract content and participants' reality. In EBL, the PM

compared a water treatment plant's activity to a hospital, treating the water whereas her colleague explains their effectiveness with the fact that nowadays in Portugal, babies do not die anymore because of contaminated water, but e.g. in Nigeria many still do (Annex 1, protocol 5). Not having gathered any feedback about their understanding of the water cycle, we still believe that examples like these help participants. A supporting point to this assumption is that teachers would always rephrase T's explanations during the demonstration. Discursive structures are therefore interpreted as immutable mobiles of their own, because they activate an entire network of references.

In the second part of the first session, participants observe how the faucet aerators (and cistern discharge reducers) are installed in the washrooms they regularly use, comparing the water flow with and without it. Again, the entire washroom but especially the sinks, taps and toilet flushes are important actants as ECH2O-Água turns them into the participants' centre of attention. The given physical closeness is supposed to help participants relate this option of easily reducing their individual and collective influence on water resources to their daily routines. The actual installation of *AllAqua*'s faucet aeration devices, our main mediation tool and immutable mobile, illustrates the project's transformative impact: The possibility to observe the technician's work, to ask him questions (direct exchanges), and to have a look at or maybe even touch the device (possible in CCT thanks to timewise flexibility), creates translation links between different actors and actants from the two ANs involved. This interaction creates an AHA-moment and with it a space of its own, translating that taking responsibility and positively influence on one's water footprint doesn't need to be difficult or demanding: The new "AN-session" connects through the experiment conducted either by T or by them together (at EBL, pupils participated by down-counting the 10 seconds of water flow) helps against possible mistrust concerning scientists and their gadgets and is the origin of the common AN existing during these sessions (we felt like the teaching situation of phase 1 does rarely lead to enough emotional involvement as to consider the AN-session as already existing then), merging the executive project team and the AN of participants.

As the giveaway kit is only handed over from AN-executive-ECH2O-Água-team to participant-ANs without being addressed, it is only an actant, even though we see its potential to be an immutable mobile between them, and between the participant-ANs and their surrounding ANs (new level-5-AN), when they pass on what they learned through the project to family and friends.

The following comments on our observations will further illustrate the relations within and between the here exposed ANs.

4.4 Attended sessions of ECH2O-Água

Organisation. As indicated by the table in chapter 3, we attended the launch presentation of the project at the Calouste Goulbenkian foundation, one preparatory meeting (EBL), three phase-1-and-2-sessions (EBL, CCT, DHA-LNEC), one presentation to future ECH2O-Água mediators (CIM) and four monitoring follow-up phase-3-sessions (EBL, CCT, ESSA, CSPB). No official, scheduled interview was conducted with any of the executive team members. Regular exchanges with D and PM in person at the occasion of the events and per email or via phone permitted us to discuss all upcoming questions. T responded via email to a series of questions about his view on the project and actants involved. Other than that, a total of eight interviews, three with staff and six with seniors of CCT, plus three (headmaster and two teachers) at EBL was conducted with the help of our two Portuguese speaking research teams. In CCT, interviews were conducted in private between our research group and one interviewee at a time, in a separate room without any temporal restriction. All interviewees agreed on us recording and transcribing the interview (annex). In EBL, due to a delay in the regular activities of our interviewees, members of the executive project team were present while we interviewed the headmaster and teachers. We consider this to be a source of bias to their answers. Moreover, it alternated the interview situation we assumed to have, as the PM and D participated in the conversation we initiated with our questions. Nonetheless, these exchanges gave insight in the interviewees perception of the project and the water issue in the context of sustainability efforts. The headmistress of EBL denied recording our conversation, as expressing one's opinion on educational aspects is politically sensitive. This is why the content of these interviews is only partly reflected in our comments.

Interest: how to create new ANs by introducing a common concern? While observing, we were interested in the way in which APRH's experts on water issues adapt their knowledge and discourse to their audience so that they turn into multipliers of the public awareness-spreading initiative. We will now see how AN-ECH2O-Água and ANs-participants connected through translation. We will see that the creation of these new ANs-session is facilitated by a range of material immutable mobiles and interactive elements. This new AN is supposed to provide space to bring about the intended shift in participant's concern by activating their internal locus of control concerning water security and personal responsibility for ecosystems and humankind.

Presentation of our data base. In the following, we will discuss our observations of the activities we attended. Doing this is supposed to help us understand the dynamics of ECH2O-Água's activities which are a presentation including videos, photos and text slides that

aim to make the participants reflect on positive and bad habits, followed by the installation of the water-saving devices, and monitoring follow-up activities adapted to the target groups.

Avoiding a long report of the entire fieldwork period sessions (protocols are to be found in Annex 1 - Diary), only interesting and for answering to our research questions relevant moments and aspects will be mentioned along the following six criteria

- (1) Perceptions of the project
- (2) Project-internal coordination and internal learning processes
- (3) Participants' initial state of knowledge and their interests in saving water
- (4) Mobilisation of immutable mobiles in this science mediation project
- (5) Knowledge transfer and translation
- (6) Emotional involvement.

(1) Perceptions of the project

All participants, interviewees and coordinators we spoke to confirmed that protecting the environment was important to them. The basic ideas about the resource being indispensable to life on earth have been expressed and confirmed by most participants in the visited communities. Also, water savings have often been related with the intention to save money.

The emotional involvement of the executive team (and, if not all members, at least a majority of APRH) is proven by the bare existence of the project.

T's involvement is a consequence of his personal wish to participate in projects within the area of sustainability in the water sector. His teacher, a co-director of APRH, invited him to join ECH2O-Água as a case study for his Master thesis.

"I always wanted to participate in projects and be part of something within the area of sustainability, so my mentor, [name], invited me to join the project. We had some meetings on the subject so she could explain the details and goals of the project and depending on that I made the decision to participate.", translation of an extract of an email of T. (05/09/2019)²³.

In a conversation after the presentation session at CIM, a member of AllAqua explained the company's interest in participating in the project, which he finds important for society and the environment. He's convinced that public awareness of water scarcity is low because the Portuguese price of water is too cheap to make people recognize how precious it actually is. The entrepreneur insists on the link between cost-related intentions to save water and superficial eco-consciousness that needs to be filled with meaning, for example through

²³ "Eu sempre quis participar de projetos e fazer parte sobre algo dentro da área de sustentabilidade então minha orientadora [...] me convidou para entrar no projeto. Tivemos algumas reuniões sobre o assunto para ela me explicar os detalhes e objetivos do projeto e consoante a isso eu tomar a decisão de participar.", extract of an email of T. (05/09/2019)

projects like ECH2O-Água. However, we cannot realistically measure its impact on participant's perception and water uses as we would have liked. We need to rely on their honest feedback and interpret their high interest in the faucet aerators (e.g. as expressed by interviewee 4 in CCT who bought the device after the first session and recommended it to her son in law)²⁴ as an indicator for their concern and willingness to act, even if only via technology in this first step.

(2) Project-internal coordination and internal learning processes

Team. Communication between executive team members was observed to be very constructive. All human actors are getting along well and are used to work together. They build a well-functioning team without visible tensions and semi-permeable boundaries between their tasks and responsibilities, which helps them adapting quickly, if need be. An example is that PM and D (eventually other APRH members) spontaneously switch presenting, preparing the kits and taking photos of the session, accompanying the demonstration in the washrooms and eventually completing T's explanations (see protocol of the 1st session at EBL).

Impact on APRH. The project shifted responsibilities within APRH. As we know, the secretary, normally doing administrative work turned into the project manager. Still charged with the organizational part of it, she is also attributed the responsibility of translating scientific content to lay people. So far, this field was unexploited by both, her and the entire association. We could interpret that this change is one of the main funding steps of the AN ECH2O-Água, distancing the new activity from the AN APRH's original field of work and their binding links. Here, the emotional commitment to the cause of preservation definitely grew stronger over the bare scientific and technical interests of APRH members. The common activity thus doesn't only have an impact on the ANs-participants, but also on its "mother", APRH itself. The

²⁴ L: A gente queria saber o que você se lembra, o que você tirou de interessante em relação daquela apresentação do projeto.

ITW 4: Sim aquela história de estarmos a reduzir, a poupar a água, isso é a parte principal. Já comprei aquelas peçazinhas pra por..

L: Ah já?

ITW4: É, comprei logo.

L: Olha, que legal.

ITW4: Tive uma experiência, e claro. Agora quero ver a fatura da água.

[...]

L: E você chegou a comentar sobre esse assunto da apresentação fora do centro?

ITW4: Falei com o meu genro, com os meus filhos. Meu genro também pôs nas torneiras dele., extract of Annex 1, protocol 7, interview 4, p.54.

orientation goes towards a more social perception of discussed issues, strengthening the emotional dimension of IWRM through the acceptance of the association's responsibility to spread their knowledge about water scarcity and conservation. Intense cooperation for the development of the concept and its realization during the sessions started a new way of reflection considering the ECs eventual needs to understand the issue in question. This collective internal learning process was intended by D so as to trigger a more substantial redefinition of APRH's position in society.

Technician. Thanks to his personal emotional involvement in the topic, judging public participation in water preservation an essential lever to resource conservation, T got even deeper involved than first planned: Initially T was only supposed to make the installations and measurements during the sessions, and use the data for the calculation of the water footprint of each EC. Motivated and a good communicator as he is (terms used by other members of the team), his responsibilities were expanded to delivering the explanation coming with the installation. In fact, now it is him who accompanies the AHA-moment of the participative part of science mediation through ECH2O-Água. He is aware of this moment's importance to the knowledge transfer process, judging not only the faucet aeration devices, but their connection with the taps (unreflected objects of people's daily life) as the main immutable mobile.

"I believe that people become aware of the amount of water they consume and realise that they can reduce this amount without the loss of comfort in their daily life. However, this perception only occurs after the demonstration I do, i.e. people need to see with their own eyes that saving through the devices is possible. The presentation and discussions [of phase 1] alone do not clearly transfer this. When observed in practice, doubts get erased and participants come to see the obvious change", translation of an extract of an email of T. (05/09/2019).²⁵

His assumption is confirmed by an expression of a teacher at EBL: "[...] P.8 says she [was] "...impressed by the difference. I had no idea it would be like this".", (Annex 1 – Diary, protocol 5, p. 35)

He is aware of different target groups' specific explanatory needs and tries to adapt his discourse and demonstration to those. As he also indicated, we observed that often, within the dense timing and without special training to approach different groups appropriately, his efforts unfortunately do not succeed completely (leaving them in incomprehension, one group at EBL had to leave before the end of the demonstration in order to stick to the school's

²⁵ "Acredito que as pessoas tomam conhecimento da quantidade de água que consomem e passam a perceber que podem reduzir este valor sem a perda de conforto no seu dia a dia. Entretanto essa percepção só ocorre após a apresentação que faço, ou seja, quanto as pessoas veem diante delas que é possível. Somente através de conversas e apresentações a ideia fica subjetiva a dúvidas, mas na prática passam a acreditar e então parece que "tudo ficou claro", extract of email of T. (05/09/2019).

schedule, whereas in CCT and CIM the groups are smaller and there is time enough for him to hand the devices around so that participants can have a close look at them and touch them).

“K: Do you think they understand how the device works?”

T: I believe that this depends on the participants’ age group. I have noticed that very young children are curious to learn something new, but they do not understand what it means to “reduce the flow”. So during the practical part, when doing the demonstration, I try to interact more with this age group and use illustrative words so that they can understand what the device does, however it can be seen that not everyone can absorb the message.

Another age group that requires more attention are teenagers, due to the fact that they joke about everything that they do [or see], tend not to believe in it or do not question why it is happening. Of course, some are very interested and want to know more about the subject and help, but these cases are rare compared to the total of teenagers involved.

In relation to the elderly, unfortunately some already suffer from cognitive limitations due to their age and health condition. This is why they receive greater attention in the presentations and interactions with the project so that they can perceive the message and idea, and understand how the devices work.”, translation of an extract of an email of T. (05/09/2019).²⁶

Pre-session phase. Preparatory meetings are held to facilitate the organisation and realisation of the actual session by agreeing on the final format (session 1 from 15-20 minutes of presentation for little kids at EBL to almost one hour of presentation for elderly people at CTT; session 2 individually adapted to the institution’s particularities, e.g. long-term mediation project with “cidadania”²⁷-students in ESSA), and for the project team to understand particularities of the institution and participant group. The PM told us that they were numerous and the interactions indicated the institutions’ high interest in having ECH2O-Água (this assumption was proved by our interviews with the coordinator of CCT and the headmaster and teachers of EBL, see: Annex 1 – protocols 8 and 9). The only one we attended was indeed marked by a very productive and positive two-way communicational exchange between the PM and the HM, who got along well. In half an hour, smilingly, they agreed on a common project that merges their two different fields of expertise and ANs; for the PM project and water scarcity issue, and for the HM her familiar work environment and responsibility to deliver

²⁶ “Você acha que eles entendem como o dispositivo funciona?”

Acredito que isso seja de acordo com a faixa etária das pessoas. Tenho percebido que as crianças muito novas tem curiosidade por ser algo novo para eles mas que não percebem o que quer dizer “reduzir o caudal” então durante a parte prática, ao fazer a demonstração, eu procuro interagir mais com essa faixa etária e usar palavras mais comuns de maneira que eles possam entender o que o dispositivo faz, entretanto pode se perceber que não são todos que conseguem absorver a mensagem.

Outra faixa etária que exige mais atenção são os adolescentes, devido ao fato de “levarem na brincadeira” tudo o que fazem, não acreditam ou não fazem muita questão de estarem envolvidos. Claro que temos casos onde alguns se interessam muito e querer saber mais do assunto e ajudar, mas é uma quantidade relativamente pequena quando comparada ou total de adolescentes envolvidos.

Em relação aos idosos, infelizmente alguns já tem limitações devido a sua idade e condições de saúde, então recebem uma atenção maior nas apresentações e interações com o projeto para que possam perceber a mensagem e ideia de tudo e como funciona.”, extract of email of T. (05/09/2019).

²⁷ “citizenship”

meaningful education about a sustainable way of life to the children. Here, the project's contents were not discussed, the HM already knew about it (Annex 1 – protocol 1). The very polite and informal conversation seemed to set all details for the session, however, on the activity day several organisational difficulties occurred (Annex 1 – protocol 5, 1st session at EBL).

To make the sessions start on time, the team normally arrives around 15-5 minutes in advance to the beginning of their intervention and they stay on site, available for questions and discussions for 10 to 45 minutes after its end, depending on their availabilities, and in the case of the first session the number of devices that need to be installed by T.

Sessions. Ideally, the project team-AN achieves to translate their concept to the participant-ANs and form a new common session-AN, experiencing together. Depending on the accompanying staff, the organisation in the washroom changes from run to run, but together with T, all make sure that every participant sees well. T is welcoming, smiling and attentive to the participants' reactions. From session 1 at EBL, he integrates one group's idea of counting the ten seconds of the measurement together into all of his future demonstrations for kids:

“In the first class, the technician asked the professor to make the 10-second count on his cell phone, while he filled the plastic bag. In the following class, the children took the initiative to count the 10 seconds aloud, which demonstrates how excited they were with the experience. In the following classes, the technician started to stimulate the count aloud with the children.”, Annex 1 – protocol 5 of C., p. 38.

The children enjoy this participation which makes them feel connected to the experiment and allows them to openly express their excitement about the flow difference achieved through the faucet aerator increasing water pressure by “mixing it with air” as T explains it. The difference in water flow shown is a great source of surprise and excitement, always rewarded with applause (citizen science AHA-moment). Younger children were observed to need this explanation to be repeated and rephrased by their teachers, who are important translation-facilitating actors. This moment is crucial: Together children, teachers, T and other present people discover how change can be initiated. Signalling their enthusiasm, many ask T if he can come to their house to install the device there, too (e.g. Annex 1 – protocol 5, group 1, p. 23).

At CTT and CIM, the groups did not count together as in the school. The measurement is something they only observe, not participate in. Still, everyone was impressed by the flow difference and, after checking, agrees on the fact that there is no loss in comfort:

„One man wants to test the feeling when washing hands, he seems sceptic. When, instead of only one time he has to push the button two times to wash of the soap, he feels approved in his assumption that it's not as good as presented. DAA does the maths for him: that is still one third of water saved, and most

people push a second time even without the faucet aerator in place because they soap up while the water is already running. The other man has to admit he was mistaken.”, extract of annex 1, protocol 6, p. 45).

Compared to the children, the seniors and adults have more opportunity to understand the device: the groups being much smaller, T can hand it around for them to study it. All of them are thrilled to observe the installation and most feel free to ask questions concerning the objects (device, pliers), process (installation, duration), use (water pressure), and even to tease the T, accusing him to waste a lot of water with this demonstration (Annex 1, protocol 3, p. 14). This proves that, in the moment of the session, they understand the relation between the presentation inviting them to save water and the demonstration in the washroom. Communication in this session-AN is flowing easily, at least with some participants. From our own interviews with some retired people and approved by staff and the CC, we know that many elderlies do not understand the links due to their poor memorising conditions (Annex 1, protocol 7, interview 5, p. 56 and interview 7, p. 59: and protocol 8, p. 60).

Considering user comfort and satisfaction as crucial to a sustainable change, monitoring session 2 collects feedback on it and T is charged with maintenance of the devices. When making adaptations checking, he insists on the fact that there is always an adapted solution to every tap and use. Whereas in CSPB only the staff answered to our questions, in CCT a witness group of retired people were consulted on May, 30th. They were generally satisfied with the faucet aerators, and those who experienced the cistern discharge reducer told they liked it very much, just as their colleagues we interviewed three weeks earlier on May, 7th:

“L: Concerning the devices that have been installed here, the faucet aerators and the cistern discharge reducers, what do you think? Do you like them? Do you feel any difference?
Int. 2: I don’t mind, I don’t feel a difference.”, extract of protocol 7, interviewee 2, p. 50²⁸

(3) Participants’ initial state of knowledge and their interests in saving water

Community contexts and participation. All participant groups showed interest in the project and confirmed to consider the protection of water resources to be important. They differ in their state of knowledge about the subject, even though the latter is understood to be an individual aspect, only partly influenced by one belonging to an institutional group. Evidently, people’s social networks and exchanges shape their knowledge base which then influences on how they perceive and participate in the sessions. However, measuring participation is biased

²⁸ “L: E em relação aos dispositivos que colocaram aqui, tanto no autoclismo, quanto na torneira. Você gostou? O que você achou? Você chegou a sentir diferença no uso aqui? Como foi para você?
Int. 2 : Não percebo, não estou a perceber.”, extract of protocol 7, interviewee 2, p. 50

by the individual ease of talking in front of a group to strangers about personal habits (water use) and in most cases only partly known content (water cycles). We suggest that their participation differed mainly because of the conceptualisation of the particular sessions and not due to their initial familiarity with the topic. Here, the project team already apprehended the respective different needs and partly adapted to them.

Relation to water. Focus at EBL lay on the water cycle and major water uses, translating a general willingness to save retail water. Independently from one another, all groups mentioned showering, washing clothes, dishes and the car as regular water-consuming activities, which indicates that they regularly participate in or see them, giving us an insight on their daily reality (Annex 1, protocol 5). The fact that they did not mention invisible uses (virtual water) contained in any industrial or agricultural product indicates that they have not been familiar with the topic beforehand. It is the same for non-natural elements of the water cycle, which were just very quickly introduced to them with the PPP, an actant we will specially comment on later. A teacher told us how much she appreciates the action as children enjoy playing with water, wasting it and spilling it all over the washrooms. She hopes that, referring to ECH2O-Água asking them to stop it will be more successful in the future, based on the children's new understanding of the need to conserve water (EBL, 04/29/2019 / Annex 1, protocole 5, p. 65: "the kids sometimes stand in a line just to use only the tap that has it. She says that most of the time the kids here care about the environment but don't link their action to it, that's why she considers the project to be important and interesting.").

Bias in team's perception of communities' state of knowledge. The way participation is framed in session 1; by inviting participants to name the water cycle's elements they already know, and to explain to the others how to save water on a daily routine excludes (1) those who have not thought about these aspects yet, and/or (2) are less outgoing or self-confident. This is why the team might always get the impression that their participants already know a lot about the water topic, since exactly those who would need more basic explanation are less likely to speak up during short sessions as ECH2O-Água's.

Seniors in CCT rather commented on the actions presented in APRH's videos than they shared their own experiences. However, their understanding and therefore participation was restricted by hearing and seeing difficulties. This shows us that offering information limits participants' reflexivity and creativity in finding answers to specific questions.

Senior participants claimed to have known about water scarcity before the first session and the involved children have been said to be eco-conscious, too, e.g. interviewee 1 on

05/07/2019 in CCT: “I like to save, no matter what and where, I save it.”.²⁹ Here we encounter an important bias: Both institutions are situated in relatively wealthy, highly educated neighbourhoods in the Portuguese capital and both coordinators are exceptionally concerned with sustainability (at EBL projects about plastic waste, food supply through gardening, marine life, etc. are common; and the CCT is actively involved in the neighbourhood’s eco-friendly festival). Their initial state of knowledge is not expected to be representative for the Portuguese society.

Adaptation to target group’s interests. In the senior’s cases we discovered that their concern about water is much more related to the financial aspect of saving than to actually do some good to the planet. Most interviewees at CCT and the technical director of CSPB insisted on this: When asked if she felt any difference using the faucet aerator, interviewee 4 who had bought it directly after the first session and spread the word to her son in law, who also installed them in his house, answered she hopes to feel the difference on her water bill.³⁰ The coordinator explained to us that the generation who frequents the centre had to pay attention to their spendings throughout their entire life, thus adopting measures to save is completely natural to them. Their first interest remains financial, not ecological.³¹ This fits the Environment Work Programme’s (2008: A Resource Efficient Europe) argumentation about the grid priority, saying that it is generally cheaper to save than to waste, even after an original investment in technological support such as the faucet aerators and flush bags (which are very cheap and amortized in almost no time). The team could consider implying this point in their discourse and advocate the parallel between saving water and money at a time.

This kind of adaptation will be undertaken for the new EC Centro Porta Amiga da Olaias (another partner of NoPLANetB-AMI). As participants of this community are rather poor, ECH2O-Água will insist on the financial benefits of water saving and distribute devices so as to motivate their efforts through a real measurable impact on their water bill. Here, for the sake of motivating the community, the team decided to overstep the initial border of not

²⁹ “Eu gosto de poupar, seja naquilo que for, seja no que for, eu poupo.”, extract of annex 1, p.48. The same sentence was told by another person on 05/16/2019, p.65.

³⁰ “L: O que que você achou desses dispositivos? Você achou que fez alguma diferença, se você sente o mesmo conforto?”

-ITW4: Eu acho que, pronto, nota-se já, nota-se na conta da água. A gente poupar um bocadinho de água nota-se logo. Quando é pagamento. [...] “Eu tenho o cuidado de poupar porque a despesa vem na fatura.”, Annex 1, p.52. [...] p. 54.

³¹ CC: Eles têm uma preocupação econômica, não me parece que seja uma preocupação ambiental., p. 60

communicating on technology being a solution to environmental issues caused by excessive human activity.

Case CCT. By conducting interviews, we learned that the majority of the seniors quickly forgot about the first session, even though they liked it and had confirmed to believe that saving water is important. Still, as already outlined, they relate saving water (and any other good) with saving money, which is an important factor to them. All confirmed to us, that they have been paying attention to not wasting anything throughout their entire life (even before coming to the centre). Here, the monitoring second session is experimental and inclusive: A group of six seniors was invited to accompany the team to the washroom where they were asked, on the spot right next to the project's flag in the hall, how they felt about the devices and project. All six confirmed being satisfied with the device, describing the flow as "confortável", meaning convenient. One of them explains that he even prefers it to his regular taps at home, because he enjoys the increased water pressure that washes off the soap more quickly. Only when one man mentions being happy not to have it at home because it is uncomfortable to drink directly from the tap with the device installed, do they discuss the actual aim of saving water and its environmental importance. None of them commented on the session 1 and 2 activity day. We can see that their main interest lies in a convenient use, and completed by our findings through the conducted interviews, that their primary motivation to save water is reducing expenses through it, not reducing their personal negative impact on the environment (Annex 1, protocol 10).

Knowledge-Action Relation. At DHA-LNEC, where participants were clearly familiar with the presented contents, they still carefully followed the basic presentation. Content wise, their participations were more diversified than in EBL and CCT. The PM was impressed by the children's advanced state of knowledge and report of their diverse ways to save water, including the use of a domestic cistern and conscious consumerism aspects such as not buying too many cloths. None of these (technological approach and awareness of virtual water in produced trading goods) have been mentioned in the other sessions we attended, proving that personal ANs frame our understanding and capability to contextualise knowledge. We can also conclude that awareness about the need to save water leads to involvement in the process via concrete resolutions concerning people's consumer habits and investment in technological assistance. Nevertheless, members of the executive team reported contradictory experiences with their colleagues' relation to water saving in their work space. Apparently leaking toilets and taps in the department were not always reported or fixed directly, as one would expect.

AHA-moment. The demonstration of the water saving devices, second part of the first session, generally led to more interest in all target groups than the theoretical part. Experiencing how easily change can be initiated without a loss of comfort made adult (CIM) and elderly (CCT) people reconsider their idea of a sustainable lifestyle and in some cases leaves them astonished. In our interview, the coordinator confirmed that her group preferred the practical part.³² Recognising this supports us in insisting on active participation to be a major criterion for ECH2O-Água's success.

Yet, the idealistic focus on reducing people's water footprint was communicated at the presentation of ECH2O-Água at CIM to future project team members, even though it is framed as an awareness raising and knowledge transferring activity. The mediators, too, were impressed by the T's and AllAqua member's demonstrations (in the entire Centre, including showers) and technical explanations. Water scarcity itself was considered a known and evident issue, not having to be further discussed in this context (other than when the Centre's employees explained its conceptualization to be practically self-supplying, or at least circular in its use of resources). Portugal's lack of rain is subject of discussion since Monsanto park needs to be watered to avoid changes in its biodiversity and reduce the risk of fires during summer (Annex 1, protocol 6, pp. 44-46).

(4) Mobilisation of immutable mobiles in this science mediation project

Individualisation of the common approach. Most explicitly observed at EBL (04/29/2019), each team member has their own way of addressing participant groups, including their individual style of explaining (choice of words and metaphors) and communicative expressions (body language, ways for seeking regular eye-contact with all participants to keep them focused). The sessions varied due to this, we best observed it at the first session in EBL on April 29th 2019 (Annex 1 Diary, Protocol 5), but a real co-creational dialogue with the participants was installed in none of the first sessions we attended. We state two main reasons for this: the members are not used to presenting their content to these target groups and the presentation is not conceptualized for qualitative knowledge exchange other than strictly related to the presentation's direct content. Other than that, tight schedules, group size and composition can also block an exchange from being participative and co-creational (e.g.

³² ME : Você acha que eles gostaram de intervenção com a apresentação e os dispositivos?
CC: Da parte prática gostaram, adoraram, sim.”, extract of Annex 1, p. 60.

session 1 at EBL where time was short and the groups were too big and diversified; a discussion interesting to a 10-year-old can be boring for a 4/5/6-year-old and vice-versa).

Degree of contextualisation. The project's intention of creating concern about water and the environment, as well as APRH's regular activities were not always explained. Its visual identity was only partly to be found in the presentation. Most of the time, the giveaway kits were handed over to the participants after the presentation, just before they went to see the demonstration of the tap flow rate measurement and the installation of the faucet aerator by T in one of the institution's washrooms. Neither the very informative leaflet nor the images included in it were used for the presentation. Again, its content translating power and communicational potential are disconnected from the discourse proposed during the presentation. Knowledge transfer is not facilitated through this aspect. We still insist on the materials' potential: While waiting, about one third (a team member's estimation) of the kids was beginning to read carefully, the younger ones focused more on the bottle, took it out of the box and were excited about it, laughing, opening it. They like the design (colour and illustrations) and highly appreciate the game part in the leaflet.

In the second session at EBL, we were surprised that "[i]n contrast to what we expected, [neither PM nor D] don't introduce themselves referring to the [first] session the kids attended four weeks [earlier]." (Annex 1, protocol 9, p. 65). Even when the picture is finished, nobody would actually explain the content. Here we are confronted with a lack of explanation leading to poor understanding in participants. The well-conceived action does not achieve its intended effect, as can be seen by one girl's question about where the water running out of the tap comes from, shortly after in the washroom.³³

AHA-moment. Most evident and immediate is the impact of the T's demonstration: Illustrating the difference in the flow-rate by showing the measurement bag before and after installation is self-explanatory and still all participants have been astonished by the faucet aerator, even without necessarily understanding how it functions. Water pressure is an abstract concept to children, whereas adults and seniors understood it more easily.

"On the way out, [P asks one child] which part of the day he liked most.
He answers: "To see the switch.", Annex 1 – Diary, protocol 5, p. 36.

³³ P questiona se as crianças possuem alguma dúvida para tirar com T e um aluno pergunta de onde vem essa água. T diz que a água vem do Rio, vai pra estação de tratamento e depois vem pra cá. D aproveita o exemplo e diz que é a mesma forma que eles desejaram na tela hoje., Annex 1, protocol 9, p.80

The motivational power of phase 2 is evident but in the same time contradictory with the project's core intention to make participants change their user habits, as it implicitly invites to rely on technology to solve the scarcity problem. Still, it communicates individual responsibility to engage in saving, as one single conventional tap is shown to waste tremendous amounts of water. We consider the demonstration to be the main AHA-moment of session one, even if its participatory degree highly varies between target groups, due to their size and the underlying time schedule.

Link between sessions and contextualisation of content. We were surprised that during monitoring sessions 2, the reduced participant groups were not systematically reminded of the first session attended roughly four weeks earlier. For example, at EBL, neither PM nor D asked the group of the collective drawing session if they remembered any elements of the water cycle they were introduced to in phase 1. The activity started right away by handing out the cards. Generally, all participants enjoyed the drawing session, but even after finishing the canvas, no explanation of the entire water cycle or flow was given, neither would the project team tell about missing elements (mostly of the urban water cycle) (Annex 1, protocol 9).

Participatory dimension of phase 3. The main part of the monitoring session consists in gathering participants' feedback about using the device and if they had talked to their surroundings about it. T also either explains the one-week monitoring action or collects the results of it. The sheet on which participants are supposed to indicate each time they use the tap is another mediation tool (session-AN actant). However, it is much more abstract than, e.g. the faucet aerator itself because it is only present for a restricted time-period and does not directly illustrate any change. Nevertheless, it is a means of participative data collection, giving value to the term "experimental communities", and making ECH2O-Água a citizen science enterprise. In order to make the activity more interesting and playful for them, T adapted the design of the recording sheet for young children (see: protocol of 06/05/2019 at ESSA, CSPB). The entire project team happily accepted this change.

In ESSA, the chosen students exposed various ideas to promote project and cause in their community, ranging from distributing content via Instagram, over "trying to convince the town hall to create a campaign to promote them because [Girl 1] thinks they are a good way to raise awareness. [...] but PM quickly makes clear that APRH does not sell or promote the devices, since it is not the intention to give people the impression that technology alone is the solution to the problem.", (Annex 1, protocol 11, p. 85), to how to install an autonomous knowledge transferring chain (ibidem, p. 87).

(5) Knowledge transfer and translation

Triggering concern. As just outlined concerning the immutable mobiles activated by the project, different elements are conceived to transfer knowledge selected by the project team to their audiences.

When possible, the video “Water’s Promise” (World Bank HLPWater, 2017) describing the urgency of the global imbalanced water situation, and two other videos of APRH about good and bad domestic water use practices are shown in phase 1 as part of the PPP. The composition of the PPP is always slightly adapted to the respective target group, responding to eventual focuses demanded by the institution during the preparatory meetings (in the case of CTT, the coordinator asked the team to speak specifically about why we should not flush waste down the toilet). Given the limitation in time and the linear structure of the session (one slide after another, presented by one to two persons at a time), the collective reflection did not go beyond the quick expression of personal experiences, just listing them, with hardly no discussion of the named ideas and elements. As literature on participative science indicates, verbal call and response – exchanges like these are very limited in their impact on participants’ personal reflection and involvement (J. Defrance, 1988).

Understandability. Trying to interpret reactions to the presentation, such as facial expressions, gestures and comments to fellow participants, we observed that young children do not respond to the PPP other than when it shows an image or when a slide is changed. If it contains mainly written words, they directly lose track (many try to read which demands their entire concentration) except for when the presenting person indicates a specific part of the slide by pointing on it while speaking. This creates a referential link between the verbal discourse and the material shown. It is the same for seniors, who tend to focus on the speaking person and, depending on their seeing abilities, pay more or less attention to the PPP. Considering all these aspects, we suggest rethinking the PPP and reduce the part of written language to a strict minimum and make more use of the self-speaking illustrations of the leaflet. Finding these in the giveaway kit can later help participants orient their reading or talk about the presentation they assisted. In return we argue for making more use of the leaflet, maybe printed in a poster format. That way, it could be turned into an immutable mobile helping participants to communicate on the project to third parties. This can be even facilitated through referencing to content-wise related aspects such as the well-being of marine wildlife that citizens generally care about because they think that animals are cute, and metaphors (such as “water hospital” for treatment plants, the comparison of evaporation to steam in the cooking pan) used by the ECH2O-team to make the topic more tangible, generally led to a rise in attention of the group

expressed by either surprised remarks, turning heads or lifting eyebrows. Only very few questions aroused from participants who were exposed to a lot of (at least partly) new knowledge. Unfortunately, we sometimes observed the provided answers to be slightly too complex, what eventually led other participants having questions not to ask them since they feared not to understand the answer. The same imagery speech and metaphoric translations need to be used by all team members and mobilized when answering to questions. Repeating them helps participants relate them to the subject and use them later when spreading word about the issue and project, eventually with the support of the communicational material.

Session's frames. The framing aspects of the sessions should not be forgot. We first argued, that experiencing the sessions in a familiar environment gives them confidence and helps them concentrate on the content. However, another turn is also possible: This was observed at EBL when age groups were mixed because minimum two classes followed the presentation at a time. Older pupils responded more quickly and actively than younger ones, they were more at ease with the format of the presentation. At CCT, only few seniors spoke while most of them contented themselves with approving nods and quick comments to their seat neighbours. One person first arrived late for the presentation and then participated a lot with remarks meant to be funny (e.g. "I don't have no more hair to flush down the toilet, so I'm behaving well!", "I'm not responsible for water scarcity, I'm very far from drinking even 1L per day.", Annex 1, protocol 2, p. 8). Some seniors expressed their disapproval with his behaviour by shaking their head. Being much more open to listen to others' proposals, the persons in question have probably been annoyed by him beforehand.

For the researchers having their office in the building, it is the same with the entry hall at DHA, a little less for the children who only come there to see their parents or during school holidays when they attend the day-centre (Annex 1, protocol 4). The case of the preparatory meeting in the localities of CIM is still different, as not all participants work in this building. We can leave this aside since this session was rather intended to promote the project than to run through the phase 1 and 2-activities of it.

(6) Emotional involvement

Valorisation of participation and lay knowledge. Structured by the academically-inspired PPP presentation and often intensified by a strict agenda, the relative stiffness of the concept leads to a classic teaching situation, meaning one-way communication from the APRH experts to the participants. All APRH members are applied to hear out a participant they ask to talk until s/he finishes their point, even though others would talk in the same time. By

confirming with positive, encouraging terms like ‘exactement’ or ‘e muito importante’, all try to give the person they talk to the impression that their experience is worth being talked about. But, lay knowledge is only recognised, not actually discussed or collectively reflected about, which is why the first phase’s presentation triggers only little emotional involvement. Still, we can conclude that by addressing the facts the session triggers curiosity and a feeling of responsibility in all communities.

AHA-moment as the origin of new ANs spreading the message. The demonstration is definitely the most interrogating and participatory part of session one. Adults were observed to be interested in touching the device and testing the modified water flow for comfort, often by washing hands. During the session, children and teachers in EBL had to be contented with the observation of the measurement. An interesting aspect of this activity day was that after taking back her class to their room, one teacher (group 7) returned to the bathroom entrance to tell us how much she has enjoyed the presentation and demonstration (Annex 1, protocol 5, p. 34). In the next days there will be a parents’ meeting, where she would like to have some of her pupils report about the event and the results achieved thanks to the device, creating a fifth level of knowledge-diffusing-AN. It is her, not the project team who thought of this implication of the target group in transferring the acquainted knowledge. When told that APRH does not sell them, she asked the technician for advice concerning good brands of similar faucet aerators he recommends and where to buy these. Her intention is to spread word about the urgency to save water with the school’s surrounding community. In this particular case, the project led to water-saving and knowledge transferring engagement. The teacher’s implication indicates the project’s success in triggering further actions. It also indicates that a new AN will arise, composed of the children as knowledge translators, the teacher who decided upon the action and the parents who will themselves learn new aspects and might then pass them on to other people.

4.5 ECH2O-Água, A citizen science project?

As mentioned in our introduction, defining ECH2O-Água as a citizen science project may help promoting its value for further funding or expansion as the term underlines the intention of integrated understanding of scientific facts, demanding appropriate governance and creating the needed emotional involvement of lay people to make them adapt to it.

Expectations. Based on the description of the project (reflected by the short presentation in Chapter 2.3) we first suggested that the project ECH2O-Água can be qualified

as a citizen science initiative (see Chapter 1.3), because it aims to empower people to conscious actions through sharing knowledge and triggering awareness, creating a feeling of responsibility that makes them participate in the diffusion of the message. Studies have shown, that social, collective learning influences on people's motivations to act which initially emerge out of individual and collective cognitional processes. These can be triggered, accelerated or intensified by trust and knowledge acquired through positively experienced social interactions (M.S. Reed et al., 2010; J. Vinke-de Kruijf et al., 2014). The concept of citizen science involves these interactions and defines empowering people to act responsibly thanks to integrated knowledge as its ultimate goal (F. Serrano Sanz et al, 2014; E. Lewandowski et al., 2017).

Realisation. The above outlined extracts of our research data prove that through ECH2O-Água, APRH definitely has the intention to act as a science mediator during the three different phases of their interventions, corresponding to Sarah R. Davies' et al. (2011) conceptual framework of material deliberation, close to citizen science: (1) knowledge through dialogue, (2) knowledge through experience, and (3) learning by doing. But how exactly does APRH's approach and material fit into this concept?

(1) Observing the executive team members present the water issue and interact with the target groups during the sessions gave us insight in ECH2O-Água's way of mobilizing frames concerning water, in order to create a critical lens regarding its domestic use and governance. Mentioning social and/or cultural interactions of people with the physical system was expected to be an essential part of the answer to the question of how to instruct sustainable human agency in the context of constantly increasing competition for water. Realising how pressuring the situation is bears the intention to turn into a feeling of responsibility for more civil mobilisation to save resources, making governance more participatory and democratic.

(2) The experience of a team-member measuring water flow and installing a device for reduced water use in phase 2: The faucet aerating devices' proven effective and immediate reduction in water flow has a strong impact on the awareness-raising power of ECH2O-Água as participants see with their own eyes (thanks to the measurement sac, another immutable mobile) how much they could save at every hand wash, if using it. Experienced sustainability learning leads to the general turn in the direction of a more sustainable resource use, making people aware of non-technological options to save water, reconsidering their own user habits (R.D. Saveland, 1976; E. Mostert et al., 2008). That's why we had a close look at the project's informative communicational material about water scarcity and best practices, as well as the way the project is promoted in order to get an idea of its actual outreach.

(3) Since it is not yet in use, we left the analysis of the electronic application for mobile devices to calculate individual water footprints to future investigations on ECH2O-Água. We expect it to be an effective means to disseminate knowledge from participants to their entourage as it permits to communicate about the project and the water scarcity issue in general. In respect to the project team's awareness of the social aspects of IWRM, we focused on the other participative parts stimulating the learning process and qualifying ECH2O-Água a sort-of citizen science project. These are mostly happening on AN-levels 4 and 5: the demonstration and explanations of the faucet aerator and cistern flow reducer, and participant's initiatives to disseminate their newly acquainted knowledge. The AHA-moment happens when participants observe or execute themselves the measurements and can take the devices in their own hands.

Citizen Science for People's Empowerment. Let's assume that theoretically, the three dimensions of acquainting knowledge can be found in ECH2O-Água, introducing non-experts to a certain scientific culture characterized by rationality, reserve, selflessness, and powers of argumentation through proof. That way, knowledge increases social justice as conceptualised, amongst others by philosopher John Rawls (*A Theory of Justice*, 1971), economist Amartya Sen (*The Idea of Justice*, 2009), and Martha Nussbaum (*Creating Capabilities. The Human Development Approach*, 2011; and M. Nussbaum and A. Sen: *The Quality of Life*, 1993), and equality, which are necessary for individuals to develop their capabilities, awareness of their position in this world, and enable mindshifts through integrated learning processes (U. Schneidewind et al., 2016). As we see it, the project was conceptualised with the intention of starting such collective cognitional processes, influencing back and forth on the participating individuals' respective perceptions. This exchange and experience of the possibly achievable change in water use are supposed to be continuously building a collective learning base, creating common knowledge to be questioned (M.S. Reed et al., 2010), consolidated and then spread to third parties (ANs-participants interact with AN-ECH2O-Água and create one shared, temporary identity AN-session, then AN-participants, marked by its participation in AN-session communicates about it to other ANs, creating an AN-level-5 expanding the reach). This involvement technically turns ECH2O-Água into a citizen science project.

Intermediate Assessment. However, assisting the sessions, our perception slightly changed. ECH2O-Água's citizen science potential is real, but the realisation shows a lack of opening the dialogue and participation to real co-creation from the project's start on. The project team presents knowledge to participants, listen to their experience, but do not valorise

it by a discussion or other related action. Even though they make members of the ECs participate in data gathering, the scientific analysis is made by the technician alone. Instead of being turned into a community action, the final results are later simply shared with them. We suggest adding another session to the project after the monitoring phase 3, so as to demonstrate the real water saving potential of the devices and participant's awareness about saving water, by doing the maths together. Further suggestions are outlined in the following chapter 5.

5 Suggestions for further editions of ECH2O-Água

Intended impact and outlook. After having exposed and related our main findings to the conceptual frameworks we intended to use, we will now comment on them with well-intended suggestions of how to increase ECH2O-Água's positive impact on public awareness about water scarcity and on user habits. To do this, we would like to remind our reader of the earlier mentioned notion of the internal locus of control, meaning a social desire to act responsibly, that leads individual behavioural patterns (J. Heinström, 2010; Y.-T. Chiang *et al.*, 2019). By explaining why water scarcity concerns everyone, ECH2O-Água intends to activate it and trigger voluntary commitment in a society-wide spread tendency towards sustainable consumption of resources and generally more pro-environmental behaviour.

We have seen that the concept of social responsibility is implied in this pedagogic knowledge transferring approach. As we know, APRH wishes to expand its science mediation activities in the future and eventually even launch a public observatory of water consumption and attitudes. This future project perfectly fits into the concept of citizen science just discussed and even meets Kearnes *et al.*'s (2006) vision of creating a new, socially robust science, that includes the ethical, legal and social implications of a project through public participation.

For reasons of simplicity we will again follow the six criteria exposed in Chapter 4.4 to structure our proposals.

Introductory note. Opposing to what we first expected after having seen the launch presentation on March, 1st, ECH2O-Água was observed mainly to share possibilities to save water in the domestic sphere rather than to diffuse information on the global and local water scarcity issue, caused by over-exploitation and contamination through human activity, during their sessions. Even in follow up actions explanations of e.g. the water cycle were hardly used, neither to integrate water into a global complex of eco- and exploitation-systems, nor to relate it to the local reality (but for always giving the example of the Tagus river when speaking about surface water). We wonder if more contextualised information could lead to more concern in participants and make them adopt other sustainable habits in the future.

(1) Perceptions of the project. For the AN APRH, engaging in a completely new field of activity (science mediation) bears the risk of losing precious time and energy. We suggest that the unnatural seeming step was rather motivated by their common concern and emotional involvement in the protection of the resource than by any professional or technical orientation. The earth and its water must be protected by the international but also by local communities,

thus the engagement of scientists communicating to non-experts is meant to set this process of conservation in motion. The fact that public institutions fund the project also proves its relevance for achieving sustainability goals and public understanding of science. It's expansions (takeover by CML and new ECs) prove that the idea finds local supporters.

(2) Project-internal coordination and internal learning processes. The only suggestion we would like to make for a minor internal adaptation is that the entire ECH2O-team shares one common agenda that updates automatically when one person adds or modifies an aspect. That way they can save time calling or sending emails and concentrate on content when discussing.

When leading a session together, they might consider clearly splitting what is about to be said and done by whom, so as not to interfere with the other's explanatory approach and to avoid eventual communicational blank moments with the participants (as we have observed at the beginning of the monitoring session at EBL, where neither of the two team members created a link with the kids as we were still waiting for the last pupils to arrive, Annex 1, protocol 8). When retarded like this with a situation of uncertainty (for at least one of the two parties), the creation of a common AN-session is complicated and needs more effort because the links between the two original ANs team and participants do not connect as naturally as if there was more explanatory verbal communication. We suggest developing an in-situ communication guide for all regular interactions with the different types of participant-ANs. This can reassure the team members and give more structure and clarity to the sessions, facilitating entry into co-creational moments (session-ANs).

The experienced high interest of institutions into ECH2O-Água might be biased. In this first round of the project, most institutions participated thanks to personal or previous positive professional contacts of APRH members (Annex 1, protocol 9). The APRH-AN and surrounding ANs are expected to be relatively eco-conscious and connected through shared perceptions and values. Therefore, it seems obvious that they would like to host their acquaintance's project to spread awareness about a topic they consider to be relevant. The executive team might want to prepare themselves to less fruitful exchanges (as experienced with the elementary school in Telheiras where the preparatory meeting was cancelled just a few hours ahead because teachers considered participating in the project too much of an effort) when trying to expand the experimental communities to institutions less aware of their social responsibility. A strategic concept reflecting on the kinds of ECs ECH2O-Água wants to approach in the future can be helpful to convince those when first getting in contact with them.

Assuring a positive learning atmosphere during the sessions, especially in big institutions, we suggest taking the preparatory meetings very seriously. Recognising that the sessions are exceptional and surely disturbing the institution's regular organisation, the team should take the time to clearly explain to the respective coordinators how much time is needed per session, that small groups are highly preferred since the knowledge transfer and exchange is more fruitful than in bigger ones (feedback of coordinator of CCT, Annex 1, protocol 9: "[...] I think that information and awareness are best transferred in small groups", p. 60)³⁴. The session room should be visited and compatibility of IT material checked. The team also needs to make sure that their activity is not just one amongst others, especially concerning participant's receptivity and organisational ease. Regarding participant's concentration, the team might ask coordinators which moment of the day is most suitable for an intervention to take place. Some kind of meeting checklist could easily lead through all these points so as to avoid stressful situations such as we experienced in session 1 at EBL.

(3) Participants' initial state of knowledge, and their interests in saving water.

The team always needs to be remember that individual members of target groups do not necessarily dispose of the same initial state of knowledge. The impression of them already knowing a lot emerges from the fact that those who are not familiar with the topic are unlikely to say so. This is why it is crucial to always provide complete, for "newbies" to the topic understandable explanations, that can easily be related to their own reality. Otherwise, they will quickly lose focus and a rise in their awareness will be impossible as their understanding of the urgent reasons why it is necessary to pay attention to our consumption does not improve.

(4) Mobilisation of immutable mobiles in this science mediation project.

Organisation. It is legitimate to contextualise all first sessions within ECH2O-Água's activities, and the projects origin in APRH, mentioning their intention of countering the water crisis through soft changes in consumer behaviour. Explaining why the mediators are present to talk about water is a first opportunity to signal how urgent the situation is. Repetition of this urge is expected to lead to more reflexivity in the audience.

Concerning the session's organisation, we insist on suggesting to carefully analyse this first run of the project and to solidify a universal working format for future interventions in

³⁴ [...] acho que determinadas sensibilizações e informações eu acho que é melhor fazerem em pequenos grupos , Annex 1, protocol 9, p.60

other institutions. This format should include the length, basic discourse with main important messages and appropriate metaphors to always be mobilised to explain them (at least with one particular type of participants at a time). Also, the PPP should be adapted to this lowest common denominator. Evidently, time and space (additional slides) should be taken into account for eventual specific extensions fitting the respective groups. To contextualise and expose relations between the audience and water, it appears useful to mention local or/and recent problems related to water, eventually showing a picture of a, not shocking, but explicit situation of water stress, an extreme weather event or water treatment processes.

Phase 1. Then, the communication material must be valorised more explicitly. We consider the project's visual identity and the giveaway kit as very well designed. The team should make use of the content translating power and communicational potential by mobilising the slogan calling on mutual responsibility. The leaflet's illustrations should be integrated in the PPP, eventually in an interactive version of the different water cycle parts: The base should be the illustration of the natural water cycle on the front page, extended with a settlement in the picture on which one could click, so as to lead to the domestic water cycle from the back page of the leaflet. Another click on the user section in the right bottom corner of the illustration can then lead to the resume of different water uses. Their sectorial listing leaves enough freedom to participants to find examples for these abstract notions but might be instructive enough to also make them think of virtual water consumption. It thus helps with overcoming the current not profound participation mode, consisting in a simple question-answer-exchange. A click on the domestic use section on the left of this illustration can then lead to the examples listed under "o nosso contributo"³⁵.

If the team prefers to stick to their current version of the PPP, we highly recommend referring to the leaflet by opening it during the session and showing the respective images inside the leaflet so as to make finding them easier.

Expressive and easily repeatable sentences like "Ciclo da agua, [é] uma viagem sem fim"³⁶ should be used more often. This activates their potential of translation from one AN to another. Together with the earlier mentioned metaphors to use, this framing of the discourse may appear restricting in the first place, but is expected to lead to more autonomous knowledge dissemination, one of the project's core aims, and needed multipliers of outreach.

³⁵ Our contribution.

³⁶ The water cycle is an endless journey.

Having seen the water bottle in use in three institutions (CTT, EBL, ESSA), we know that its design and purpose please a range of different audiences. Again, in an attempt to contextualise the project and the water issue in a sustainability logic, when quickly presenting the kit in session 1, the team should insist on related issues such as contamination and health issues caused by plastic, the good quality of tap water in Portugal and eventually its cheaper price compared to bottled water.

Phase 2. The main immutable mobiles of phase 2 are already very efficiently used in the project: The T's efforts to make all participants see well even in unadjusted, small spaces that the bathrooms often are, facilitates the two AN's joint existence in one temporal common experimental AN-session inside this closed space. Taps and toilet flushes, objects that always surround citizens in Portugal become actants of special interest. The faucet aerator itself surprises through its unimpressive appearance and its fast installation through only some simple turns with a pair of pliers (also important actants, if not even immutable mobiles, directly related to the main actor T because he brings and takes them with him). Further, its immediate influence on the water flow, illustrated via the before and after measurements, and visualised thanks to the special bag transposing a ten-seconds experiment's result to its one-minute dependent. The direct observation of the immediately achieved change leads to participants' surprise and exaltation. We interpret this as proof for the participant's general concern about the environment and willingness to take part in its protection, especially if the process is this unsophisticated. But, as expressive and useful they are to the demonstration of how to easily save water, the faucet aerators also represent a paradox in the project's concept: Even though technology can help us with this task, it cannot save the planet all by itself. Conscious use of resources and a reconsideration of what we need and what kind of efforts we can make in our personal lives to protect it is essential. Another example once mentioned by the PM are "smart" washing machines (first session at CCT), that should still only be used when fully loaded since their energy consumption cannot be reduced in ratio to the partial load as is done with the water use. The problem is that all members are regularly confronted with the recurrent question of where to buy the device for taps, showers and toilet flushes. We recognize that the intention of promoting the technology without promoting the actual product is challenging. The already mentioned working format of future sessions must include a more distinctive insistence on individual consumer responsibility in order to avoid participants focus on the technological "solution".

Linking the phases. Connecting knowledge and experiences is crucial when inviting audiences to communicate themselves about a certain issue. This is why we suggest referring systematically to other phases of the project whenever possible. Other than these auto-references, project phases and contents should be related constantly. A need for more explanation to link so far for some participants disconnected contributions of ECH2O-Água was experienced during the monitoring session at EBL: After her participation in the collective drawing of the water cycle picture, one girl wonders about where the water flowing out of the tap in the bathroom comes from. Here, the team could have used the just co-created science mediation object (drawing) to explain the cycle. But T did not refer to it. Instead he quickly verbally summarised the water cycle, mentioning elements such as a treatment plant, which cannot be found in the drawing. In the same session, the children were asked to take notes about their observations in their little ECH2O-Água notebooks. The executive team could interact more specifically by suggesting noting down all elements involved in the process (actants: tap, device, pliers, water and actors: T, themselves, other kids who use this washroom), explaining how mentioning them can be useful when spreading word about ECH2O-Água. So far, these direct interactions were mainly left to the teachers.

Intensify participation. Expanding the participative citizen science approach, we suggest charting the monitoring data of water use with the reduced session 2 participant group: In a short session, they can count the amount of uses recorded (actant: record sheet) and do the maths themselves. The surprising effect will be much more intense when they discover how much water has been saved within the experimental week, thanks to the devices. By obtaining the result themselves, they are much more likely to identify as knowledge transfer elements (“multiplicadores”) within and beyond the institution. For little children or retired people assistance with the calculation should be ensured, e.g. through illustrating material like toy bricks, water bottles, etc. with which the quantitative difference can be demonstrated.

(5) Knowledge transfer and translation. A means of increasing laypersons’ awareness and capabilities.

Videos. When shown in phase 1, the videos’ content must be discussed with the group. Otherwise seeing it will be too disconnected from the following presentation. ECH2O-Água must make sure that the presented content is understood and integrated, at least to the extent that their audience can rephrase and make use of it when they speak to third parties about the water issue.

PowerPoint Presentation. Generally, we feel like the PPP is a very academic way to present something. If the team still counts on keeping the principle of projecting content as a convenient tool to support their speech, they might consider having less text on the slides, leaving more space to illustrations to be commented on (see our propositions above of how to valorise the leaflet via the PPP). These overcome the illiteracy barrier of some participants and are less distractive (just literate kids and seniors with seeing issues struggle to read and forget to listen over it). Rather do they stimulate participation and discussion as the entire audience would focus on the same image but eventually highlight different aspects. As we experienced in EBL's first session, where the videos have not been shown due to a technical problem, when schedules are planned shortly, the little time available is best used for an exchange with participants, to impact on their personal reflection and involvement.

More training for more flexibility and exchange. When intervening in an institution, its internal dynamics and communication rules must be respected. The project team needs to practice communicating with a big non-academic audience, including rules such as the school-internal rule of speaking after raising a hand to signal participation, make regular eye contact with all participants (in EBL, depending on their position in the room, the presenting persons did not even see some kid's intention to participate as they always focused on the same part of the room).

Sticking to the transfer of the main aspects, the team should prepare to cut their presentation short if need be, preferably without reducing the time for lay knowledge expression and even transforming these moment into valorising discussions permitting learning by dialoguing, regarding the importance of "individuals being encouraged to participate actively for the construction of solutions for problems, by discussing them, intervening, demanding, cooperating with public services and other organizations", (Saúde *et al.*, 2015, p.7). However, care should be taken to avoid situations like in EBL, where one group couldn't finish watching the demonstration because of a problem in the schedule. They did not understand what it was about, which is frustrating, but proves that this communication tool works to make participants gain consciousness.

Valorisation. When communicating about the project, e.g. in the summaries published on the website, ECH2O-Água should open up to considering children (and other participants) as an active and competent element in social relationships and give them a voice by integrating their knowledge, perspectives, doubts and remarks in the awareness rising project 's concept and communication (Delicado, 2017). We happily recognise that this process is about to begin

soon, with the kids from APL at DNA-LNEC presenting the results of their survey to a greater audience.

(6) Emotional involvement. How are participants invited to relate the global issue to a personal context, triggering curiosity and a feeling of responsibility? For further improved communication on the subject, the executive team might consider reflecting more about how to frame their discourse. Our ideas for a new PPP already slightly indicated this. As we know from G. Lakoff (2010) progressive frames, that is contextualising knowledge, need to be activated; via language (framing the truth effectively) and experience (e.g. providing experiences of the natural world [here: participation in measurements]); as a system of frames in place to help make sense of the facts. Moreover, physical participation is important, “since the brain is set up to run a body, ideas and language can’t directly fit the world but rather must go through the body” to enlighten reason (G. Lakoff, 2010, p.72).

Internal organisational learning processes. A common training in pedagogy adapted to the different target groups might be interesting for the entire executive team because it would equal their approaches and with it probably also further define what we earlier called the lowest common denominator, relating to the project’s communicative identity. Such a training can also be the possibility for the team to reflect together on how their participants might experience their efforts. These internal organisational learning processes will not only be beneficial for the programme ECH2O-Água, but for any public-oriented action APRH will undertake in the future.

Other propositions: Let’s think bigger. Making ECH2O-Água a valuable experience by promoting public empowerment through knowledge and awareness could be extended to a more inclusive, participatory concept, closely related to the outlined citizen science principles. We imagine entire activity days including an explanatory informative session, the installation of the device and then training workshops about getting involved in protecting the resource in small groups: Here everyone thinks of one way to avoid wasting water and illustrates it as a best practices video (example from K. Haynes & T.M. Tanner, 2015, pp. 358-359), picture or any other mediation tool judged appropriate. Later these objects can be used as immutable mobiles of the project’s message by being presented at institutional events, e.g. school or community celebrations, just like the collective drawing of session 2 in EBL.

We are fully aware that this takes much more time and involvement and we understand that this is difficult to achieve, also because human resources are expensive and time is precious

in the institutions ECH2O-Água targets. This workshop-based approach might therefore be considered to be created by and hosted in the future public water observatory. In this case, the executive team has complete control over framing organisational aspects which might facilitate such a co-creative citizen-science session's realisation. Outsourcing these activities to another entity would also help overcome the time restrictions of the current team, who bears many other, more traditional responsibilities in APRH.

6 Conclusion: How can science mediation projects influence on lay peoples' awareness of ecological issues and make them participate in the strive against them?

Research Question. With this study based on the case of ECH2O-Água, we seek to understand how a public awareness-raising project can achieve its main intention of turning passive consumers of water into active, eco- and socio-responsible citizens who participate in the strive for generalised water security. Therefore, we concentrated on the project's strategy of spreading awareness through knowledge transfer and exchange in chapter 4, interested in how the experts on water-related issues translate the need for an urgent change of individual and collective attitude to water use for the sake of its preservation. Different project phases were found to be inclusive to different degrees, which is fine as participants were slowly lead to realise how direct an impact on the resource they can have.

Science mediation is a form of informal education. The latter's success is known to depend on correct framing and active participation. This is why verbal communication in simple, to the participants familiar terms, and visual stimulation as a support to the understandable explanation of abstract notions and concepts best have to be completed with moments of experimental learning, focussing on special objects. In our ANT jargon, we called these "immutable mobiles", because they are part of participants' routines and help them remember and relate a project and its message. They form the actual link between the lived experience and learning process to how participants will bear the activity and transmitted content in mind. Generally, contextualisation was found to be important, be it content wise or concerning different phases of a project, their connection and intentions.

Achieving the intended impact. To have an actual impact on different audiences' perception and awareness about ecological issues, their inputs must always be taken seriously and valorised (either through discussion or any other form of expression). Presented proposals must be adapted to the different audiences and social realities approached, taking into account how either of them conceives the issue in question. In the case observed here, this consisted in understanding the ECs' water use patterns so as to react to them and suggest their improvement. Generally, this demands a preparative study of these social realities and training for the executive team to be able to understand these and approach them best. The conceptualisation and improvement of a project are ongoing processes that go hand in hand with critical self-reflection and constructive feedback within a team. For these processes, time and human

resources need to be made available, demanding to prioritise the project's preparation and development within an expert group's activities. Such a conceptualisation's influence on its "mother organisation" should therefore not be underestimated but rather welcomed as an internal learning process.

Limitations of the underlying thesis. Unfortunately, our study and analysis were limited by several external factors including the short time available, occasional delays in the project's schedule and the author's difficulty to systematically organise the findings from the big amount of data generated through the interesting fieldwork. This is why we are not able to objectively answer the question if APRH's intentions with ECH2O-Água are achieved successfully. We leave this to other works, suggesting a systematic feedback approach. We know that the technical results of water saving in the ECs are good and experienced interest in the project to be high and diversified. As wished, some participants turn into multipliers of the mission to create awareness about water scarcity (CC of CCT communicates a lot about it in the neighbourhood, students in ESSA autonomously developed many ideas of how to reach out to others, and a teacher in EBL had her pupils report about it at a parent's meeting). Most impressive are the latest expansions of the project through CML, and the new EC Centro Porta Amiga da Olaias. In total this lets us assume that ECH2O-Água is successful in creating concern about water security, resulting in a local rise in the involved communities' awareness. In order to further improve it we exposed some ideas in chapter 5, mostly insisting on discursive (or technical) and structural clarity of the proposals and participative elements to intensify collective learning processes that lead to profound understanding and shape laypeople's interpretation of reality (which is supposed to be reflected by the scientific content).

Main levers to a rise in public awareness: involvement of participants, internal training and awareness about the own position and concept. Besides our main suggestions to intensify the participatory dimension to actually turn ECH2O-Água into a citizen science project with influence on governance, to initiate more internal training for the executive team to be aware of the own AN's dynamic, and to prepare to get in touch and merge with different participant-ANs, we would like to remind that the strength of mobilised immutable mobile must not be underestimated. They drastically reduce the distance between different actors and/or actants, leading to their joint existence in a new, through the common experience co-creating AN. We experienced ECH2O-Água struggling to draw participants' attention away from the easily applicable technological support to reflecting on and eventually adapting their consumption habits as the starting point of an actual solution to the problem. The intended emotional involvement is not only about excitement but mainly about self-reflection. But this,

for the executive team obvious, position must be made clear to participants. Focus must lie on individual and collective responsibilities towards the environment and human populations today and in the future.

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