Exploring Interactive Narrative for Science Communication: a design approach using interactive documentary as a proposal

XploreDesign4SciComm

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"If you can dream it, you can do it."

(Walt Disney)

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Abstract

This study explores interactive narrative, manifested through multimodality in the format of the interactive documentary (i-doc), as a proposal to science communication, in a specific context. The oldest botanical garden in Portugal celebrates, in 2018, 250 years of existence and is the scenario for that proposal. This choice was preponderant because the subject to be communicated is in the ambit of Botany and Biodiversity Conservation and point out the importance of citizenship in the mobilization of efforts that can minimize the complex problems and challenges associated with those fields.

In science communication the format of the interactive documentary has been little explored and in this sense this work has been developed to produce an original empirical contribution that opens the way to new approaches in this sense. 360 video, virtual reality and augmented reality can be explored and remixed with traditional media trying to promote more engagement of people with Botany and related sciences. Transdisciplinarity is a key component of this project that aims to explore Design, not only in the several perspectives as a discipline, but also as a scientific area of extreme utility and that enables to build bridges between different areas.

Articulating storytelling, gaming and multimodality, one prototype was produced and its respective proof of concept was carried out in two classes: Biology and Geology students from regular secondary school and Journalism students from university level, and the respective teachers were involved in the process. Action-research was applied in an original way that intends to add value to practical case studies, and plan targeted actions. Bibliographic review, questionnaires, semi-structured interviews, participation observation and focus group were the used techniques to test and evaluate the inherent project concept. The results obtained are favorable to the usefulness and viability of the idea and it will be interesting to investigate in a more systematic way, to better understand opportunities in the intersection between science, technology and art. Emotions, cognition, and human-centered design are very interesting fields to investigate.

The author argues that i-doc rather than being only a media or digital media channel, which represents reality, can be interpreted as a builder and enabler of knowledge. Besides i-doc can facilitate the teaching and understanding of the curricular contents, the exploitation of i-doc can be also a great method to develop innovative contents that promote a differentiating journalism and that reinforce its social function, as this project proposed in environmental education. Another point of view suggested by the author, is that UX Design is essential to the planning of communicative relations between people, digital objects and real life. At the present, with all the technological evolutions established more and more faster, will be important to understand better how users interact, immerse and participate with those evolutions. Digital and physical interactions are both essential, and the author intends to interconnect them, creating one digital object about Ajuda botanical garden, that

may promote the interest of users to visit it, physically, and be more awareness for its importance.

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Resumo

Este estudo explora a narrativa interactiva utilizando a multimodalidade no formato do documentário interactivo (i-doc), que se materializa numa proposta para comunicar ciência, num contexto específico. O jardim botânico mais antigo de Portugal celebra, em 2018, 250 anos de existência e é o cenário dessa proposta. Essa escolha foi preponderante, pois o assunto a ser comunicado é no âmbito da Botânica e da Conservação da Biodiversidade e salienta a importância da cidadania na mobilização de esforços que possam minimizar os problemas complexos e os desafios associados a essas temáticas.

Em Comunicação de Ciência, o formato i-doc tem sido pouco explorado e, nesse sentido, este trabalho pretende obter uma contribuição empírica original que abra caminho a novas abordagens, nesse sentido. Vídeos 360, realidade virtual e realidade aumentada podem ser explorados e remixados com os meios tradicionais, com vista à promoção de um maior envolvimento das pessoas com a Botânica e ciências relacionadas. A transdisciplinaridade é uma componente chave deste projecto que interpreta o Design, não apenas nas diversas perspectivas como disciplina, mas também como uma área científica de extrema utilidade e que permite construir pontes entre diferentes áreas.

Articulando narrativa, jogos e multimodalidade, foi produzido um protótipo e realizada a sua prova de conceito, em duas turmas: estudantes de Biologia e Geologia do ensino secundário e estudantes de mestrado em Jornalismo e Novos Media, e os respectivos professores estiveram envolvidos no processo. A pesquisa-acção foi aplicada de uma maneira original, pretendendo agregar valor a contextos práticos e planear acções direccionadas. A revisão bibliográfica, questionários, entrevistas semiestruturadas, observação participante e *focus group* foram as técnicas utilizadas para testar e avaliar o conceito inerente ao projecto. Os resultados obtidos são favoráveis à utilidade e viabilidade da ideia e será interessante investigar de forma mais sistemática, para compreender melhor as oportunidades na intersecção entre ciência, tecnologia e arte. As emoções, cognição e design centrado no ser humano são áreas de estudo muito interessantes para investigar.

O autor argumenta que o i-doc, em vez de ser apenas um canal ou um meio digital, que representa a realidade, pode ser interpretado como um construtor e um facilitador do conhecimento. Além de poder facilitar o ensino e a compreensão dos conteúdos curriculares, a exploração do i-doc também pode ser um método muito útil para desenvolver conteúdos inovadores que promova um jornalismo diferenciador e reforce sua função social, como é proposto na educação ambiental. Outro ponto de vista sugerido pelo autor, é que o UX Design é essencial para o planeamento das relações comunicativas entre as pessoas, os objectos digitais e a vida real. No presente, com todas as evoluções tecnológicas estabelecidas cada vez mais rápidas, será importante entender melhor como os utilizadores interagem, imergem e participam nos conteúdos, com todas essas evoluções. Interacções físicas e digitais são essenciais, e este projecto pretende interligá-las, criando um objecto digital sobre o jardim

botânico da Ajuda, que possa promover o interesse dos utilizadores em visitá-lo pessoalmente e uma maior consciência da sua importância e valorização.

Palavras-chave: cidadania, comunicação de ciência, design, documentário interactivo, educação, jornalismo imersivo, jardins botânicos, transdisciplinaridade.

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1. Introduction

1.1 Context

The objective of this project is to build an active relational communication between people, digital tools, techniques and practices where Design[1] is a root language of the whole process to communicate science. The interactivity, participation and immersion are the engines that are explored, using interactive documentary (i-doc) as a tool to promote greater engagement of formal school's communities in issues such Botany, Botanical Gardens, Biodiversity´s Conservation and Citizenship.

This exploratory study in science communication intersects science, art and technology, drawing on several studies. One of them, which is based on the topic of transdisciplinary design, opens horizons for the social process of research in design, education and practices (da Silva Vieira, 2018). Thus, it is intended to investigate the potentiality of design practice to other areas of human activity and the transfer of knowledge, beyond the domain of design as a discipline.

Intuition and the combustion of multiple ideas are a pillar of the whole process, not forgetting to balance the inherent limitations, competences and the refinement of reality to consolidate the vision, mission and theory of social change involved in this project. Based on different studies and approaches, are used multimodality, storytelling and gaming to realize a demo-production of a hybrid i-doc, intersecting two specific arenas in the field of Science Communication: Science Education and Immersive Science Journalism, mediating between the text and the audiovisual formats. In an increasingly visual society, the demand for new forms and technologies of communication has increased, where multimodal language tends to become dominant and there is a growing need to study multimodality in different areas, such as education, arts and other professional contexts (Vieira & Silvestre, 2015).

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[1] In this project, the term Design is used considering the Three Space Model (da Silva Vieira, 2018) and is better explained in the theoretical framework, with more detail and in the contextualized action associated to the present research

1.2 Motivation

The author of this work has an academic background in Agronomy Engineering and over the last 20 years she has worked in several areas, like pharmaceutical industry, agricultural services, marketing of organic farming products and, in education, teaching mathematics and natural sciences in basic and secondary levels, in formal and non-formal contexts. In the last 5 years, her professional activity has been focused in environmental education, with several types of audience, mainly school groups. She has been developing these activities in different entities in Lisbon, which has been an enriching experience given the complementarity of the actions, in the fields of: Conservation, Taxonomy and Identification of Plant Species, Horticulture and Life Cycle of Food and in Forest Management - Native Biodiversity and Conservation. She thinks that people have a genuine interest in these topics, despite the lack of knowledge. People need to be involved in a more continuous and participative way, in contextualized actions, being urgent to explore new communication approaches, remixing new digital technologies within the traditional ones and researching new methods and practices, to improve the quality of communication´s scientific issues.

Nowadays, she is studying science communication and wants to converge her experience in this area, exploring interactive practices and technics that can engage and unify people to achieve common goals. In the classes of Techniques and Practices in Science Communication she was curious about the application of non-linear narratives and the format of the interactive documentary as a communication tool. It was thus an impetus for this work project along with the other seminaries attended during the master's course. Being able to turn problems in opportunities is a motivation that has been with her for a long time and so, she wants to stimulate an iterative and problem-solving approach process, in the field of environmental issues, where Design and Quality[2] are key sources.

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[2] In this project, the term Quality can be understood in the first paragraph of this reference: https://explora.live/2017/11/24/featured-content/ and, in the scope of the last edition of the International Norm ISO/FDIS 9001:2015, Quality Management Systems – Requirements, with focus on the item 8.3 – Design and development of products and services and the cycle PDCA – Plan, Do, Check, Act

1.3 Objectives

Being an initiative of social entrepreneurship, this project aims to find solutions or ways that can minimize social problems, in the field of science communication. Promote environmental education at formal level education, focusing on the importance of botany and biodiversity´s conservation, and its communication, as vital pillars to welfare of society. The logic is to explore languages and formats, involving various stakeholders and seeking to involve and empower the specific target audience for this subject: academic communities, initially students of regular secondary education and university students of journalism. At this point, is not intended to develop a final product but to give life to an iterative dynamic that can improve a social transformation, with focus in education, in a long term.

This research is exploratory and is devoted to the study and its application in education experiences to promote engagement in Botany and related sciences. The focus is to explore i-doc as a valuable tool to be used in contextualized classroom´s activities that can promote awareness to environment issues in the short term and be adapted with a long-term vision. Thinking about specific problems associated with science communication, more than treating the symptoms is intended to investigate the causes trying to create conditions to build better communicational practices. In 2018, the oldest botanic garden in Portugal, Ajuda Botanical Garden (JBA), celebrates 250 years, despite it isn´t so well known by Portuguese people, and so it is the main scenario to prototype one digital object, which simulates one hybrid i-doc.

Is intended to develop one concept that can be represented for one prototype, using the genre interactive documentary that serves as a model for analysis and evaluation by two different types of users: Biology and Geology students from secondary school and Journalism students from university level. The evaluation with the students occurs in natural context, inside one normal classroom ant the respective teachers are involved in the process.

On the other hand, a complementary objective is to celebrate JBA´s 250th anniversary, proposing to this scientific museum a new model of communication that can contributes to its notoriety and a better recognition by citizens. A future challenge will be to establish partnerships that enable the implementation of digital resources in JBA, with focus on audiovisual formats, like 360^0 formats (photos and video), virtual and augmented reality.

In summary, this project has the following research objectives:

- To explore how to use i-doc to promote Botany and associated sciences in regular classrooms.

- To promote teaching methods from traditional practices to inquiry-based approaches, using innovative tools and stimulating Responsible Research and Innovation (RRI).

- To provide moments of reflection, highlighting social capital (citizenship) as an important engine for the recovery/maintenance of memories that are part of our history and culture.

- To design innovative strategies to improve science communication, using a case study in JBA and testing the main idea in natural context (proof of concept).

1.4 Research Questions

Making is one productive form of science teaching and learning that uses design, construction, testing and revision of a wide variety of objects, with technology and integrating different disciplines as art, engineering and science and actually there is a huge need to shift pedagogical strategies to support more reciprocal and less hierarchical ways of investigation (Bevan, 2017). Mainstreaming making and thinking can be a valuable proposal in that meaning. "But many questions remain and there is a need for further programme development, documentation, and research." (Bevan, 2017, p. 24).

This project uses one scientific theory - "Plant Blindness"[3] - to promote one reflection and a call for action, in the context of classroom, to identify possible paths that can promote citizenship as a pillar for raising awareness of key issues to the human species and ecosystems.

The research questions (RQ) to clarify with all the stakeholders, considering "plant blindness" a threat to combat, are:

RQ1:   Can the proposal for the multimedia hybrid be a valid medium to promote awareness for plant blindness and science education?

RQ2:   What added value and constraints are created with multimedia hybrid format when addressing plant blindness, in the context of this project?

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[3] Information available in:

http://www.conservationmagazine.org/2016/08/plant-blindness/   and
https://www.researchgate.net/publication/284106711_Toward_a_Theory_of_Plant_Blindness/citations

RQ3: Does the observation of the hybrid contribute to inform and alert to the importance of botanical gardens, particularly to the recognition of the JBA?

RQ4: What are the main causes of "plant blindness" and which effects it can cause, particularly in the regular teaching of botany and associated sciences?

2. Theoretical Framework

2.1 Science Communication: Challenges and Opportunities

"Science Communication" is the broadest, inclusive and technical term that can be used in the context of all activities that intersect Science and Communication. Regardless of the public considered, the context in which communication has place, the tools used and the purpose of that communication (Granado & Malheiros, 2015).

Nowadays, science communication is suffering a deeply process of transformation and, has many citizens and policy makers get information about science mainly or even exclusively through the media, it will be vital to analyze recent trends and tensions and their implications in those processes (Schäfer, 2017). In the last 20 years a lot has been achieved in the promotion of scientific and technological culture in Portugal and even with limitations arising from financial crises, both national and international, among other factors, people and institutions have been able to carry out this task, being essential at the present "to try to define more clearly what, as a society, we expect and demand from science and technology, and, on the other hand, what the scientific community considers useful, possible and desirable " (Granado & Malheiros, 2015).

The expression "to understand the future, you have to look back at least twice as far as you're looking ahead", from Institute for the Future (IFTF), is useful at the present if we want to build solid paths with a long-term vision (McGonigal, 2011).

In Portugal, the troubled history between the National Museum of Natural History and Science and the academic entities is remarkable but, in the last decades, since the democratization of the country, was possible to activate an internal reorganization and identification of the educational, cultural and social mission of this space, which is at the present in a "phase of great dynamism in science communication, in the identification and protection of the natural heritage, in the promotion of an environmental conscience" (Póvoas, Lopes, Melo, Correia, & Alves, 2016). Scientific museums can be understood as "a wide range of institutions dedicated to showing science through exhibitions, which include museums and science centers, natural history museums, botanical gardens and zoos" (Delicado, 2013). In the vast field of Science Communication, many concepts are used as scientific literacy, scientific culture, public understanding of science (PUS), public engagement in science and technology (PEST), among others and, although related, each one delimits a potential field of research. PEST is a concept that empowers research in relationships among various social actors and manifests a focus of action: "it places the emphasis of communication on a relationship between equal citizens, whose knowledge and

hopes have equal dignities, whose opinions must be respected, in a true dialogue between specialists and common people instead of a lesson where some speak and others just listen." (Granado & Malheiros, 2015).

In the context of science communication, social semiotic is an useful studying area in the clarification of opportunities in the resources used, especially when using various types of language and modes of representation: mediation between text and audiovisual as an essentially qualitative and dynamic methodological proposal, is an interesting way to explore in the study of the effectiveness of media, involving the main actors in the communication process, producers and consumers of scientific knowledge (Pinto & Zagalo, 2016). In an increasingly visual world, where audiovisual content proliferates, teaching and communication through moving images is more and more important for educators and academics in all areas (Eriksson & Sørensen, 2012).

In relation to Botany, two researchers, Wandersse and Schussler, created the term "botanical blindness" in 1998, after several years of study on the perception of the public about plants[4]. This theory defends a botanical neglect on the part of the society, that is analyzed by Salatino and Buckeridge (2016) in a work whose title is: "De que te serve saber Botânica?" (a possible translation: "But why is good for you to know Botany?"). In this context, those researchers point out several reasons for this reality, not only in Brazil but elsewhere in the world, showing a vicious cycle in several fields of action, where the school (at various levels of education) and the media stand out:

"(…) Media have enormous influence in molding society's trends and behaviors. The potential of the media as complementary agents to the actions of parents and teachers in the scientific training of the people is undeniable. Educational programs can make a substantial contribution to mitigating the effects of botanical blindness. Unfortunately, most journal articles and videos of scientific nature have been characterized by zoocentric attitudes. Even high-profile and respectable media productions, such as the BBC, are included in this group. (…)" (Salatino & Buckeridge, 2016, p. 190)

In a time of great changes and convergence of the media, it is imperative to explore and experiment new languages, formats and practices that foster one of the major objectives of the Science Communication: to reach and engage audiences through resources and

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[4] Available in: http://www.jstor.org/stable/4450624?seq=1#page_scan_tab_contents

strategies that promote greater involvement and responsibility. The interest in Botany and related sciences can be enhanced with innovative formats that promote the stimulation of the senses and the motivation for discovery.

Digital storytelling is a multimedia practice that, with multimodality, manifests complexity not only at the production level but also in the final interpretation, in the consumption of these formats: the interaction between the different modes of representation of the stories (such as text, images, sounds) is preponderant in the conception and delineation of storytelling, as well as in the understanding of the effects produced on the consumers, who are not just recipients of information but participants in the construction of narratives (Alonso, Molina, & Requejo, 2013). With the adoption of Web 2.0 tools in the scientific field, the ability to communicate effectively is even more a vital competency, since along with the inherent advantages of a participatory culture and technological convergence, new challenges also arise and even threats, such as the legitimacy and quality of science (Azevedo & Moutinho, 2014). These authors warned of some implications of the explosion of content that has been generated by people on the Web and that contribute to the change of habits and expectations: "The boundary between amateur and professional researcher will blur and the number of traditionally scientific authors and extra-institutional authors who claim the scientific status of their work will grow." In the future scenario of science, as we predict here, scientific production can easily be reviewed, evaluated, voted upon and commented upon by virtually everyone. " (Azevedo & Moutinho, 2014, p. 4). The same authors quote Henry Jenkins about the phrase with which he begins the introduction of his book "Cultura da Convergência" (Convergence Culture): "Welcome to the culture of convergence, where old and new media collide, where the corporate media and alternative media, where the power of the media producer and the power of the consumer interact in unpredictable ways. " (Azevedo & Moutinho, 2014, p. 2). Recently, Sir Tim Berners-Lee shared his vision for the future of the web and how it will achieve its true potential in the service of humanity, along with the growing threats in recent years, highlighting three main trends which must be tackled: loss of control of personal data, ease of disseminating fake news on the web and political advertising online with little transparency ("Three challenges for the web, according to its inventor," 2017).

Considering the advantages associated with the online presence of scientists and researchers, a recent study evidenced the difference between online presence and use of social networks (having a social network profile does not necessarily mean being present) and showed some skepticism in the use of social networks by researchers, which will be

interesting to analyze in a perspective of new approaches (Greifeneder, Pontis, Blandford, Attalla, & Neal, 2017). "Citizen science is the engagement of the public in science or monitoring to address real world problems. Citizen science programs have the ability to provide excellent data for researchers at large spatial and temporal scales." (Traynor, Lee, & Duke, 2017, pp. 740, Abstract). Thinking about the quality and credibility of science communication and public debate one important issue appears – democracy in science – and one interesting fact is that very little has been explored to choose, adapt and evaluate information for specific contexts and public´s needs, instead, a lot of efforts have been developed to limit the circulation or even censoring some contents, as the case of the Italian immunologist who promoted one debate about vaccination in 2016 through his own Facebook page and canceled later all comments by claiming: "Here only those who have studied can comment, not the common citizen. Science is not democratic." (Bucchi, 2017).

In the Meeting with Science and Technology in Portugal 2017, Heitor Alvelos, director of ID+ Research Institute for Design, Media and Culture from the University of Porto (School of Fine Arts), informs about the 2 main missions of his research group: the re-registration and re-calibration of traditional media, often considered obsolete, that through design can re-assume an important role and, on the other hand, the critical interpretation of the impact of new media, especially digital, on the social, cultural and economic health of our society. Also, highlights the strong link between design and communication, focusing on the audiovisual sector, and reinforces the need for greater visibility and recognition of design as a scientific territory, exploring and establishing bridges between different areas.[5] Design-based approaches offer a range of potentialities and interfaces for innovative actions, especially in the interconnection of Design and Education, promoting engagement in sustainability and pro-environmental behavior among young students (Mouchrek, 2017). In one recent PhD dissertation was studied Design as a planner for communicative relationships between things and people and the possible interpretive actions of the utility of things, to facilitate the planning and implementation of useful artifacts to people in various contexts (Miñana, 2017). The concept STEAM can be seen as the evolution from STEM (Science, Technology, Engineering and Mathematics) by the integration of Arts, but, in a deeply sense the acronym STEAM is related to interdisciplinarity, creativity, authentic or real-world learning and project-centered thinking, where Design Thinking is vital to support an expanded view of STEAM experiences, in

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[5] Available in: https://www.youtube.com/watch?v=_vPXiYHVDOM

particularly in education contexts, promoting creative thinking, collaboration, student ownership and responsibility of their learning (Henriksen, 2017).

"(…) We argue that the science communication community should take active steps to integrate with the science education community and provide practical, facilitative support for its counterpart, especially in primary and secondary school education. The more support, and the sooner it is delivered, the better. If the two communities are to achieve their mutual objectives, we should make full use of science education as a main channel for the improvement of public scientific literacy and the continued construction of scientific culture. (…)" (Donghong, 2008, p. 152)

"(…) The current attention to issues of professionalism and professionalization in science communication may be taken as a sign of the growing maturity in practice, education and research in the field. This article suggests that greater care should be taken in how this process is understood. As outlined above, it should be seen as a process that is bringing benefits to those working in the field but also as a process that may never be completed, in that science communication takes its place alongside formally recognized professions. (…)" (Trench, 2017, p. 6). "(…) It would represent dangerous hubris if (professional) science communicators were to define the practice of science communication as theirs alone. University education and other activities in the field should aim to support the present specialists and prepare the future ones to facilitate scientists in doing public communication as much as to do it themselves." (Trench, 2017, p. 7).

In the context of environmental education, Edgar Morin´s theory of complexity can be better explored as a theoretical tool, where knowledge is produced by the actors involved in a collaborative and participative way, stimulating the potential of the transition from linear knowledge (specialization) to an interdisciplinary approach and its intrinsic relationships, where practical and theoretical knowledge can inhabit the same space, influencing each other (de Jesus Pereira, Friede, Narduchi, & de Miranda, 2017).

2.2 Immersive Journalism: New Formats and Practices

The adoption of mobile technologies in Journalism practices opens the way to new (re) configurations and it will be interesting, in this scenario, to highlight the role of journalism, regardless of the media form of publication (press, radio, television, online) (Vicente). At the present, it is extremely important to rethink the role of the journalist. The Internet has broken with formats, practices and supports and with standards of objectivity and impartiality. When the journalist assumes a look and a voice, her or his record

distinguishes itself from others and resists the trivialization of information: the image as a testimony of the reality closest to the truth, allied to storytelling, a journalistic technique that manifests itself in the "art of telling a story", act as a solution to the homogenization of content and the disinterest of the public (Lind, 2015).

The use of new languages that stimulate the senses of consumers will not unfeasible the rigor of the facts, inherent to the journalistic essence, and, immersive journalism can be identified with the use of a hybrid language that brings together elements of the digital game, entertainment and reporting, on a way to explore (G. G. da Rocha, 2016). Immersive journalism starts from the premise that the journalist must know the reality he wants to transmit to his audience: immersion of the journalist is a necessary condition for the subsequent immersion of his audience (Martín, 2013).

Although the concepts of immersion and immersive journalism do not have a consensus among the various authors, there is a tendency of a logic of transposing consciousness towards a reallocation of realities, triggered psychologically or through technical resources: immersion should not be confused with sensory stimulation and not only related to technology, but may manifest itself in different levels of diving and interaction (Cordeiro & Costa, 2016). Journalism has always worked with the representation of reality, whether using traditional media, such as the text, or, with the evolution of practices, the combination of multimedia media such as images, sounds, animations, among others. New experiences are a reality today and it is possible to note that the trend of immersive reporting is intended to establish a journalistic narrative with greater user participation, encouraging their interest in the news, placing it in the place of events and thus, as the journalist , to be a witness of the facts (da Costa & Brasil, 2017).

Eva Dominguez, in her doctoral thesis, analyzes the investigations carried out in the field of immersive journalism which, in the digital sphere, understands as an interactive narrative construction that should foster immersion capacity. She describes the opinion of some authors, such as Nonny de la Peña, regarding the use of virtual reality technology, considered a fertile field of investigation, which not only enhances visual but also immersive ability in a first-person experience. On the other hand, she highlights the interaction with digital content as a feature with immense potential, not merely functional but also narrative (Martín, 2013).

Immersive journalism can be understood under two principles: from the point of view of production, which requires the author to have an in-depth level of research and reflection on the reality to be represented and, from a technical or technological point of

view, where the result of production will be materialized in immersive formats, such as virtual reality productions, augmented reality, infographics, photos and videos in 360o, that will allow different sensory experiences comparing with traditional audiovisual formats (Cordeiro & Costa, 2016). In the last study carried out by ERC, Regulatory Entity for Social Communication in Portugal, regarding the new dynamics of audiovisual consumption in Portugal:

"In relation to the audiovisual consumption by equipment, following the television, the mobile phone / smartphone is the device with the greatest presence in the Portuguese home (75.2%), followed by the laptop / laptop computer (52.9%), (48.5%), desktop / desktop (32.5%), tablet (30.2%) and game consoles (26.2%). Regarding the type of audiovisual consumption, "information" is the most sought-after segment (89.5%), followed by stock products "telenovelas", "films" and "series" with an average of 56.3%. The "entertainment", with 50.3%, precedes "documentaries" (47.2%) and "sports" (44.6%)." (C. Martins, 2016, p. 25)

Information and entertainment are the most popular segments. Infotainment is a concept that intersects two segments - information and entertainment - and which has been increasingly manifesting itself on the Internet, requiring a research effort to better understand the associated processes and potentialities to this phenomenon of communication, taking into account the author, content and effects produced in audiences (Berrocal Gonzalo, Redondo García, & Campos Domínguez, 2012). Assuming the principles that better informed citizens make more responsible decisions and that, rather than pondering whether journalism should inform or entertain, it is important to study its social implications and to address media literacy and literacy for citizenship in an integrated way in younger populations (Brites, 2017). "(…) Thus, news *social consumptions* are important elements that contribute to thinking about new forms of civic media literacy, more focused on social processes than in the quantification of knowledge and skills. (…)" (Brites, 2017, p. 147).

According to the National Environmental Education Strategy[6] (ENEA 2020) for the period 2017-2020, recommendations for the media are (p. 25): "Reinforce environmental education in the academic curricula of media schools; Encourage the continuous environmental training of media professionals, through the organization of training actions, seminars, journeys, among others; Strengthen the educational dimension of environmental

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[6] Available in: https://www.apambiente.pt/_zdata/DESTAQUES/2016/ENEA_final.pdf

information, using a language that is understandable and accessible to the majority of the population, without losing scientific rigor; Create spaces in the media, fixed and stable, specializing in environmental issues."

With the evolution of digital media and creative technologies, there have been significant changes in the production and distribution of stories, and new strategies have emerged based on assumptions that are strongly different from traditional ones (Noronha, Zagalo, & Martins, 2012).

Interaction, participation and immersion are three key concepts to understand digital communication. "The stories of the future (or many of them, at least) will not just be told. They will be actively experienced. And interactivity, participation and immersion will continue to be among the core concepts that we will need to soundly understand in order to successfully engage in a creative process that is successful in terms of audience reach and on its own creative goals." (Soler-Adillon, 2017, p. 6)

In the context of classroom environmental education, the use of emerging technologies, such as virtual reality and augmented reality, must be confronted with the educational objective to be achieved, with the classroom dynamics and the specific context of learning, requiring the consideration of various issues and recommendations (García, Ortega, & Zednik). The new strategies for integrating interactive elements into digital educational resources will allow students to be more active in relation to content, facilitating learning and promoting greater attractiveness and satisfaction (Tomaz, 2011). It has been demonstrated that, in the search for new approaches to attract attention to scientific topics (such as climate change) by using online games, it is possible to integrate narrative and gaming promoting the creation of innovative communication solutions (Ouariachi, Olvera-Lobo, & Gutiérrez-Pérez, 2017).

At the present, journalistic contents that exploit interactivity and multimodality by adding gameplay characteristics are still scarce, most of them use the choice of links and little else. In education, gamification has shown positive results but, in the media communication, initiatives are not expressive. *Newsgames* can be an excellent educational and communicational tool, promoting a differentiated journalism (Silva & Barboza, 2018).

Digital media are currently protagonists of a new materiality, not only technological but understood as an instance of communication and it is increasingly necessary a classification of emerging narrative species (taxonomy) and the development of a multimodal notation that allows the consolidation of immersive journalism, which is becoming more and more a medium of experience (Vicente, 2017). This author points to an unsustainable

reduction of digital media to the status of "remediation" of previous forms of communication, when they are interpreted just only as channels or supports, and not as different creative substances, or new languages, and it is extremely important distinguish between the digitization of mass media - a reconversion of the species - and the digital nature of new media. In his view, it is fundamental to organize a grammar that supports producers and consumers in defense of a human-centered design, and not just in technological attributes.

2.3 Digital Storytelling and Interactive Documentary

The interactive documentary (i-doc) is a recent genre without rigid definitions, and it has manifested one rapid development with the technological advances, in an interdisciplinary environment, intersecting areas of knowledge and creativity from the cinema and audiovisual, the programming, interactivity and design interfaces (Amorim & Baldi, 2013). In this emerging environment, the documentary is reformulated in an attitude of experimentation and an updated look at the possibilities it can manifest: nonlinear, interactive, multimedia, hybrid, convergent, immersive, virtual, 360º, collaborative, participatory, among others, some still unknown (Nash, Hight, & Summerhayes, 2014).

Sandra Gaudenzi views interactive documentary as a new entity that does not follow the continuity of traditional documentary, and should not be confined to the simple act of human-machine interaction, alerting to a greater systemic understanding of the process (Gaudenzi, 2013b).

One of the premises of the traditional documentary is the desire to organize a story that associates the informational and the entertaining role, and in this sense, the interactive documentary must keep this tradition as efficient, original and attractive as possible (Castells, 2011). In the articulation between the conventional format, with a linear structure, strong authorial and unidirectional in the relation with the spectator, and the documentary with interactive characteristics, it is taken into account the remodeling of discourse and aesthetics, for a more participatory culture that promotes an active construction of knowledge (Gouveia & Antunes, 2011). The interactive documentary constitutes an aesthetic change, organizing the content in levels of interactivity that establish functions for the user-spectator, within different possibilities of interaction (Levin, 2015).

The first symposium about interactive documentary was held in 2011 at the Digital Cultures Research Center (DCRC) at the University of the West of England, in Bristol. Since

then, three more symposia have been held in 2012, 2014 and 2016 and recently a book has been published that brings together several works on this format to date, which can be seen in the words of Prof. Brian Winston (in the foreword to this book) as a very useful cartographic work that reconfigures the boundaries between author, product and viewer, enhancing hybrid formats, at the boundaries between these elements (Aston, Gaudenzi, & Rose, 2017). According to these authors, the definition of interactive documentary is open and generally frames "any project that begins its intention to engage with reality and uses interactive digital technology to accomplish this purpose". Since there is a secular tradition related to cinema and therefore to the documentary genre, in which the constitutive raw material is originally a moving image, a generalist approach to the term documentary, associated with the current scenario of the production of new formats, can be seen as a semantic abuse that should not be neglected (Almeida & Alvelos, 2010). I-docs appear therefore paradoxically not only as the future venue for documentary film and for cinema at large, but also as a tribute to documentary films 'own past and origins (Favero, 2013, p. 274).

The complexity and innovation associated with the establishment of interactive documentary in the last ten years, in parallel with the evolution of Web 2.0, has prompted Sandra Gaudenzi to carry out her doctoral thesis, looking at this format as a "living documentary" and proposing a classification in four families: hypertextual, conversational, participatory and experiential, a way of classification, which although not the only one, helps to understand the concept of interactivity, briefly indicated below (Gaudenzi, 2013b):

- **Hypertextual**: adopts a hypertextual form as it establishes links between the various objects (such as videos) of a closed database, allowing the user to explore the preprogrammed options. Also called *webdocumentary* (web-doc).

- **Conversational**: uses 3D virtual worlds that allow the user a freedom to explore the content, in a logic that the interaction simulates reality, as if the user is positioned in a continuous "conversation" with the computer.

- **Participatory**: it addresses the logic of one open database and an evolutionary way, that is, the contents can be added by both users and authors, in one group of construction that remains for as long as there are interested people.

- **Experiential**: incorporates the Global Positioning System (GPS) into an adaptation in dynamic environment, that is, as the user moves in a physical space their senses will be challenged by the addition of information layers.

"What Living Documentaries allow us to do is to look at interactive documentaries as dynamic entities that co-emerge while they live through the interactions with the Internet, their users, subject, producers, or any acting entity They put the emphasis on *becoming*, rather than explaining." (Gaudenzi, 2013a, p. 26). The web documentary will then be a form of interactive documentary, since the first one highlights the support where the interactivity takes place (the Internet) and the second puts the interactivity as the central aspect to take into account, something that is not only present on the Internet (Penafria, 2014).

The possibilities of the interactive documentary, in which the interactivity is intrinsic, bring several tensions, from various angles and points of view, namely about the need to explore what is a narrative, about the representation of reality and its main purpose and the role of the author. The freedom of users in an interactive documentary can proportionally reduce the author's point of view and author´s ability to argue, with a considerable risk in terms of user involvement, which may compromise or even cancel the author's purpose (Forceville, 2017). Based on the premise of user participation as expected, the interactive documentary establishes a specific position of the audience in relation to its content, and it will be interesting to evaluate who speaks, the extent of reciprocity, and how the audience positions itself in that exchange (Levin, 2015). A new and creative imagery scenario has emerged, with the use of interactive digital languages and technological devices to narrate stories, but it will be important not to forget the hermeneutical purposes involved in the dialogic stories or underestimate the semantic thickness of texts (Amorim & Baldi, 2013). Nonlinear narratives have been seen as threats to the authorial voice but, in this new genre as interactive documentary, are a great opportunity to share more varied and immersive experiences and to satisfy three needs of the interactors: entertainment, education and communication with other participants (Castells, 2011). In relation to the tensions associated with authorship, Sandra Gaudenzi reinforces the authors' role in a process centered on end users, with the following considerations: "What is left in the hands of the author is the intentionality of the project: its general story/idea, the choice of who it is aimed at and the delineation of its final purpose. I-docs storytellers are more facilitators than narrators and, together with a creative team, they are responsible for the coherence of the final user experience." (Aston et al., 2017, p. 126).

In journalism, the transformation of digital storytelling, along with the evolution of interactive documentaries produced in the last twenty years, has manifested itself in a wide spectrum of techniques and approaches in the design and production of the interactive documentary, and so there is no single standard of design (Pavlik & Pavlik, 2017). How to

explain that since 2005 hundreds of interactive documentaries have been published on the internet and that, despite the apparent success, most of them do not involve their users in an effective way? To try to answer this question, Samuel Gantier and Michel Labor proposed a methodology based on the evaluation of user experience, in the context of the production of a web-doc in the television environment, to try to perceive the tensions associated when "real users" are not at the center of the productive process (Aston et al., 2017, pp. 101-116). These authors support the idea that the heterogeneity of decision-makers, who participate in the production of an interactive documentary, tends to be oriented in different "user models" without verifying who the "real users" are. Sandra Gaudenzi has studied, within her research project i-doc UX Series, the misunderstandings and clashes between expectations and creative approaches to the elements that make up the production teams. And, in this sense, thinking about the user experience versus author experience dichotomy from the perspective of User Centered Design (UCD), Gaudenzi recalls that without a hearing there can be no design in which: "Designing for, and with, an audience means committing to an aesthic, a platform and a language that best suit such an audience – even if these do not fit with the personal taste of the author. The question here is not to `please´ the audience, but to ´make sense´ for such audience" (Aston et al., 2017, pp. 121-122).

William Uricchio in an analysis of the future possibilities of the documentary in a historical perspective, ends his contribution with the phrase: "Our task is neither to lament the passing of the old nor grow frantic over the emergence of the new, but rather to assess carefully and critically their capacities and implications for documentary practice and representational literacy more broadly" (Aston et al., 2017, p. 203).

In a recent research was highlighted nonlinearity, as a central trend to contemporary ways of seeing and living, and, interactive documentary as a rich field of enquiry and a valuable methodological tool for geographers (Harris, 2017). Liz Miller is one researcher who argues that interactive documentary is a format with extreme potential in education (@i_docs, 2017). In a recent study, the authors suggest "new best practices" for university journalism students to think and act as web designers in creating the interactive documentary format, alerting journalists and educators in this field to adapt to this challenging environment in constant change (Gyori & Charles, 2017). Things acquire meaning from the moment they are used in specific activities and contexts and according to the interpretations that people are able to conceive from the meanings that the things offer them (Miñana, 2017). In one recent study, is pointed the main use of web documentary to create awareness about social issues, the lack of use of that format in science communication and the needs of further

investigation about that approach, to connect people to identity, memory and places and promote plural perspectives about one specific subject (Casella, 2018).

2.4 Remix and UX Design

In a recent academic work, the concept of Remix is analyzed and validated as an aesthetic resource of great utility to develop a critical spirit and to promote a creative process: inherent in the culture of the remix are actions such as cut, copy and paste, activities that characterize some of its creation processes, which by combining and recombining existing or original material, analog and digital are retransformed into new communicative possibilities (Sousa, 2017). The documentary "Everything is a Remix Remastered" (2015) from Kirby Ferguson[7] is commented in that work in which analyzes the use of remix in different areas such as music, engineering, science, internet, among others, bringing a new perspective to the uses of the remix, questioning the absolute originality, the fact that everything is created from an existing creation. "The remix can thus be considered as a form of speech, that is, it can be understood as a linguistic tool for a particular audience. This tool offers the public grammar that, when assimilated and understood, enables them to create information that uses the same grammatical universe. As we have seen, the remix adapts to the different areas where it is inserted and used in different ways, like speech, methodology or aesthetics" (Sousa, 2017, p. 55).

UX Design (User Experience Design) is a complex concept. "To the uninitiated, UX design can seem like an intimidating field. The sheer number of topics it touches is mind-boggling: there's interaction design (the psychology of motion and feedback), design thinking (an iterative, empathy-based problem-solving process), and usability (how easily a product can be used), just to name a few. Nevertheless, that's also what makes the field so fascinating to so many people." (Foundation, p. Preface). According to Peter Morville, a reference in the field of UX study, there are 7 factors that describe and facilitate the understanding of the UX Design concept, indicated in the image 1, below:

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[7] Available in: https://www.youtube.com/watch?v=nJPERZDfyWc

Image 1 - Source: The Basics of User Experience (UX) Design by Interaction Design Foundation (p. 22)

The premise of this project is Design thinking that can be understood as a problem-solving approach to improve design of creative solutions, and the communicative proposes of the strategic action are:

- Developing familiarity with the topic plant blindness (PB) and associate it to Botanical Gardens (specifically JBA) and their importance to society putting into practice Responsible Research and Innovative (RRI)

- Raising awareness of causes and consequences about plant blindness promoting citizenship and responsibility on topics as Biodiversity, Conservation and Sustainability

- Stimulating the development of ideas and solutions to attenuate PB, promoting a better plant science communication, with focus in a case study in JBA, using innovative digital media and exploring interactivity, immersiveness and participation in classrooms of different levels of education

Mainstreaming the social sciences in conservation, incorporating social science research and insights in natural science and conservation is seen as an unique and important contribution to society´s understanding of the relationships between humans and nature ant to advancing conservation practices and outcomes (Bennett et al., 2017). "(…) A productive engagement with the conservation social sciences will likely require long-term ongoing partnerships, knowledge and capacity building, open dialogue, clear communication, reflection on past and present practice, and a willingness to adapt programs of work. A more inclusive conservation science (i.e., one that includes methods and insights from the natural sciences, the social sciences, and the humanities) will enable the conservation community to

produce more ecologically effective and socially just conservation. Mainstreaming the conservation social sciences will facilitate the uptake of the full range of insights and contributions from these fields into conservation policy and practice" (Bennett et al., 2017, p. 65).

Journalism can have an important role in its own activities, strengthening the dissemination of knowledge about conservation of nature and becoming a bridge to create "spaces of environmental education". It is important to investigate the potential learning, socialization and innovation that are capable to support and encourage sustainable choices and the social change among young people - and the possible strategies for design-based interventions (Mouchrek, 2017). "The practice with various pedagogical models of online learning, in the context of several Portuguese and European universities, has demonstrated that it is not enough provide the student with pre-formatted teaching / learning models, supported by standard virtual environments or in the teacher's educational communication, it should also be given to each student the opportunity to choose his / her own personal learning environmental (PLE) by adding the tools and resources that best fit his / her style and personal goals in a given context. (…) The rather common attempt to use the computer with the mere aim of making learning more attractive is failure. It is necessary to use pedagogical models that can ensure the effectiveness of cognitive processes, which provide a better understanding of the subjects and simultaneously provide great satisfaction to learners, using new interactive multimedia environments." (Bidarra, 2011, p. 13). "In addition to the curricular content foreseen in formal education, exhibitions and museographic elements have the important role of instigating following aspects: a) Manual interactivity; b) Mental interactivity; c) Interactivity cultural. Emotion lies at the basis of the three classes of interactivity presented." (Lamim-Guedes, 2018, p. 87). "There is a need for greater interaction between museums and schools, including public policies and private actions that positively stimulate the association between these institutions. In this sense, it is important to carry out activities that bring teachers inside the museum, demonstrating better ways of using museum space and expositions, in an articulated way with the contents approached in the classroom. On the other hand, traveling exhibitions are an important way of taking the museum to schools and communities." (Lamim-Guedes, 2018, p. 91).

In this context, is interesting to explore the mobilizing and educational potential of interactive documentary in formal education, as a science communication tool, in botany classes and in journalism classes. Using Ajuda Botanical Garden (JBA) as a scenario to test the proof of concept of this project, rather than expressing a specific point of view in that

format, is intended to develop an orchestra of debate and reflection around the central theme, botany and conservation of biodiversity as a vital pillar of environmental sustainability, and achieve some clues how to develop an interactive documentary to promote citizenship about those issues and that can be useful in the context of educational activity. It is also intended to promote new forms of interpretation and exploitation of audiovisual formats and digital literacy. More than producing a final product the aim of this project is the whole experience of the design process, where is intended to produce with the target audience (and not for), and so, both the research process and the development of the final product are equally important (although we are still at a very early stage of the project). This work has an exploratory approach, and the exploration focus is on the potential of interactive documentary to engage all the stakeholders. "Engagement is not only about looking nice but also about looking right." (Foundation, p. 31). "(..) Firstly, I think it's clear that in spite of all the new ways of tracking audiences: hits, clicks, shares and so on, most people are engaging on the inside. This isn't unique to idocs – there are now a large number of studies in various contexts showing that people are much more inclined to listen than comment. (…) The challenge for idocs makers is to cater for the non-fan as well as the fan; to make space for different levels of engagement with content. In closing, I want to make a plea to all of you – as the idocs community we should all start to think of ourselves as audience researchers. We should all be looking for opportunities to work together on understanding what makes the idocs audience unique and being able to show funders and broadcasters the kind of impact this work can have." (@i_docs Nash, 2014)

Despite the rapid evolution of the genre, interactive documentary, is still little known by the audiences, and most of the productions have been carried out focusing on the authors / producers' view in a more technical way and not so much on the level of social involvement and the possibilities associated with this posture. That´s the aim of this project, to look how interactive documentary can be a great ally to induce social change in a beneficial and sustainable way. According to Gaudenzi (2013), is pointed the argument that i-doc, rather than representing reality, builds and experiences reality. According to Almeida & Alvelos (2010), in a medium of uncertainties and dilemmas, a heuristic impulse in a new orientation will be an important approach to searching for i-doc identity.

"Advances in scientific visualization and public access to data have transformed science outreach and communication, but have yet to realize their potential impacts in the realm of education. Computer-based learning is a clear bridge between visualization and education that benefits students through adaptive personalization and enhanced access.

Building this bridge requires close partnerships among scientists, technologists, and educators. The Infiniscope project fosters such partnerships to produce exploration-driven online learning experiences that teach basic science concepts using a combination of authentic space science narratives, data, and images, and a personalized guided inquiry approach. Infiniscope includes a web portal to host these digital learning experiences, as well as a teaching network of educators using and modifying these experiences. Infiniscope experiences are built around a new theory of digital learning design that we call "education through exploration" (ETX) developed during the creation of successful online, interactive science courses offered at Arizona State University and other institutions. (…)" (Anbar, 2018, p. abstract). Design thinking is being increasingly used for innovative efforts and being a subject of interest by both academics and practitioners (Engberts & Borgman, 2018).

The signature of this project, XploreDesign4SciComm, can be understood based on the considerations of a recent work, exposed below:

"(…), drawing action in specific situations and recognizing them as guidelines for the construction of meaning through design is a transdisciplinary invariant, that is, it extends to other practices of human activity. (…) designers prioritize values in decision-making that are based on emotions, intuitions, reasons, experiences and constraints; five invariant categories in designers." (da Silva Vieira, 2018, p. 108). "Design is a social process of negotiation, interaction, rectification in which sometimes even misunderstandings contribute to a process rich in ambiguity and uncertainty. Each discipline has its own set of features, some constituting entirely parts of larger sets, some sets overlap, others are disjointed, that is, they don´t contain elements in common. Areas of overlap between disciplines are, in their feature set, also a recognized unit. (…) Each discipline or shared space finds its place and creates its atmosphere and influence, overlapping the aspects that have been absorbed and that have become predominant. Partially shared spaces between design discipline are hybrids of greater creative freedom, very focused on communication (theater, cinema, animation, documentary, digital media)" (da Silva Vieira, 2018, p. 110).

3. Methodology

This project intends to clarify the subject under study and, regarding the nature of the problem, has a qualitative approach. The objectives are exploratory aiming to have a greater familiarity with the theme, since it is an area yet to be consolidated. The method used was action research where after a remix of theoretical content and a reflection on that set is architected an action, trying an innovative approach that can add value to practical case studies and plan targeted actions. It is not intended to test or confirm a hypothesis but to evaluate which existing theories and concepts can be applied to a given problem. For the development of this study, considering the delimitation of the problem, the objectives and method, different procedures and techniques were used:

- Bibliographical review to find theoretical references and logical foundation about the involved topics
- Interviews with people with experience in the fields of study
- Questionnaires addressed to students involved in proof of concept
- Focus Group to collect data through group interaction on the topic Plant Blindness, using the hybrid prototype (i-doc) in classrooms
- Participation observation

Below, the table 1 summarizes the classification of the action research developed in this work:

Approach	Qualitative
Objective	Exploratory
Procedures / Techniques	Bibliographical Review Interviews Questionnaires Focus Group Participation observation

Table 1 – Adopted research design

In this project, action research is considered as a way of researching for education, and not about education, a methodology that can achieve better results when it is intended to bring people together in the process, favoring dialogue, educational practices and critical reflection

(Coutinho et al., 2009). The next image 2 summarizes, in a simplified way, the main phases of the study, developed between September 2017 and March 2018 and, next, in table 2 are the key work packages (WP) associated to the work, being the respective tasks described in more detail in the following sections:
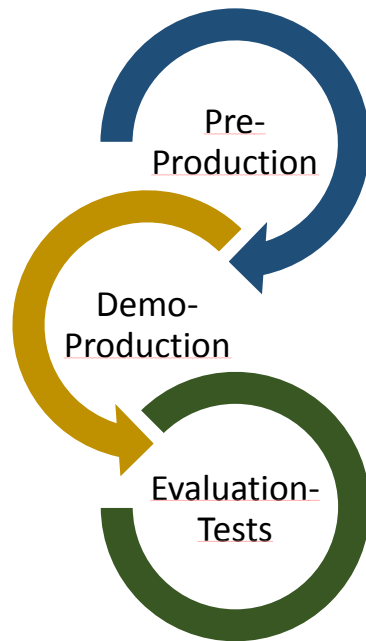
Image 2 - Source: Author´s perspective

Inputs			Transformation			Outputs
Sep	Oct	Nov	Dec	Jan	Feb	Mar
1 - Planning			2 - Action			3 - Analysis

Table 2 - Source: Author´s perspective

3.1 Work Package 1 – Planning

In the beginning, thinking about the reason of the main idea (why), for who can be useful, where and when to apply it, was the root to formulate the main questions at this phase:

- How do I gather content?
- How do I organize it?
- How do I put it in a storyboard?
- How do I get it reviewed?
- How do I get everybody brought into the process?

And so, the tasks in pre-production were:

- a bibliographical research to structure the line of action and to argue the usefulness of the interactive documentary as a favorable means to promote the teaching of sciences like botany and to promote the socio-environmental responsibility of journalism

- point out problems that need solutions and think about how to improve new approaches that can join people to work together to solve actual challenges (as plant blindness and improvements in educational practices)

- production and sharing, in Facebook, a pilot questionnaire about botanical gardens in Portugal, focusing on JBA, to verify if the oldest botanical garden in Portugal is known by the Portuguese (annex I)

- participation in coffee-meetings, a iNOVA Media Lab´s event, where students, researchers and teachers talk informally and share their research and lines of action (November and December)

- participation in tree meetings of XR Immersive Media Portugal, which is a regular event in Portugal created by iNOVA Media Lab (FCSH-Nova), NowHere Media and Chicas Poderosas, and promotes the sharing of interests, ideas and knowledge between all persons who want to learn and innovate in the media sphere (September, November and February)

- in the first meetup in XR Immersive, Diogo Melo, Partner & Director of Innovation and Products at DIFR, manifested interest in this project and a meeting was held with the DIFR team, for future actions (annex II)

- research about interactive documentaries produced and well-known up to the present, internationally and nationally, and select some of them to serve as a reference to simulate the concept to be tested - 3 references of interactive documentaries that helped to architect the lines of the script for demo-production:

  https://interactive.aljazeera.com/aje/2014/piratefishingdoc/

  http://hollowdocumentary.com/

  http://avespaixaoeuropeia.wixsite.com/webdocumentarioaves

- establish contact with Azambuja secondary school on November, personally and via email, with the director and professor of Biology and Geology of 11th grade, to ensure the possibility of carrying out the tests in the classroom (annex III). It was agreed that the test date would be occur at the end of February or beginning of March

- It was also agreed by the same time, personally with the teacher of master´s journalism, to run the test phase at FCSH - Nova, at the beginning of the second semester (February/March)

The choice of the two classes was not completely random. It considered the purpose of the study and the fact that the author had previous contact with the Azambuja Secondary School, during one work developed at the Master's Science and Society seminar. Being a student at FCSH-NOVA and developing her project at iNOVA Media Lab also facilitated the choice of the master´s class to participate in the proof of concept.

Initially, in the bibliographic search, the following keywords were used, in Portuguese and English, in the search engine Google, YouTube and Google Scholar: interactive documentary, science communication, scientific education, emerging digital media, 360 videos, science journalism, immersive journalism, communication science and design, design thinking, botany teaching, environmental education, virtual reality and augmented reality, UX Design. Later, with meetings with other students, researchers and professionals in those areas, I received references such as books, scientific journals and other resources, including social networks references, which allowed me to explore different sources. Being the focus to explore the interactive documentary, this was one of the key words behind all the research, after which the theoretical clipping was carried out at, the same time the field and the respective possibilities were deepened. One important reference, in this phase, was a transmedia meta-documentary that reflects on the interactive documentary as a new audiovisual format with specific characteristics, COME/IN/DOC[8]. The model for producing an interactive documentary in 7 steps was very useful to plan in more detail the initial idea of the project[9]. Another important reference was the work "i-docs", a term coined by Sandra Gaudenzi, available in this site[10], where is possible to explore several resources and trends, as looking for i-docs as a field to explore in education[11].

Portuguese academic theses about interactive documentaries were found, but the clear majority (Correia, 2015; A. d. L. C. da Rocha, 2017; de Oliveira Marques, 2016; Ferreira, 2016; Guimarães, 2014; Quintas, 2015; Ribeiro, 2017; Rodrigues, 2013), based the study on analyzing or comparing existing interactive documentaries or exploring the associated

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[8] Available in: http://comeindoc.com/educational/about/

[9] Available in: http://comeindoc.com/educational/video-produce/

[10] Available in: http://i-docs.org/

[11] Available in: http://i-docs.org/2012/08/15/interactive-documentary-and-education-a-field-to-explore-i/

taxonomies and potentialities, without focusing the study on self-production for a specific purpose and including the audience in the initial process of the project, and this is a differentiation that is aimed to point out. On the other hand, botanical gardens, being scientific museums, can improve and innovate their communication, with new digital media, providing differentiating experiences to target-publics and promoting its recognition and notoriety while reinforce its social and educational role. Some academic works were taken into account in the audiovisual perspective (dos Reis Ramalho, 2015; Ferreira, 2016).

Another motivation was the research about the use of 360 video and virtual reality in innovative journalistic formats and the need for more research on the subject (de Oliveira Marques, 2016). In a recent academic work, it was also emphasized the use of immersive media, such as 360 video and virtual reality, in the promotion of tourism in Portugal, and more research is needed on the use of 360 video, particularly in terms of tourism experience (de Oliveira Magalhães, 2017). In online research about interactive documentaries, two Portuguese works, with that specific attribute, were found[12]. In both works, it was verified the tendency to the format "website", based on the hyperlinks and scroll, with text and images, traditional photographs and videos, and, therefore, more distant from the cinematographic format. Any of them fall into the category of web documentary. Two award-winning multimedia reports, both interactive narratives, were also found[13], and is interesting to see some similarities with i-doc format. The Portuguese documentaries accessed on YouTube about botanical gardens in Portugal, including Ajuda Botanical Garden, are in the traditional format and so it is interesting to seek a differentiation, exploring the field of interactive documentary as a proposal to improve the communication of these scientific museums. The project FCSH +Lisboa[14] is also a reference, a work that reinforces the importance of university in contemporary societies and the need to adapt it to current social reality, where cultural journalism and digital platforms are key fields (Ponte & Silva, 2017).

This reality was vital in the planning of the project and allowed, to see connections between concepts, problems, experience, interventions and outcomes, in general between theory and practice, making possible the actions:

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[12] Available in:
http://avespaixaoeuropeia.wixsite.com/webdocumentarioaves (2014)
http://cavalgaraondanazare.ulusofona.pt/ (2016)

[13] Available in: http://rr.sapo.pt/a-sul-da-sorte/
http://multimedia.expresso.pt/jihad/PT/matar-e-morrer/index.html
[14] Available in: http://maislisboa.fcsh.unl.pt/

- to use evidences to understand the change process

- to motivate to generate ideas for change and improve situations

- to work with others to clarify complex problems

An important decision was to identify what would be produced, within the human and technical resources and having the limitation of the time factor. Articulating Storytelling, Gaming and Multimodality in the i-doc format was the premise to move on to the next phase, being itself the planning phase an iterative process. The next phase is planned to a demo-production of one prototype that simulates the interface of interaction with the user and that allows the simulation of the content, the interactions of the interface and the test of the main interactions, the closest to the concept designed by the author.

3.2 Work Package 2 - Demo-Production

There were also many iterations during this phase and an important question that arose was in relation how to produce the artifact that could represent, as close as possible, the concept to be tested with the target audience. The distinction between wireframe, prototype and mockup was an initial doubt but it helped later to architect the digital hybrid used in proof of concept. One reference that helped was this one[15]. For the author, it was a great challenge to experiment the production of audiovisual content, given the limited experience. What the author could present in the prototype resulted from several attempts and using different free digital tools. She developed 360 photographs, besides text, traditional photographs, used simple and in slideshow with music, proposal of games about botany and related sciences and a story about Ajuda Botanical Garden, written during a Storytelling training. Other formats, like audio design, 360 video and virtual reality, were presented only with practical examples of the associated possibilities, in the context of interface design presented.

The main tasks in demo-production were:

sketching and paper prototyping, based on author´s professional and academic experience and the theoretical framework obtained, choosing the target and context

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[15] Available in: https://designmodo.com/wireframing-prototyping-mockuping/

- write the script with the described specifications of the experience to be provided to the audience and develop the basic design of user interfaces in PowerPoint, related to the multimedia system that was imagined

- share via email the script with professionals, from audiovisual and design areas, and receive feed-back (annex IV)

- mature the idea in a multimedia object that will be the reference for the proof of concept, articulating storytelling and gaming, in a digital prototype

- make experiences with photos 360 and 2D photos and videos, despite the lack of practice of the researcher. Most of the audiovisual experiences in the prototype were produced by her, using her smartphone (Samsung, model GT-I9195, Android version 4.4.2) and Cardboard Camera in Google Play to take 360 photos

- produce botanical games about JBA in Rise, one web-based e-learning tool in Articulate 360, to simulate the main idea, and compile all the information on a website, built later

- study the alternatives to produce the hybrid, storytelling software as Eko Studio (Interlude), Klynt, Korsakow, Articulate Storyline, and choose the "best" option, considering the technical and temporal limitations and the ability to represent the concept, without using programming language

- participation in a training course at Cenjor, a professional training center for journalists, on Visual Narratives, between January 29 and February 26, 2018 (the inscription had been made in September 2017 but only at the end of January began the course) and produce one narrative (text and photos) (annex V)

- gather all the contents in one website, simulating the hybrid: xploredesign4scicomm.wordpress.com (annex VI)

Both the initial pilot questionnaire, about Portuguese botanical gardens, and the developed narrative were based on an academic paper developed in 2013 at the higher institute of agronomy - (Rosa, 2013) - and a book about Ajuda botanical garden (JBA), published in 1999 - (Castel Branco, 1999), in addition to the author 's experience during the Guide training in JBA, between October 2012 and March 2013, and the experience accumulated with this activity in the last 5 years. The choice of content developed in the hybrid, botanical games mainly, focused on the themes that the 11-year classroom´s teacher

said he would be teaching in February and March. However, it was tried to take a more general approach, not only focused on curricular contents of Biology and Geology.

In hybrid i-doc´s design, although are used web site's characteristics, is tried to achieve one format closest to the cinematographic view and, in the content structure, are considered 3 axes, according to this reference[16]:

- Author-User: author defines possibilities, paths in the narrative, and defines the freedom of the user, according to the main objective. The aim is to provide a moment of discovery and excitement to user, informing and stimulating reflection / action.
- Author-Text: author balances the control and discovery that is available to users (such possible paths to explore)
- User-Text: an attempt to balance the degree of fun and difficulty associated with the user, neither very fun nor very difficult, articulating different media and content (narrative, gaming, exploratory, participatory)

The following table 3 summarizes the topic/subject, platforms and user experience that are thought in this project and is adapted according to this source[17]:

	Topic / Subject	Support / Platform	User Experience
Hybrid Multimedia	Ecology and Environment (focus in Ajuda Botanical Garden and Plant Blindness theory) Education, Heritage, Culture and Tourism	Web Mobile Multiplatform	Narrative Hypertext Game Branched Geolocation Collaborative

Table 3 - Adaptation in author´s perspective

Although interactivity is inherent to the whole process in this study, one important reference to the narrative design in the developed prototype is a point of view from Nelson Zagalo who defends "linearity for the construction of new virtual reality entertainment artifacts. Linearity that should not be viewed in a simplistic way, but rather as an enhancer element an argument with more robust results, namely, in terms of gratification for its users."

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[16] Available in: http://comeindoc.com/educational/resources-4-4-content-structure/
[17] Available in: http://comeindoc.com/educational/resources-4-1-getting-started-subjecttopic/

(Zagalo, 2009, p. 367). In the preface of that work, written by Anthony Barker, can be read: "Evidence supports the suggestion that narrative receptors respond positively to previously defined endings. Open endings can be a threat to the human desire to see their expectations concretized." (Zagalo, 2009, p. 9). Despite the difference in the scope of that work, with focus on traditional narrative cinema and its convergence with videogames, it seems pertinent, to the author, to consider the fact that traditional narrative cinema is one artifact with greater capacity of emotional involvement, and being the documentary a cinematographic genre it is interesting to explore that vision for the exploratory purposes of this current research. That´s the reason why the prototype is designed with the proposed linearity, that is, the challenge to users is to discover and reflect about their "plant blindness score" after experiencing the i-doc, and the contents of the site to be tested must be observed in a specific order to facilitate the understanding of prototype, in the evaluation-test phase, which is: storytelling – botanical games – proof of concept.

In summary, the main tasks at this stage resulted from the intersection between: exploring technology – validating the direction – communicating the vision, being the Google´s Methodology, in this reference[18], a great help. The next image 3 sums up the technique based on UX (user experience):
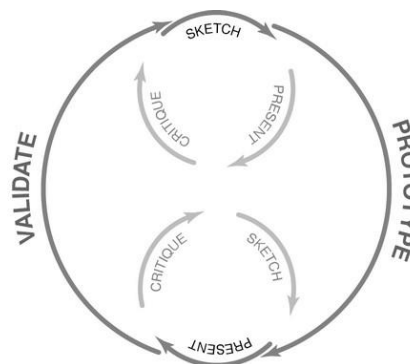
Image 3 – User Experience Technique

Source: https://www.interaction-design.org/literature/article/a-simple-introduction-to-lean-ux

3.2 Work Package 3 – Analysis

At this phase, author is part of the process in a self-iterative process, practitioner-based, self-reflective and improvement focused. Basically, it starts with the demo-production, that is not random but a result of experience, observation and theoretical framework, and then check if it works, involving the target audience at the earliest possible stage.

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[18] Available in: https://www.interaction-design.org/literature/article/make-your-ux-design-process-agile-using-google-s-methodology

Considering the good practices indicated by Ramona Pringle, the analysis of demo-production considers the following aspects (Aston et al., 2017, pp. 154-169):

- Test in the initial phase: identify the basic components of the history that constitute the system to test
- Perform the iterative process by unit and identify tools to test
- Identify key partners and stakeholders in the process
- Less is more: be careful about "cognitive noise", that is, with an overdose of interactivity

The three-dimensional methodology in the evaluation of user experience, proposed by Gantier & Labor, is also considered to evaluate the interface produced, both in terms of information architecture and interaction design (Aston et al., 2017: 105):

- Viewing frame
- Usability
- Sense-making processes

These three dimensions are interdependent on a whole and the approach is applied in iterative loops. The ten heuristics of Nielsen (Nielsen, 2017) are also considered in the evaluation of the usability of the digital prototype. The proof of concept of this project, before any implementation, is carried out, trying to ensure:

- Quality: to test usability and suitability among target audiences and take steps to improve
- Acceptance: If the pilot has positive results it will be easier to get help from partners and even funding to scale the idea
- Focus: in a more effective and efficient use
- Knowledge: try to reduce risks and prepare the implementation of the idea with solidity

In a systematic review of the literature on the evaluation of the usability of products and services, it was found that this is an area of great interest and there is a growing need for a normalization of terminologies, since in many studies the term usability is used in an inconsistent way (A. I. Martins, Queirós, Rocha, & Santos, 2013). These authors found that inquiry was the most commonly used method, although the combination of methods is frequent, especially inquiry and test combination, which allows the collection of qualitative and quantitative information, in a more complete assessment.

In the same study, the authors point out the orientation of organizations to usability very focused on technology, with specific approaches in technical and procedural terms. "The user experience goes beyond the efficiency, quality of tasks and user satisfaction, considering the cognitive, affective, social and physical aspects of the interaction. In this perspective, the user experience contextualizes usability" (A. I. Martins et al., 2013, p. 32). Thus, with this study as a reference, the usability evaluation model used in this project is empirical, since it uses data collected with real users, in 2 classrooms, and the used methods and respective techniques are:

- Test: participant observation

- Inquiry: to produce two questionnaires, using Likert scale (1 - strongly disagree; 5 – strongly agree), one general and the other, the System Usability Scale (SUS), based in this reference[19], and two semi-structured interviews, with the respective teachers of the two classes involved (annex VII)

- Outline a Focus Group: with focus on the problem - plant blindness - is proposed to each group draw an "exploratory tree", with problems (the possible causes of this problem) and solutions (paths or ways that can minimize the problem), the problems being the roots and the solutions branches of the tree, where the trunk is the plant blindness. It was delivered to each user 2 post-its of different colors, one to write the problem and another for the solution, and in the end all the post-it were collected to analyze the architected tree, based on the approach model presented in the first guide published in Portugal for social entrepreneurs (Santos, Salvado, & de Carvalho, 2013) (annex VIII)

After this process, the author shared the contents with some colleagues, that are studying fields as Science Communication, Immersive Journalism and New Media, trying to obtain clues and opinions about this approach, to find points of view and can improve the project. Interactive documentary productions have mostly established interaction with audiences in a disclosure posture. What can be a distinction is to establish interaction with audiences in a custom dialogic form, where users are an inherent part of the process, in a production focused on UX Design. Power should not be centralized in a single part and, in this sense, interactive documentary can be used as a scientific communication tool that allows mapping possible paths, while introducing adaptations. In this project, the interactive

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[19] Available in: https://usabilitygeek.com/how-to-use-the-system-usability-scale-sus-to-evaluate-the-usability-of-your-website/

documentary is interpreted as a communicative, knowledge-building entity, and not only as a format or a channel. Articulating storytelling and gaming, using multimodality, it has the mission of increasing environmental awareness (focusing on botany), reflection / action in an innovative and optimistic problem-solving approach, not forgetting that:

- Getting success involves "suffering", imperfections and improvements, a lot of thinking and it takes time
- Never forgetting the goal, the vital story, regardless of formats, content, launching platforms, considering the adaptation. Using a format or platform just because they are appealing can be a mistake, especially if we do not adapt the content
- Working in a laboratory is useful, but when we look at reality we may encounter bugs that were not expected. One important insight is to act in a real context, even with the associated limitations
- What is very logical for the architect of the communicative process may not be so explicit to the user, and he is an active part in the process

In the next chapter are presented the results obtained in proof of concept which are complemented later, in the discussion chapter, with reflections that aim to promote the process´s improvement.

4. Proof of Concept (PoC)

4.1 Evaluation in Natural Context

In both classrooms, secondary school - 11º level and university level - master´s degree, PoC is conducted in two phases: first, observing the initial prototype on the site built for that purpose, and a second exploratory phase, in which students are challenged to look for causes of Plant Blindness problem and possible solutions or improvements that may minimize this problem. The viability of the idea is tested and if the results are optimistic, that is, if it is confirmed that the proposal adds value and utility, in the education context and promoting a public awareness of the issue, is considered a future implementation of a functional prototype, based on the main results obtained. A small introduction is made, about what is being developed and point the fact that no one is being evaluated, that the contributions are anonymous and the only evaluation to be carried out is only in relation to digital object proposed and the possible impact, in science education and its communication.

In the beginning, is explained that:

- Participants can interact with the moderator, asking questions and doubts
- Each participant observes the prototype in its place, but the moderator shares the contents simultaneously for the class, explaining the purpose of each interface and associated dynamics, reinforcing the functionality of the proposed object

In both classrooms, the observation of the contents follows the proposed order: storytelling – botanical games – prototype observation and the respective teachers were present.

Below are two tables, table 3 and table 4, with complementary information, which represent the typology of the two classes involved in this process and the respective characteristics as: date of occurrence, number of students involved, classroom typology and duration of the event. Following, it is explained how the semi-structured interview is conducted to the respective teacher, in each class.

	11º degree in Biology and Geology **Azambuja Secondary School**
Date	7 March 2018
Number of Students	17 students
Classroom typology	Informatic classroom with available 12 computers for most students (11 students in a computer and three groups, each with 2 students, sharing one computer)
Duration	1h30: starts at 8h30 a.m. until 10h00 a.m.

Table 4 - Typology of secondary classroom

Before sharing the prototype, the author asked the class to identify the oldest botanical garden in Portugal. It was verified that the group did not know the Ajuda botanical garden, but some mentioned the botanic garden from MUNHAC – Museums of the University of Lisbon[20]. The observation of the contents happened without problem, early in the morning the access to the Internet was optimal the students could observe and try the contents proposed, in the indicated order. Afterwards, they were asked to respond to the 2 questionnaires available in the respective 2 links of the site (the general questionnaire and the SUS questionnaire). After this procedure, the class took an interval of about 10 minutes. After the break, the second session was held where the exploratory tree design was proposed. Each student received 2 post-it of different color to write, according to their vision, a possible cause and respective solution in relation to the Blindness Botany problem.

During the first session, in the observation of the prototype, the author observed in the students an enthusiasm related to the botanical games, an enthusiasm also verified by the teacher of the class who commented this detail with her and that will be more detailed in the discussion section.

Before and after the evaluation-test phase with this classroom, the author talked informally with the teacher about the main idea associated with the project, and later, in the

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[20] Available in: http://www.museus.ulisboa.pt/en/botanic-garden

same day, sent him a semi-structured interview, being the results shared in the result´s interviews section.

	Master in New Media and Journalism FCSH - New University of Lisbon
Date	8 March 2018
Number of Students	33 students
Classroom typology	Auditorium 3 of FCSH – NOVA, without computers available, students use their smartphones or laptops
Duration	1h00: starts at 06h00 p.m. until 07h00 p.m.

Table 5 - Typology of master's classroom

In this group it was also verified that the students did not know about the oldest botanical garden in Portugal, some of them also referred the botanic garden from MUHNAC. The process was similar in methodology, although some differences as:

- The students were not all present at the beginning of the class, despite most were in the room after the introduction and the author reinforced the purpose of the session during the process
- The room was an auditorium, with no computers available and therefore students observed the contents on their smartphones or laptops, with the limitations of Internet access that occurred during the event. In any case, the author projected the contents to the class and explained the associated proposals, with text, images and sounds
- Session duration was shorter and without interval
- Related to the first group, the class was not so homogeneous in terms of age and academic background, formed by students with varied training such as journalism, medicine, new media

At the end of this test phase was the interval, and the class continued later with the respective teacher. The author combined with the teacher that the semi-structured interview would be sent via email.

4.2 Results

Considering the research questions (RQ) associated with this project, results are shared in one order. First, are summarized the main results obtained in the pilot questionnaire about botanical gardens in Portugal. Then, the results achieved with the observation of the prototype and the answers of the two questionnaires, which are mostly related with RQ1 and RQ3, are shared. Finally, the results obtained in Focus Group classrooms and in the semi-structured interviews with respective teachers are disclosed, more related to RQ2 and RQ4.

4.2.1 Results obtained in the pilot questionnaire about botanical gardens in Portugal

Were obtained 293 results and only 73 persons correctly answered the question: "What is the name of the first botanical garden in Portugal?". Responses like "Lisbon botanical garden" were not considered correct because in Lisbon there are three different botanical gardens. Answers like "Ajuda", "Royal botanical garden" and "Ajuda sidewalk garden" were considered correct. 78,8% of the participants have a higher academic qualification, 32.4% with postgraduate and master's degrees and another 32.4% with a doctorate, the dominant age group (59,8%) being between the ages of 30 and 59 years (10,6% of participants are between 18 and 20 years). Full results can be seen at this link[21].

Only 32,4% of people correctly answered the question relative to the foundation time of Ajuda botanical garden (JBA), in the second half of the 18th century. The creation of the first botanical garden in Portugal was driven by the combination of scientific knowledge, technical know-how and political power, and 36,9% recognized this combination even though 36,5% emphasize the scientific knowledge as the main cause.

47% knew the city where JBA was founded (Lisbon), although 30,4% answered that they didn´t know and 21,8% responded that it was in Coimbra. In relation to the European country, officially considered the place where the first botanical gardens were established (Italy), 18,4% knew it. The frank majority, 92,5%, recognize botanical gardens as scientific museums but 52,9% don´t have the habit of visiting them. 74,8% considered that botanical gardens have an important role to play in the promotion of cultural and leisure activities for citizens. In relation to the frequency with which they visit the botanical gardens in Portugal,

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[21] Available in:
https://xploredesign4scicomm.files.wordpress.com/2018/03/questionariopiloto_jardinsbotanicosportugueses.pdf

for cultural and leisure activities, 49.1% of participants said that they rarely visit, 33.1% occasionally, 13% never visit, and only 4,8% visit frequently, at least once monthly.

4.2.2 Results achieved with the observation of the prototype and responses to the general and SUS questionnaires, in both groups

Group 1: 11-year class in Biology and Geology

- **Answers regarding the general questionnaire**

Of the total of 17 students who observed the prototype, 5 girls and 9 boys, 14 answered the online questionnaire, available at this link[22]. The participants' ages ranged from 15 to 18 years (15 - 14.3%, 16 - 42.9%, 17 - 28.6% and 18 - 14.3%). Of these, 71.4% consider themselves receptive to the use of new technologies and 85.7% usually play videogames. Of the 5 girls who responded, 4 are receptive to new technologies and 3 play videogames. Related to audiovisual contents, the three categories most searched online, are: music (85.7%), entertainment like games and movies (78.6%) and social networks (42.9%). Participants answered that they had already seen interactive documentaries on the Internet (71.4%), 360 videos (78.6%), virtual reality (VR) content (64.3%), augmented reality (AR) content (50%) and 35.7% said they had never observed content in RV an RA.

Concerning the question - Did you like the experience? - 71.4% indicated the maximum value in the Likert scale, 5, and 28.6% indicated the value 4. Most strongly agreed (64.3% scored the maximum value - 35.7% indicated the value 4) that they would like to do other experiences of this kind in classes, in this and other disciplines, emphasizing the premise that supplementing classes with interactive audiovisual content (videos 360º, RV, RA) will be stimulating and motivating for learning (78.6% for the maximum value of the scale and 21.4% to the value 4). The mayor agreed on the question, if they would like to experiment with their class and the teacher the production of an interactive documentary on a subject related to the contents of the discipline Biology and Geology (77.1% answered the maximum value of the scale, 28.6% the value 4 and 14.3% indicated the value 3).

Of the total of 14 participants, 57.1%, 8 students strongly agreed that, in addition to students, they are citizens and can participate in an active, autonomous and responsible way

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in building better opportunities, in school and in society, being the lowest value of the scale given by one student, the value 3.

Regarding one of the key questions of the questionnaire, the results can be seen below, in the graphic 1:
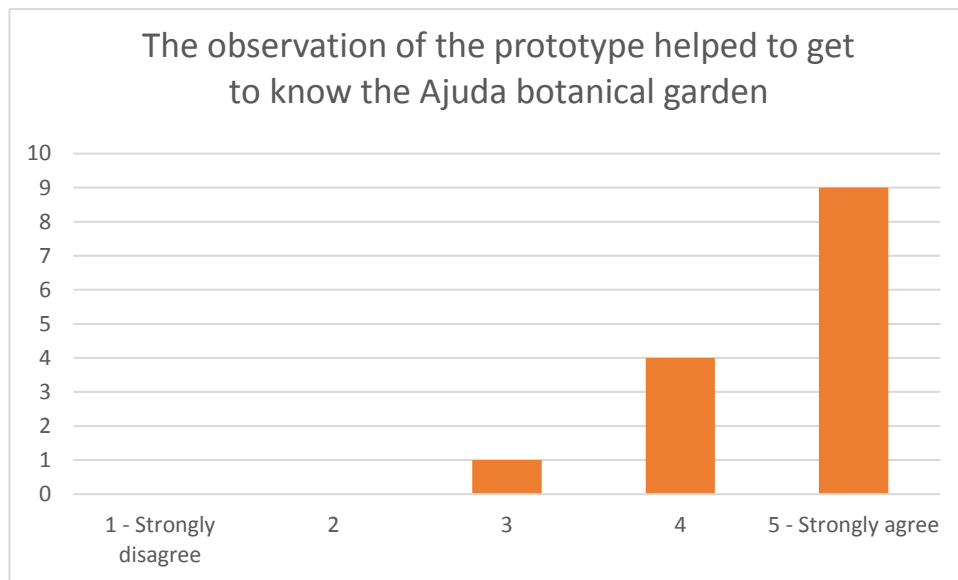
Graphic 1 – Answers from 14 students about the recognition of JBA

A related question indicated the following statement: "The observation of the prototype contributed to a greater involvement with the theme of the Botanical Gardens and their importance", obtained similar results: 8 students agreed completely, 5 students agreed (value 4) and 1 indicated the value 3. Finally, the statement: "I believe that this format will be an added value to develop innovative content that complements the classes of botany and associated sciences, facilitating the understanding of the curricular contents. " the majority strongly agreed (10 students), 3 students assigned the value 4 and 1 the value 3.

- **Answers regarding the SUS questionnaire**

Of the total of 17 students, 11 answered the SUS questionnaire, also online[23]. Participants ranked each question from 1 to 5 based on how much they agreed with the ten statements, where 5 means they agreed completely, 1 means they disagreed completely. And then, for each of the odd numbered questions, was subtracted 1 from the score, and for each of the even numbered questions, was subtracted their value from 5. Then, those new values found, were added up to a total value, that was then multiplied by 2.5 and calculated the average

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[23] Available in: https://xploredesign4scicomm.files.wordpress.com/2018/03/sus-11ano_11respostas.pdf

SUS. Although the calculations were performed manually by the author, to facilitate the presentation of the results, a spreadsheet was used in this source[24], and the respective results were confirmed.

The result - **73.9** - being not one percentage, gives an estimative about the usability of the proposed object. One reference value is 68, but in the discussion section is more detailed the SUS score. The results of these calculations can be seen in the table 5, below:

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Statement 6	Statement 7	Statement 8	Statement 9	Statement 10	SU Score
A	5	3	5	4	4	2	4	5	5	5	**60,0**
B	5	3	4	5	5	4	4	3	4	3	**60,0**
C	5	1	5	1	5	1	5	1	5	5	**90,0**
D	5	1	4	1	5	2	4	1	5	5	**82,5**
E	5	1	5	1	5	1	5	1	5	5	**90,0**
F	5	3	4	2	5	5	5	5	5	5	**60,0**
G	5	1	4	5	4	1	3	1	5	2	**77,5**
H	5	2	5	1	5	1	5	1	5	5	**87,5**
I	5	1	5	4	5	1	5	1	4	5	**80,0**
J	4	3	3	3	4	4	4	2	3	1	**62,5**
K	3	3	3	4	4	1	3	1	5	4	**62,5**
										AVERAGE	**73,9**

Table 6 – Results of SUS questionnaire in 11-year class

Group 2: Master´s Class in Journalism and New Media

- **Answers regarding the general questionnaire**

Of the 33 students present in the room during the questionnaire completion phase, 23 answered this questionnaire, online[25], the largest group from the 20 to 25 age group (78.3%) and the female gender (73.9%). Of the 23 respondents, 15 participants considered relevant the concept that was tested in their class, 6 answered in the middle of the scale (value 3) and 2 students disagreed (value 2). 87% of participants already seen the interactive documentary genre on the internet, and the clear majority never produced such content (95.7%). In relation to the habit of playing videogames only 21.7% confirmed this reality. Of the 17 women who responded, 14 do not have this habit, and of the six male participants, four do not have this habit either.

82.6% of the participants considered the inclusion of interactivity in audiovisual content to be advantageous, and the majority had viewed 360 videos (91.3%). Regarding the observation of VR and RA contents, 69.6% and 47.8% of the participants had already observed, respectively, and 17.4% never observed these contents.

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[24]Available in: http://satoriinteractive.com/wp-content/uploads/2015/09/Satori-SUS-Calculator.xls
[25]Available in:https://xploredesign4scicomm.files.wordpress.com/2018/03/poc_mestrado_23respostas.pdf

The results about design, in the proposal context, can be seen in graphic 2:

Design is essential to the planning of communicative relations between people and emerging digital objects
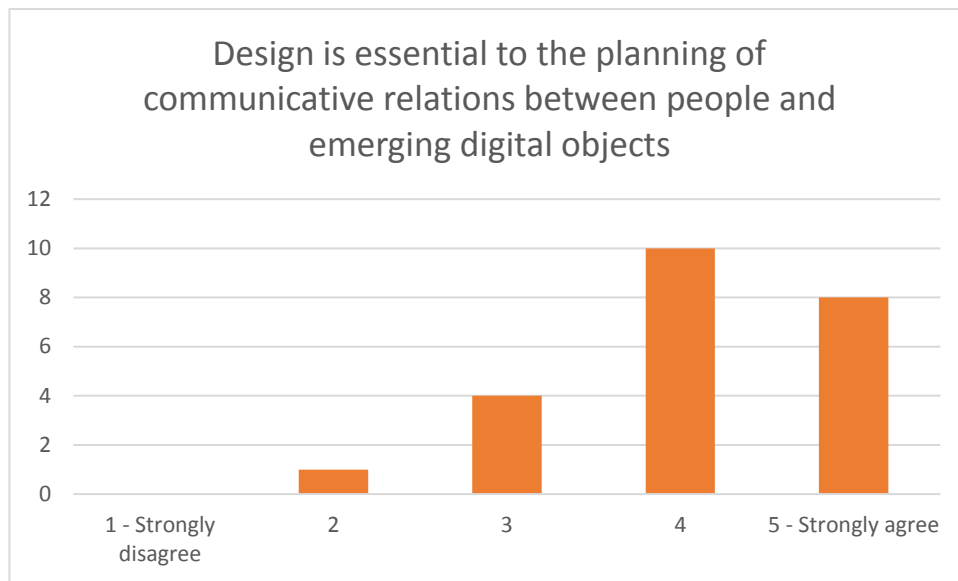
Graphic 2 - Answers from 23 students about the importance of design

. Regarding the statement: "This approach is interesting, given the challenges and opportunities that journalism and its teaching are experiencing today.", 5 students agreed strongly, 9 agreed (value 4), 6 had a neutral opinion (value 3 of the scale) and 3 disagreed (value 2). In the context of the project, 17 students fully agreed that the exploitation of interactive documentary will be an asset to develop innovative content that promotes differentiating and multidisciplinary journalism, 5 students expressed a neutral opinion (value 3) and 1 student disagreed (value 2).

In the context of Media Education, 82.6% of participants agreed that digital media, as well as pedagogical resources, are objects of study that allow us to understand and interrogate the ways of constructing meaning that they originate, no one disagreed. 17 students agreed, 6 completely, that the concept tested, in the scope of journalism, promotes citizenship as an important motor in the maintenance and recovery of the memories that are part of our history and culture, 5 with a neutral answer (value 3) and 1 student disagreed (value 2). With some differences, in relation to the importance of the responsibility of Journalism in Environmental Education and in the associated problems, the answers were close to the previous question: 18 agreed, 9 completely, 4 with a neutral answer (value 3) and 1 students disagreed 2). Only 1 of the 23 participants reported that have produced an interactive documentary, and the answers to the question: "What would be the best way to produce a hybrid interactive documentary, based on the prototype that was tested?", were: 5

students choose the "pure code implementation" option, 9 the use of "online tools" and the remaining 9 said they did not know.

The results obtained to the same key question, placed to secondary students, are expressed in the graphic 3, below:
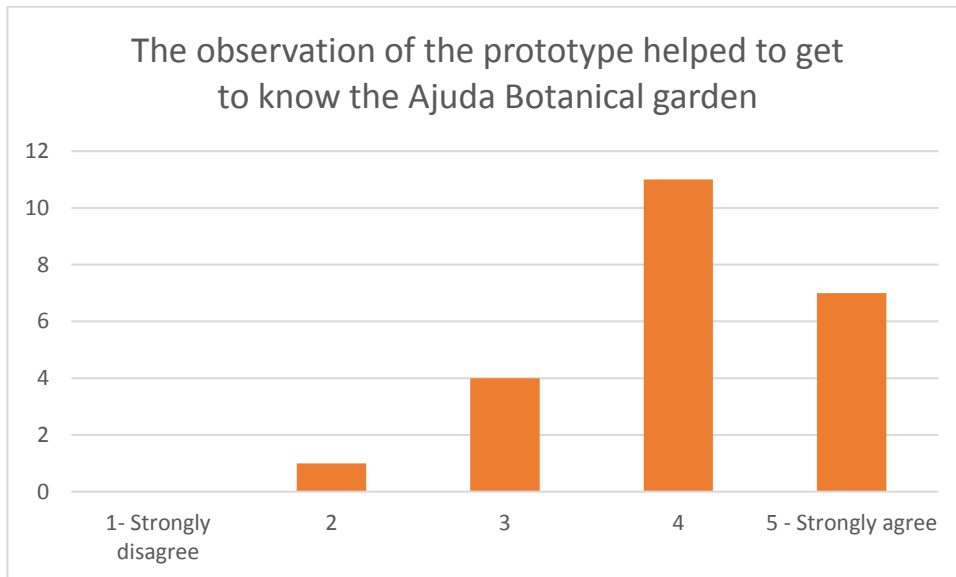
Graphic 3 - Answers from 23 students about the recognition of JBA

Eighty-seven percent of the 23 students agreed with the statement: "interactive documentary rather than a media or digital media channel, which represents reality, can be interpreted as a builder and enabler of knowledge", and no student disagreed.

- **Answers regarding the SUS questionnaire**

The procedure associated with this SUS questionnaire, was the same as indicated for group 1, and of the 33 students present in the room, 20 answered this questionnaire, online[26]. Table 6, below, shows the values obtained for each participant in the 10 questions involved, and the average value of the SUS score obtained – **62.8**.

Participant	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Statement 6	Statement 7	Statement 8	Statement 9	Statement 10	SU Score
A	4	4	3	4	4	2	4	2	4	4	57,5
B	4	4	3	4	4	2	4	2	4	4	57,5
C	5	2	3	3	3	3	3	4	4	2	60,0
D	5	1	4	3	3	2	4	2	4	3	72,5
E	5	2	3	2	3	2	3	1	5	2	75,0
F	2	3	3	4	3	3	3	3	4	2	50,0
G	4	3	3	4	4	4	4	2	5	4	57,5
H	3	2	4	2	4	3	4	1	4	3	70,0
I	2	3	3	3	3	3	3	3	3	3	47,5
J	2	2	2	2	2	4	2	4	2	2	40,0
K	3	3	3	3	3	3	3	3	3	3	50,0
L	5	4	4	4	4	4	3	3	4	3	55,0
M	2	3	3	3	3	3	3	3	3	3	47,5
N	4	1	5	1	2	2	5	1	2	4	72,5
O	5	1	5	1	4	2	5	1	5	1	95,0
P	4	4	2	3	4	3	4	3	3	4	50,0
Q	4	3	5	1	4	2	5	1	5	5	77,5
R	4	1	5	1	5	1	5	1	5	4	90,0
S	2	4	2	5	3	4	4	3	3	2	40,0
T	5	1	5	1	4	1	5	1	5	4	90,0
										AVERAGE	62,8

Table 7 - Results of SUS questionnaire in master´s class

4.2.3 Results obtained in the semi-structured interviews with respective teachers

- **Interview with 11-year classroom teacher:**

Edmundo Martins, teacher of Biology and Geology of the 11-year class, said that this activity help him to know JBA and the potential of using it to complement his classes, because he was unaware of this institution and its pedagogical potentialities, although he had already done some classes at the botanical garden of MUHNAC. He considered the approach of this project interesting, emphasizing the virtual contents as a complement of great utility, before, during and after physical visits. Considering "plant blindness" as a problem, Edmundo Martins said: "In fact, we suffer several blindness including plant blindness, the knowledge transmitted in the school are a little encyclopedic, very turned to histology and plant physiology, with many names to decorate and very little turned to the observation, discovery and effective knowledge of flora that surrounds us. Many students do not know,

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[26] Available in:
https://xploredesign4scicomm.files.wordpress.com/2018/03/sus_metrado_20respostas.pdf

for example, the flower - fruit relationship and could learn more by observing and simulating everyday phenomena."

Edmundo Martins often uses audiovisual contents in his classes, considers the image very necessary, being the written supports a complement. In relation to traditional audiovisual media, he thinks they are not sufficient interactive but to implement more interactivity in classrooms there are some limitations in technological resources that can limit these approach, as availability and speed of the internet and appropriate classroom conditions for this purpose.

He considered relevant the concept that has been tested. Confirmed that the use of the proposal can add value to his activity as a teacher, without losing scientific rigor. It can motivate one future visit to Ajuda botanical garden and the i-doc´s utilization can be useful during one visit or help to consolidate the concepts in the post-visit and even, allows autonomous research paths.

Regarding the questions below, Edmundo Martins replied:

- In your opinion, can this strategy contribute to a greater involvement of students in botany and related sciences? **Edmundo Martins**: "Yes, in general as a strategy and particularly with disaffected students, with little interest, as can be verified during the session, in which generally uninterested students were enthusiastic about the games."

- In your view, could the i-doc format be of greater use to individual or collective students? Do you have any suggestions? **Edmundo Martins**: "As an autonomous learning path more individually, it can be used in teacher-directed research activities at the collective level."

- Is the choice of the support to be used to communicate science conditioned by the complexity of the subject matter and by the degree of knowledge and information demand of the public (considering mediation between text and audiovisual)? **Edmundo Martins**: "Depending on the characteristics of the subject, the most adequate resources are used to acquire content and the existing means. In the case of a botanical garden where a transversal approach to the different cycles is possible, the learning pathways must be adapted to the different levels of education."

- In your opinion, are marked differences between the audiovisual narrative and the scientific narrative that condition the transposition process? **Edmundo Martins**: "No, they

are partners, both the audiovisual and scientific narratives are facilitators of learning and source of motivation."

Edmundo considers interesting the future promotion of this concept among students and teachers, creating conditions in the school to produce new experiences in an autonomous way, promoting education for the media and enriching school contents. But it would be very important to have more adequate rooms and to have one intermediary in the process, that facilitates the process. One specialized agent who could produce personalized contents, articulating the content to be taught with teachers. It could facilitate because it is difficult for teachers to monitor technological development and there is a lack of training in that field. Multimedia students could be involved in the process (multimedia teachers and other professionals could be partners in content development).

- **Interview with master´s classroom teacher:**

António Granado, teacher of master´s class, answered similar questions to those put to the teacher of group 1, focusing Science Communication and Journalism. Below are three questions, the same put to Edmundo, with the respective answers and then some considerations that he pointed out about the proposal of this project:

- In your opinion, can this strategy contribute to a greater involvement of students in botany and related sciences? – **António Granado**: "There is no doubt that the observation of the prototype can contribute to the students' involvement with the JBA and Botany. I think the idea will be more interesting from the point of view of education than from the point of view of the journalist, just observing the prototype. The project will be useful to produce news about it, but is not possible to do a story or news about the JBA without going there in person. It will be interesting if the journalist goes to the garden space and then, himself develops the contents. As for the greater involvement of students I have no doubt, now for the journalist to observe this format, I have doubts, he can report this event, but as a producer, will always be limited to what was filmed, photographed, he only sees what someone has already created. But, if he applies this model, that approach contributes to the journalist being able to breathe life into his voice in a different way, and in this perspective, the proposed i-doc will be interesting for the journalist. "

- Is the choice of the support to be used to communicate science conditioned by the complexity of the subject matter and by the degree of knowledge and information demand of the public (considering mediation between text and audiovisual)? **António Granado: "**In Science Communication is crucial adapting the message to the support that we use. For each

medium the speech must be adapted. Some concepts and ideas may work best for text or video, for example. Even orally, we must adapt our speech to the number of listeners or to the space where we are. People are very accustomed to communicating by text and there is difficulty in transposing to the audiovisual media, but it depends on the message to be transmitted, the text can even complicate when used in excess, which still happens frequently in some presentations. The process of scientific communication should be a process of simplifying information, appropriate to the target audience, and simplifying does not mean loss of rigor."

- In your opinion, are marked differences between the audiovisual narrative and the scientific narrative that condition the transposition process? **António Granado: "**To communicate, as the origin of the word indicates, is to put something in common, and I think that in this sense it is possible to simplify. To talk about more complex botanical concepts with doctorates, for example in nuclear physics or law, we should simplify. It will not be a matter of academic degree, but language can and should be simplified. Accuracy is very important, and in the communicative process this detail, and the ability to achieve it, are transversal and vital in all areas, and I think simplification is compatible with rigor. We can remember Stephen Hawking, in this context."

In relation to the idea that one i-doc can be interpreted as a builder and enabler of knowledge, António Granado said that when we produce any journalistic product, whether in text or images, there is always a construction of knowledge, being that fact the interest of journalism, helping to take certain themes to the society. Mixing various contents in one i-doc, such as games for example, and stimulating interaction with them, can facilitate the interplay of the message and the application of knowledge, more easily than just reading a story. There is a difference between reading and applying knowledge, and he believes that this format might enhance that application and enable the diffusion of knowledge.

António Granado also pointed out limitations associated with the project´s concept: "The time required and associated costs are limiting. There is no time to think about new formats. Journalism has been a repetition of information from someone who has already produced, and this reality limits the production of that format. Clearly, we need new content that stimulates people's attention. Currently, in relation to the situation that many newsrooms are currently suffering, there is hardly a bet on the production of this format. It would be important to do more experiments of this type, some are made, but they are not enough. The production of a format with this type of interaction will be a time-consuming process and requires appropriate teams, and the newsrooms have been shrinking brutally for many

years. There is not enough time or resources for this kind of productions. And another important issue for the managers and administrators of social media: "What will be the profit with this format? How many clicks and how many people will be interested in this format?". Bets are currently experimental. And remembered that: "University is the only place where there is time to explore these new formats and there are not profit pressures. Proofs of concept can be useful to demonstrate the usefulness in using these formats, but external support will always be necessary, considering the financial limitations".

About the importance of design to the planning of communicative relations between people and emerging digital objects, António Granado said: "Design is not just the shape, because without a defined function it will have no use. The projects can be very appealing but if they are not suitable for a purpose, respecting the function they propose, they lose usefulness. Planning is thus essential. A prototype is not as fluid as a finalized product, but I think the simulated multimodality in this project is interesting."

4.2.4 Results obtained in Focus Group classrooms

Each group draw an "exploratory tree", with problems - the possible causes of plant blindness - and solutions - paths or ways that can minimize that problem - the problems being the roots and the solutions branches of the tree, where the trunk is the plant blindness. The respective trees, tree 1 (11-year classroom) and tree 2 (master´s classroom), can be observed below.

- **Tree 1 - 11-year classroom**

The problems and solutions, written by the 17 students in the post-it, were grouped together in main themes to facilitate the understanding of the tree. Next to each is a number, which reflects the number of students who indicated the problem / solution (some students wrote more than one problem or solution in the post-it). It was not considered in the tree, a post-it problem of a participant, because what was written did not fit in the subjects referred in collective, but is considered the register of that opinion, in relation to a possible problem: "You should not interact too much with the technology otherwise you can lose the notion of life. ". The "exploratory tree" in this classroom is summarized in the next image 4:
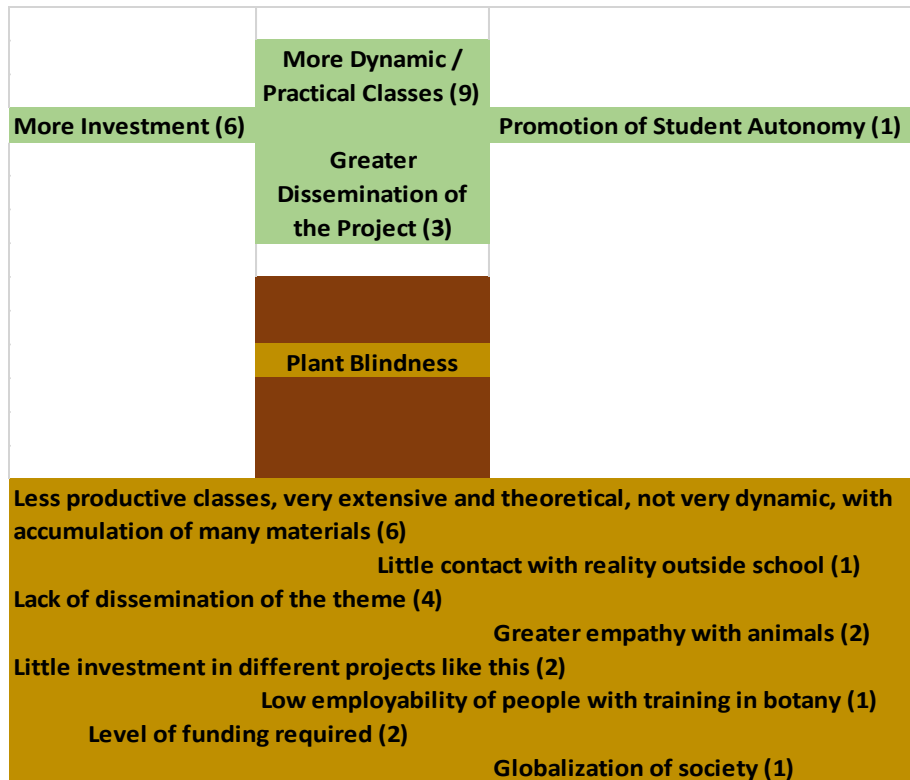
Image 4 - Exploratory Tree in 11-year classroom

- **Tree 2 - master´s classroom**

In this session, 28 pairs of post-it were gathered, and the great majority, 20, focused their vision on the complexity of the theme and on the ability to make it more empathic and dynamic. To bet on the communication, formation, dissemination and awareness of this theme, for society in general, not only in the school context but for the different age groups, was a transversal way to most of the students. Three students specified that this theme is of little expression in the media and that a possible way would be to create, in the organs of social communication, a fixed and exclusive category on botany, betting on a greater dissemination with informative videos, an example given by one of them.

Another view that stood out from the majority was the lack of training of government personnel and ministries in this area and that, one possible way would be that given the inherent responsibility and decision-making power, these people should comply with the requirement to have training in the environmental area. One participant linked climate change to botanical blindness and the general perception that the negative consequences are geographically distant, and identified a possible pathway such as identifying the negative consequences already present in the local reality in a differentiating way and disseminating these contents, adapted to each locality.

Given the size of this group, the number of students who indicated the problems / solutions was not indicated, since many of them used different words to represent the same problems and solutions, with only 3 students who focused on the specific problem: the lack of dissemination of the topic in the media. The "exploratory tree" in this classroom is summarized in the next image 5:

	Promoting the Subject not only in an Academic Environment	
More Investment		More Campaigns to Raise Awareness and Focus on Training
Establish Partnerships		
	Plant Blindness	

Complexity of the subject and little knowledge and interest of the people in general, since it is not something with direct application and with fast results

Little contact and interaction with Nature

Lack of dissemination of Media (3)

Lack of information on native plant species and little care with public gardens and green spaces

Lack of creativity in approaching the theme in a differentiating and appealing way

Little connection between entities that can try to solve complex problems

Image 5 - Exploratory Tree in master classroom

5. Discussion and Improvements

Discussion is developed regarding the original empirical contribution derived from results. According to this scenario, the research questions (RQ) are answered by the author's interpretation and proposals for improvement are addressed. An analysis grid is presented with the strengths and points to be improved in upcoming actions. The concepts of interactivity, immersiveness and participation are framed within this work and the transdisciplinary associated with design is strengthened.

From the results obtained in the pilot questionnaire on botanical gardens in Portugal, the author emphasizes the recognition by the participants of the botanical gardens as scientific museums and spaces with an important function in the cultural dynamization and leisure activities for the citizens. However, they do not manifest a habit of visiting these spaces, doing so occasionally and even rarely. In the context of her work, the author believes that the botanical gardens, with focus on Ajuda botanical garden (JBA), can improve their communication and cultural offer, contributing to their greater recognition and social importance. In the results obtained, most participants did not know how to identify the JBA as the first Portuguese botanical garden. As this space is a national reference it will be pertinent to consider new communicative approaches to increase it social recognition and promote actions that try to minimize the problem of botanical blindness. This was a pilot questionnaire and the author thinks that it will be interesting to develop new investigations in this scope, with greater detail and dimension, that can contribute to a better knowledge of this reality, since there is little academic work in this area.

In general, considering the results obtained in the proof of concept, the author considers the results as positive, since most of the answers and considerations obtained in the questionnaires, interviews and focus group, validate the concept of this project, in terms of interest and practical utility, focusing on the educational context and promoting greater environmental awareness. The author also thinks that the results are promoters of a new look not only for productive practices and technics, in science communication, but also, and specifically, in educational practices, at different academic levels.

Regarding the interactivity interpretation related to the proposed digital object, the author, in addition to using storytelling, sought to create and draw experiences for an audience as active as possible, in the sense of: "Interactivity refers to ability of a system to partake in the process of interaction. When this refers to communication, a key aspect is the fact that the passive viewer or reader of traditional media is replaced by an active user; an

entity with agency. The way this agency affects the reception of the work or the work itself is widely varied. And while interactivity is intrinsic to digital media, one can argue that not all of our experiences with it are really interactive, according to the definition below." (Soler-Adillon, 2017, p. 5). The author's view of the participation she made for her target audience took into consideration a form of social interaction, according to the same mentioned authors, the fact that: "Although some authors conflate it with interactivity, it is very useful to differentiate both concepts. While interaction always implies some sort of participation, this is a pertinent distinction in order to frame the different types of activities that can take place with technological systems that afford that the users take action in relation to them. It is especially relevant in the context of the web 2.0 and social media, where user generated content is central. The proposal here is to understand participation as contribution: That is, the creating content by the user of the system, as a different act than that of interacting with this content." (Soler-Adillon, 2017, p. 5). As for the notion of immersion, it was very useful for the author, the contribution of the same authors in pages 5 and 6, when they show the differentiation of the spatial / technological immersion of the emotional / psychological immersion that can be better understood in this sharing: "(…) it is not so much the technology but the engagement that generates immersion. Playing a game in a very small screen, or a monitor a few meters away can be as immersive as using a Virtual Reality headset, if we understand immersion as this psychological loss of awareness of our immediate surroundings.".

In relation to RQ1 and RQ3, the main annotations developed by the author are below:

- RQ1: Can the proposal for the multimedia hybrid be a valid medium to promote awareness for plant blindness and science education?
- RQ3: Does the observation of the hybrid contribute to inform and alert to the importance of botanical gardens, particularly to the recognition of the JBA?

In both groups of the two different academic levels, a positive affirmation was verified to these question, since most of the students involved agreed with the key questions included in the two respective questionnaires, confirming that: the observation of the prototype helped to get to know the botanical garden of Ajuda and the proposal associated with the project may contribute to a greater involvement with Botany and related sciences, promoting the importance of botanical gardens in that sense. In the two interviews

conducted to the respective teachers, according to the answers obtained and the shared considerations, both opinions were favorable to the two research questions above.

In secondary classroom, the majority confirm that i-doc is a format which adds value to develop innovative content, complementing the classes of botany and associated sciences and facilitating the understanding of the curricular contents. Everyone enjoyed the experience. Most strongly agreed that they would like to do other experiences of this kind in classes, in this and other disciplines, emphasizing the premise that supplementing classes with interactive audiovisual content (360 videos, RV, RA) will be stimulating and motivating for learning. The author views the enthusiasm of the students with some reservations. To understand how the format i-doc can promote awareness for plant blindness and science education, will be necessary to deepen the study, since is not exempt from controversy. The author thinks that there is no doubt that the observation of her prototype contributes to get to know Ajuda botanical garden but, to affirm that the proposal can be efficient to improve the learning of curricular contents is needed more evidences. Still, there is a resistance regarding the use of Gamification, the critics argue that it undermines the focus on study and learning and not promote the success that is promised (Orlandi, Duque, Mori, & Orlandi, 2018). These authors also mention the greater need for research.

In the master's class, where the test was more focused on journalistic activity, was recognized that interactive documentary rather than just being a media or digital media channel, which represents reality, can be interpreted as a builder and enabler of knowledge and could be one valuable tool to develop innovative content that promotes differentiating and multidisciplinary journalism. However, the author does not neglect the fact that, from the total of 20 participants, 5 students expressed a neutral opinion and 1 student did not agree with the use of i-doc in in journalistic differentiation, which indicates that it will be important to perceive this reality, in a more detailed way and with better questionnaires. The author thinks that, given the greater maturity of the master class, the results show a less enthusiasm associated and a more critical look about the proposal, which is revealing the need for further research. On the other hand, the author believes that is one evidence that the students can be skeptics to new approaches that involve adaptation or reorganization in their routines and habits. But it is necessary to investigate in a more targeted way. Efforts have been made to journalists attempting to think and act like web designers. Journalism students, in general, are used to telling stories in a traditional way (headline, beginning, middle, end) and doing it in a different way requires a different planning. It will be imperative

to become more engaged with new media design platforms and nowadays, forward-thinking educators are beginning to focus on the creation of i-docs (Gyori & Charles, 2017).

The reference value for the SUS questionnaire is 68, and below this value it is a sign that the usability is reduced or that it should be improved (Teixeira, 2015). The SUS obtained in the 11-year class is around 74 and in the master's class it is below 68, obtaining an approximate value of 63. This difference of usability in the two classes is interesting to analyze. The author considers that evaluating the usability of something that is not yet materialized is difficult and subject to error, either by the transmitter of the idea or by the receiver and interpreter. As Fabricio Teixeira highlights[27], SUS can be applied to test products, services, hardware, software, websites and any type of interface. The tested prototype, is a first iteration with the target audience, from the initial idea to its development, approximating what is proposed and expected to be performed, and therefore there is an associated limitation. That is why was very important to choose to apply different procedures throughout the work, trying to find patterns or differences in opinions. The author thinks that the fact that masters class did not interact as much with the prototype´s contents as the secondary school group did, mainly due to the limitations of Internet access and shorter duration of the event, contributed to the difference obtained at the SUS level. In addition, in the demonstrative production of the contents, despite the author tried to have a general approach, there was a greater focus on the curricular contents of the 11th grade class which may have influenced the results. But to clarify these details it would be necessary to move forward in the iteration and to materialize a new test phase, more directed and specific to each group. And with a better prototyping, more functional.

In any case, the author considers the SUS results encouraging, indicating that the overall purpose has been achieved, at this initial phase, although improvements must be made in future. The results obtained are valid in the context in which they were obtained and given the reduced sample involved, they cannot be generalized. The author considers that it will be of extreme importance to replicate new studies with this approach, with structured and transdisciplinary teams, and it is necessary to deepen the theme in a systematic study to obtain more specific results.

In relation to RQ2 and RQ4, the main annotations developed by the author are:

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[27] Available in: https://measuringu.com/sus/

- RQ2: What added value and constraints are created with multimedia hybrid format when addressing plant blindness, in the context of this project?

Considering one constraint that was pointed out from one student, in 11-year classroom - that we should not interact too much with the technology otherwise we can lose the notion of life – the author wants to highlight that the main purpose of this study is to research how technology can be a valuable medium to establish connections between online and offline world, that is, considers the use of technology as a facilitator of a responsible dialogue and promoter of a greater social awareness about the importance of Botany as a socio-economic and environmental resource, which cannot be underestimated. As Jane McGonigal remembers in the conclusions of her book "Reality is Broken – Why Games Make Us Better and How They Can Change the World" the primary functions of games are: "to provide real positive emotions, real positive experiences, and real social connections during a difficult time." And so, the author think is possible, with all the involved socio-technological challenges, to promote that dynamic in education context.

In a medium as plural as the Internet, there are also more and more threats to credible, reliable communication. Anyone can produce and disseminate content in this ecosystem. The author argues, in this sense, the need to create conditions and ensure technical and human resources that can ensure a normalization, in the future even be able to certification, in the use and dissemination of the i-doc format in science communication. In the Portuguese case, there is a manual of good design practices for journalism applied in webdocumentary[28], which resulted from a master's work (A. d. L. C. da Rocha, 2017), and is a relevant contribution from the perspective of the author, stimulating reflections and new actions in this field.

Other constraints were annotated in the interviews with the respective professors, like the need for more adequate classrooms, better equipped and with better access to the Internet, and on the other hand, the lack of time and the weak specific training of teachers in this field. António Granado concerned the time required and associated costs associated to one project like this work. Pointed out the fact that external financial support will always be necessary to implement it.

In relation to the value added by the proposal associated with this project, the author recalls the two drawn trees, obtained in the focus group of the two groups, and considers

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[28] Available in: https://paginas.fe.up.pt/~up201109749/manual_boas_praticas/index.html

them the highest value that she can discern in this phase of the project: the voice of her target audience. The author considers that the results in both questionnaires and interviews reinforce the premises that were the founding roots of the objectives outlined in this project. And, in this perspective, despite the associated limitations, the author considers that the action-research was aggregator and opened horizons for other studies.

The author argue that the concept of the project can be useful for science education and communication, being necessary to adapt to a target audience and specific objectives. Multimedia objects may facilitate the understanding of complex problems as they offer different information that can be used in layers, according to the needs and choices of users. Users that are active agents in the communicative process. One constraint that appears with non-linear narratives is in relation to the issue of authorship, but that detail is not relevant in this work, because the author defined since the beginning the possibilities of interaction and participation for her users.

The author also thinks that it will be interesting to explore the i-doc within the framework of institutional scientific communication, in a creative way that can stimulate public interest.

- RQ4: What are the main causes of "plant blindness" and which effects it can cause, particularly in the regular teaching of botany and associated sciences?

The students not only identify causes of the plant blindness problem, but also indicated possible ways of minimizing it. In two different events and with participants with demarcated socio-demographic characteristics, causes and possible solutions were pointed out, some converging in both groups. The lack of investment and appreciation of the subject, not only financially but also in terms of human resources, was common to both groups. The fact that it is a complex problem and does not have solutions that are easy to reach in the short term is another problem that the author underlines in the results. The need for greater dissemination of issues associated with botany and its importance in economic and social terms has been emphasized, as well as greater emphasis on training, not only in academic settings. In the context of the 11-year class, the students' willingness to participate in more dynamic classes that promote autonomy and greater responsibility was evident, which reinforces the author's opinion regarding the need to implement, with greater assiduity and continuity, educative practices in inquiry-based approaches, using innovative tools and stimulating Responsible Research and Innovation (RRI).

Below, is an overview analysis table, which resulted from a reflection by the author, with the strengths and points to be improved in upcoming actions:

XploreDesign4SciComm	
Strenghts	**Improvements**
Relevance of the Proposal for Society	Refine the Approach
Original Empirical Contribution	Improve Prototyping
Potencial to Implement the Idea	Partnerships and Funding
Variety of Results	More targeted Actions
Time Management	Better Use of Technology
Application of Knowledge	Transdisciplinary Team

Table 8 - Analysis table of the work project

The simplicity or complexity of multimodality used in interactive systems should be adapted to the context and objectives. The author believes that simplicity, in some contexts, may be even more beneficial, but only by experimenting and testing, in a consistent and systematic way, so that we can get to know its potentialities. Isolated and time-separated actions will not be productive, in her view, and it is imperative to follow the maturity of the market, to monitor technology and its potential, for the well-being of society.

To refine the prototype, it would be important to perform a heuristic analysis with specialists, based on the 10 heuristics of Nielsen, to verify and improve the effectiveness and efficiency of the proposed interfaces and dynamics.

In the feedback that the author received from several colleagues with whom she shared her prototype, many were the opinions and suggestions. The choice of platforms to develop was one of the key factors, as it greatly influences the software to be used so that it is possible to express the dynamics proposed in the various interfaces. The limitation associated with the functionalities of the chosen platforms was another point, especially the free versions. The improvement of a more functional prototype was another tip to consider, an also the refinement of questionnaires. Attention to the quality and design of sound is another vital factor in defining such a project.

The author applied her knowledge, had to make several decisions during the process and this approach reinforced her skills. There are no perfect formulas and the ideas to be

implemented should go step by step, in an iterative process. The implementation of an idea is always a difficult phase, but not impossible. A very useful feedback and that the author was very pleased to receive from her colleague José Maia, because it was an indicator that he understood the concept of this project, was this sharing: "I read your project, I think it is ambitious without doubt, but I remind you that the timing for a project of a master's degree is very short. Thus, a project of this size should be implemented in phases, addressed as a pizza, primarily the basis, solid and functional, and then, gradually, the ingredients.".

"There is a lack of a global and transdisciplinary understanding of design in order for Bonsieppe's (1992) omen to become reality: design as the fundamental new discipline of the 21st century, replacing mathematics with the transdisciplinary and foundational role it has had in science since the 17th century" (da Silva Vieira, 2018, p. 102).

Future Work

The author considers, according to research developed by several authors referred throughout this work, that the results of her work are consistent with the lines of action, premises and arguments presented in the theoretical section. There are no static formulas, and the interactive documentary format, alone, will not work miracles, but, without experimentation, without auscultation, we will not have results that can reinforce, or refute, the premises and arguments associated with this communication proposal. To stimulate autonomy, critic thinking and ability to realize ideas and projects, it is necessary to give conditions and invest, and nowadays both in the education sector and journalism sector, the time factor is a valuable resource, beyond the limitations, not only financial, that persist in the two areas of activity.

In education, timetables, curriculum contents and objectives of students and teachers are often not consistent with the changes that are desired. How will it be possible to introduce new dynamics, enhancing improvements, if many schools and their players still find it difficult to meet the current objectives? In Portugal, curricular flexibilization is a path that is being introduced to schools and it will be interesting to explore this option in the context of this project, in future studies that the author hopes be able to develop. These two references[29] reinforce the author´s perspective about the importance of storytelling in education. One another consideration that the author wants to point is the National Cinema Plan (Plano Nacional de Cinema)[30] which have, in the author´s perspective, convergent objectives with her line of action associated to this project. The future of Education and Skills project[31] and the Portuguese project "A Voz dos Alunos"[32] launched in November 2016, are realities that the author considered in her research design.

In journalism, maximizing profit is another limiting factor when thinking about new forms of expression and communication. Journalistic contents that exploit interactivity and multimodality by adding gameplay characteristics are still scarce, and so is one important field to explore, studying and creating links between theory and practice that can add value do this professional activity. The university can play a crucial role in establishing links between the academic community and society, particularly with the journalistic industry. Exploring new

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[29] Available in: https://www.labster.com/blog/storytelling-in-education/
https://www.labster.com/blog/how-science-teachers-can-use-storytelling/
[30] Available in: http://www.dge.mec.pt/plano-nacional-de-cinema
[31] Available in: http://www.oecd.org/education/2030/
[32] Available in: https://www.dn.pt/lusa/interior/projeto-a-voz-dos-alunos-permite-informacao-importante-para-melhorar-sistema---ministro-8480128.html

means of financing, in addition to advertising, according to the author is a way to consider, which can create conditions for more detailed studies and prove the viability and sustainability of these new emerging formats. If we do not change the *status quo*, we will hardly leave this "monotonous wheel" in which models of communication are repeated. Civil society can be involved in this process, being encouraged to express ideas and the issues that are considered urgent to clarify and communicate, in a more effective way. This project focused its attention on the school community because it considers that it is extremely important to stimulate the critical sense and the responsibility of the students, the sooner the better. The challenges are immense, digital literacy and media literacy are not immediate solutions, they can even bring more challenges as Danah Boyd[33] alerts: "If we're not careful, "media literacy" and "critical thinking" will simply be deployed as an assertion of authority over epistemology ". In this scenario, the author reaffirms the need to explore and better understand different ways of building knowledge. Although she is not a journalist, she considers, given her academic background and professional activity, that she can be integrated into a multi and transdisciplinary team, and can act in a convergent and more effective way, within the framework proposed in this work.

Partnering, crowdfunding or applying for European funds are alternatives to consider in the short term, that can accelerate the establishment of this project. Interactive documentary can improve awareness about social issues, there is a lack of use of this specific format in science communication and is needed further investigation about that approach, to connect people to identity, memory and places and promote plural perspectives about one specific subject (Casella, 2018).

The author feels motivated with the development of this work that considers to be a structuring phase in her academic formation, concretely in Science Communication. This project, in her view, is a stimulus to follow the PhD level, studying and deepening how technology and recent advances can contribute to the enrichment of educational practices, school success and promotion of a more cohesive and responsible society, with focus on human centered design.

In the absence of an own definition and taxonomy established for the format of the interactive documentary, the author thinks that it will be of great utility to study in more depth what kind of interactivity that will best adapt to the context of regular education, in the ambit of scientific education in Botany and associated sciences. The understanding of

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[33] Available in: https://points.datasociety.net/you-think-you-want-media-literacy-do-you-7cad6af18ec2

the immersion variable will be another detail to consider, since the author believes that depending on the level of interactivity proposed, the associated immersion may have some correlation, as well as the success of the participation manifested by users, but at this stage it is only a possible line of research to consider. It will be of great importance to create conditions for articulating theory and practice in specific actions, that promote greater clarification of ambivalent concepts such as interaction, immersion, participation, among other. The author believes that the interactivity-immersion-participation triangle may be common to any proposed taxonomy, and that the combination of these three variables can be an interesting contribution as a basis for analyzing possible combinations in a well-defined context and purpose, having as a reference the work developed by (Soler-Adillon, 2017).

In her meeting with DIFR, in relation to innovative communication proposals for Ajuda botanical garden (JBA), two main lines of action were defined. Actions outside JBA: to carry out an urban intervention using technology, science and art in unexpected cities places, such as squares, subway exits and shopping centers. Several ideas emerged, such as creating digital, physical and virtual micro-gardens, producing "live infographics", such as associating the age of a tree with remarkable periods of our national and / or international history, providing video mapping shows, using light to map existing plants or created virtually. Another idea is to map green routes of the cities promoting challenges to the citizens, invited them to explore a certain zone of one city and to realize objectives. Regarding actions inside JBA, alternatives such as the production of non-intrusive (transparent) displays with sensors were considered and, after interaction of the visitors, some stimuli to be defined at the design stage, such as some contact or physical proximity, these displays react with different types of information providing experiences beyond oral and written communication, as well as aural, haptic and kinetic experiences.

EUROGARD VIII[34] - Eight European Botanic Gardens Congress: "Botanic Gardens, People and Plants for a Sustainable World" will occur in Lisbon in May 7th-11th, 2018. Several themes will be highlighted since there is a huge need to develop and/or adapt botanic gardens´ policies and practices. The author hopes her approach in this project may contribute for one of the major roles for botanic gardens: Education, and to promote awareness about the socio-environmental problems we face today.

"If designers and researchers do not sometimes fail, it is a sign that they are not trying hard enough - they are not thinking the great creative thoughts that will provide

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[34] Available in: http://www.eurogard2018.org/

breakthroughs in how we do things. It is possible to avoid failure, to always be safe. But that is also the route to a dull, uninteresting life" Donald A. Norman, The Design of Everyday Things.

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ANNEXS

ANNEX I - PILOT QUESTIONNAIRE SCRIPT ABOUT BOTANICAL GARDENS IN PORTUGAL

O primeiro jardim botânico português foi fundado:

a) na 1ª metade do século 18
b) na 2ª metade do século 18
c) na 1ª metade do século 19
d) na 2ª metade do século 19
e) não sabe/não responde

A fundação desse jardim botânico ocorreu em:

a) Coimbra
b) Lisboa
c) Porto
d) Santarém
e) Não sabe/não responde

Como se chama o primeiro jardim botânico português? (resposta em aberto)

Os jardins botânicos podem ser considerados museus científicos?

a) Sim
b) Não
c) Não sabe/não responde

Tem por hábito visitar jardins botânicos?

a) Sim
b) Não

Oficialmente, considera-se que os primeiros jardins botânicos na Europa foram criados em:

a) França
b) Inglaterra
c) Itália
d) Não sabe/não responde

A criação do primeiro jardim botânico em Portugal foi impulsionada (seleccione a(s) que considere de maior relevância):

a) pelo conhecimento científico
b) pelo saber prático dos técnicos
c) pelo poder político
d) pela combinação dos factores anteriores
e) não sabe/não responde

Na escala de 1 a 5, considera que os jardins botânicos têm um papel importante na dinamização de actividades culturais e de lazer para os cidadãos?

Com que frequência visita os jardins botânicos em Portugal, para actividades culturais e de lazer?

a) Frequentemente (pelo menos 1 vez por mês)
b) Ocasionalmente (3 a 4 vezes por ano)
c) Raramente (1 vez por ano)
d) Nunca

A sua idade corresponde à faixa etária:

a) 17 ou menos
b) 18-20
c) 21-29
d) 30-39
e) 40-49
f) 50-59
g) 60 ou mais

Qual é o seu nível de escolaridade?

a) Ensino Básico
b) Ensino Secundário
c) Ensino Técnico-Profissional
d) Ensino Superior (Bacharelato, Licenciatura)
e) Ensino Superior (Pós-graduação, Mestrado)
f) Ensino Superior (Doutoramento, Pós-doutoramento)

Os resultados podem ser visualizados online no url abaixo:
https://xploredesign4scicomm.files.wordpress.com/2018/03/questionariopiloto_jardinsb
otanicosportugueses.pdf

ANNEX II - EMAILS SENT TO DIOGO MELO, AFTER THE MEETING WITH THE DIFR TEAM
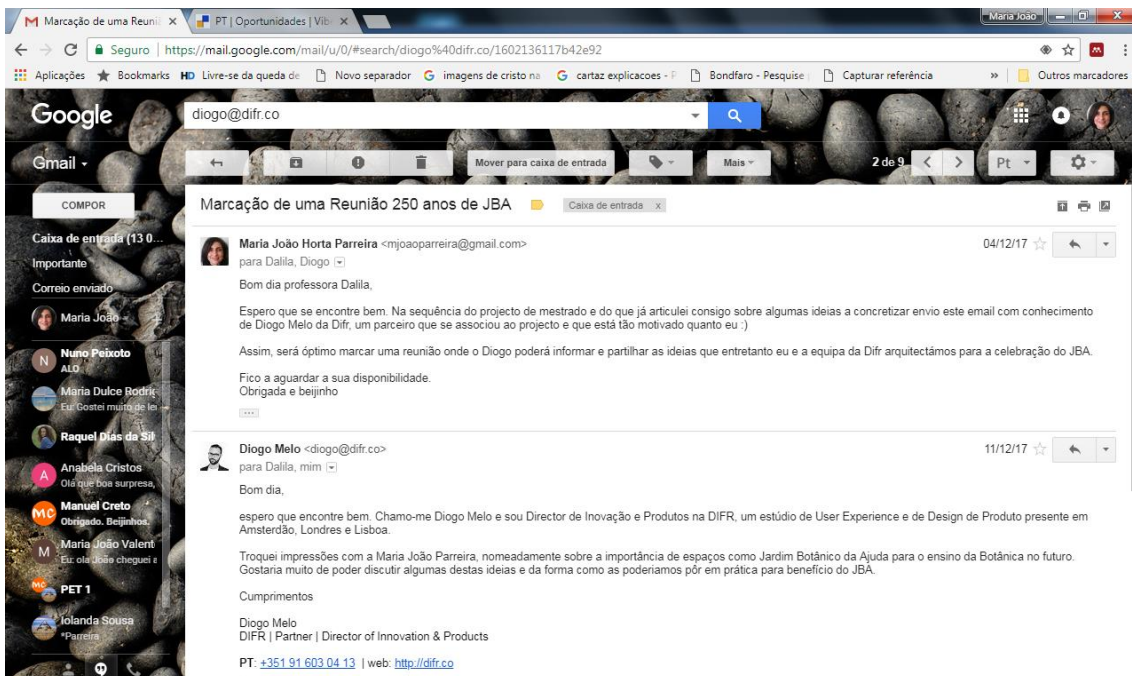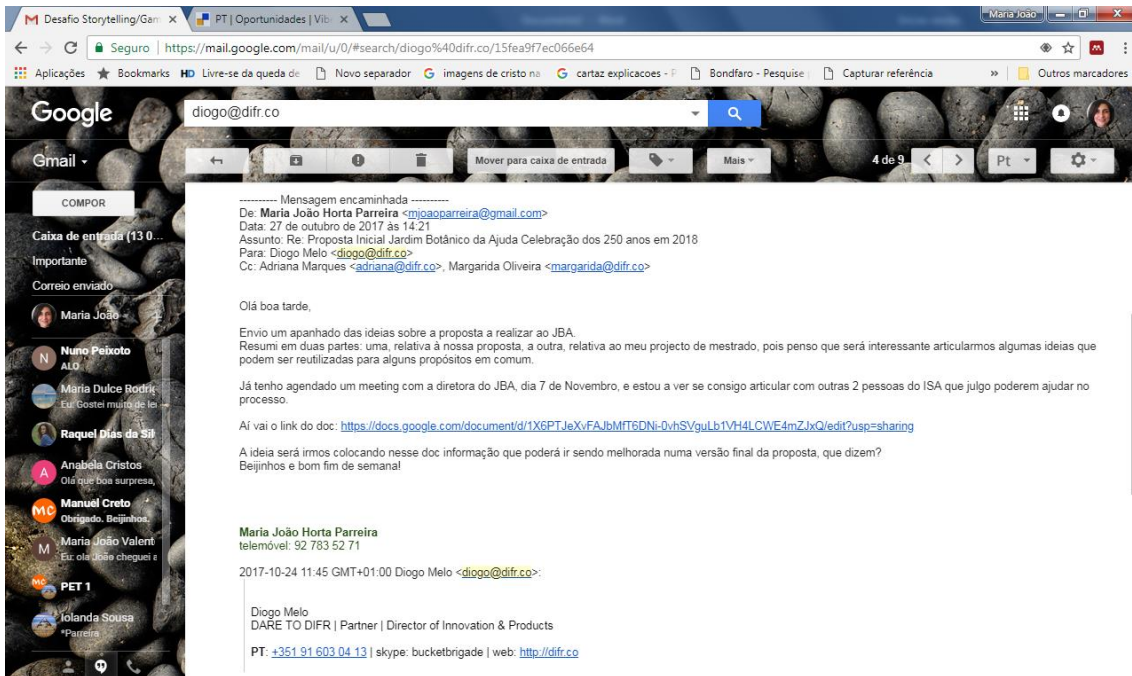
ANNEX III - EMAILS SENT TO AZAMBUJA SECONDARY SCHOOL BEFORE AND AFTER PROOF OF CONCEPT
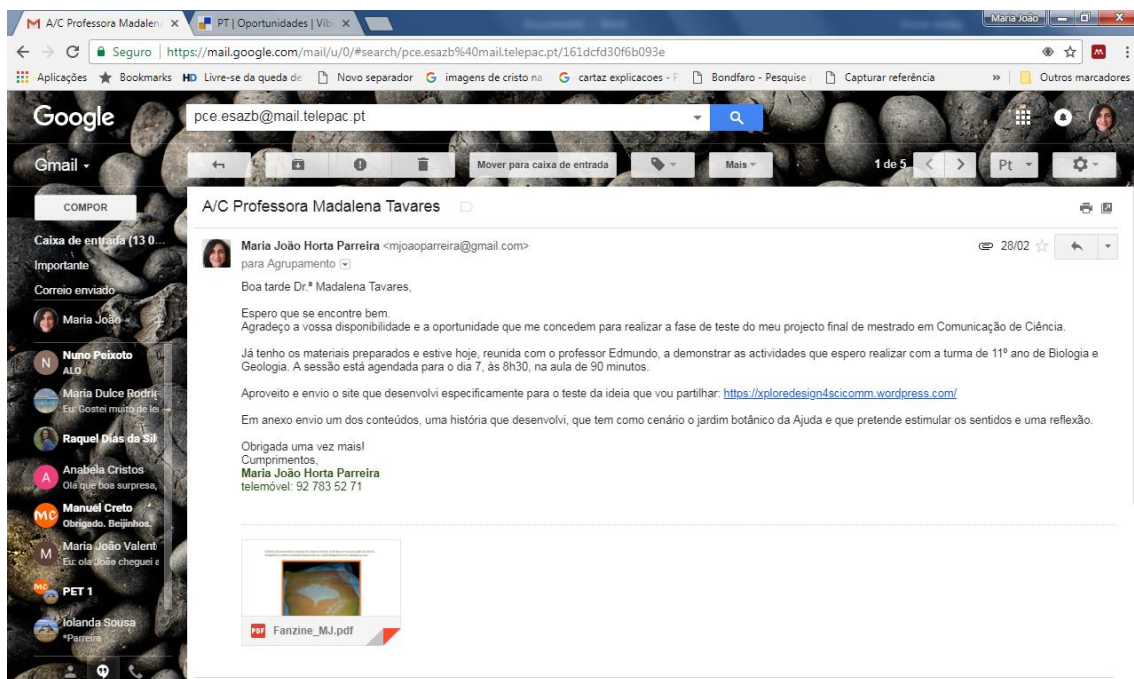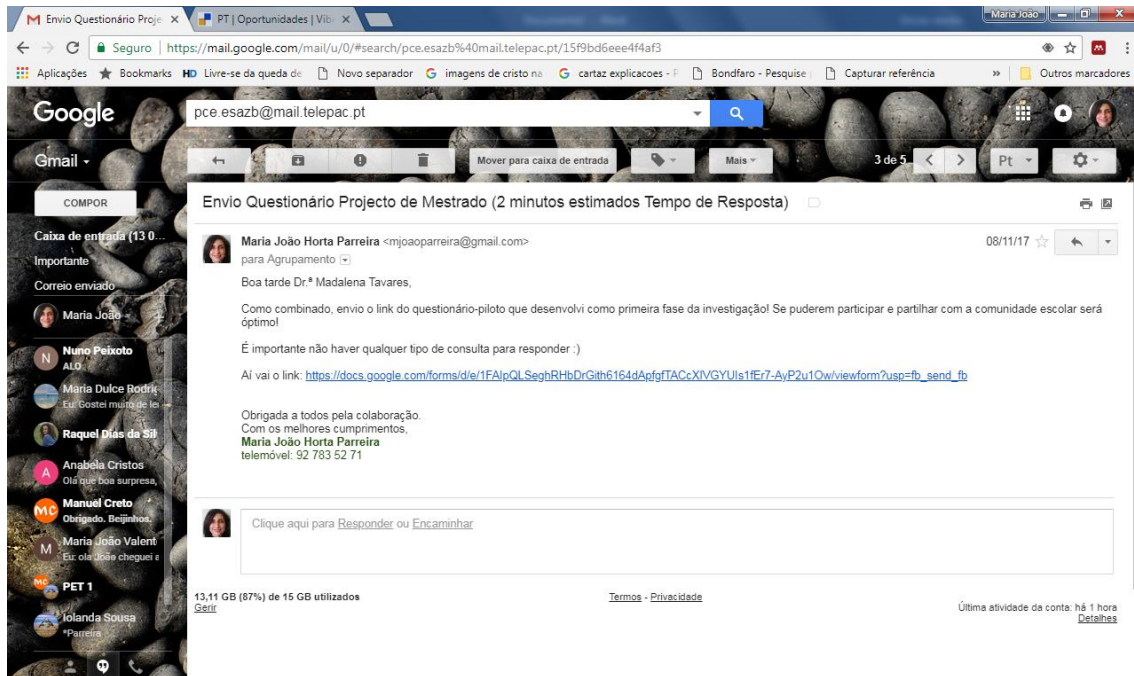
Projeto Híbrido Multimédia Teste em Sala de Aula Taxonomia/Evolução Plantas Caixa de entrada x

Maria João Horta Parreira <mjoaoparreira@gmail.com> 23/11/17
para emfcmartins

Olá boa tarde,

Como combinado, envio um pouco mais de informação relativamente ao projeto final de Mestrado em Comunicação de Ciência que estou a desenvolver.

De um modo muito resumido, a minha investigação é exploratória quanto à possibilidade de utilizar o formato i-doc (documentário interactivo) para estimular o interesse em Botânica (e ciências associadas) em 2 vertentes: em Educação, por um lado para potenciar o sucesso escolar (a nível do ensino secundário) e em Jornalismo, para induzir a responsabilidade dos meios de comunicação social para a Educação Ambiental. Vou investigar a potencialidade do vídeo 360º associado a outros formatos, como fotografias, sons, texto, infografias, tendo como referência a mediação entre o texto e o audiovisual. O tema principal para a produção do protótipo a testar será a celebração dos 250 anos do jardim botânico mais antigo em Portugal, e o protótipo Híbrido será depois testado em contexto natural de sala de aula, ao nível do ensino secundário (alunos de Biologia e Geologia de 11.º ano) e ao nível superior (alunos de jornalismo, licenciatura ou mestrado), para averiguar a usabilidade, a experiência de utilizador e ouvir as opiniões/sugestões dos alunos e do professor, saber quais os pontos positivos salientados e os que podem ser melhorados/adaptados (será interessante verificar em que contextos será útil usar esse formato a nível individual e/ou colectivo).

Assim, estimo que na 2ª quinzena de Janeiro possamos realizar um teste convosco. Eu vou articular o storytelling com mecânicas de jogo, lançando desafios aos utilizadores desse protótipo-híbrido como por exemplo identificar pedras (como o calcário e o mármore), descobrir algumas referências no jardim (como a mina de água), colocar por ordem algumas fotografias de plantas tendo em conta a evolução das plantas. Será algo simples, mas que pretenderá simular uma possibilidade real a ser aplicada.

Não sei se será necessário realizar algum processo formal para concretizar essa atividade convosco. Eu entretanto vou enviar um email à professora Madalena Tavares, mas sei que tem a agenda muito preenchida, se for possível articular consigo melhor (com o conhecimento de todos claro). Eu estou a desenvolver a investigação no iNovaMediaLab da Faculdade de Ciências Sociais e Humanas, da Universidade Nova de Lisboa, o meu orientador é o professor Paulo Nuno Vicente, aí vai o link do iNovaMediaLab: http://inovamedialab.org/

Aproveito e envio o link de um questionário-piloto que faz parte da investigação, também já enviei para a professora Madalena (o tempo de resposta estimado é de 2 minutos, sendo as respostas sem qualquer tipo de consulta associada), se puder colaborar e partilhar, agradeço: https://docs.google.com/forms/d/e/1FAIpQLSeghRHtbDrGith6164dApfgfTACcXIVGYUls1fEr7-AyP2u1Ow/viewform

Vamos mantendo o contacto, foi um prazer conhecê-lo pessoalmente, obrigada!
Até breve,
Maria João Horta Parreira

Edmundo Martins 10/03
para mim

Olá Maria João!

dentro das minhas limitações de tempo, aqui vão as respostas, foi o possível, infelizmente esqueci-me de avisar de novo os alunos, mas provavelmente os que não preencheram são os mais baldas.

Vou organizar e resumir os resultados e depois ofereço à escola para vocês ficarem com uma recordação do evento.
Aí vão as 11 Questões, são uma referência, podes adaptar as respostas como sentires melhor, ou articular algumas:

- Esta actividade contribuiu para conhecer o Jardim Botânico da Ajuda e as potencialidades na utilização do espaço para complementar as suas aulas? **Sim, certamente, infelizmente desconhecia esta instituição e as suas potencialidade pedagógicas.**

- Já desenvolveu alguma aula num jardim botânico ou noutro espaço verde? Considera apelativa essa abordagem, física ou virtualmente? **Sim, no Jardim Botânico da Universidade de Lisboa. Considero a abordagem virtual essencialmente para complementar a física, no pré, durante ou pós visita.**

- Costuma utilizar material multimédia e audiovisual nas suas aulas de Biologia/Geologia ou utiliza com maior frequência os suportes escritos? **Com maior frequência o audiovisual, pois a imagem é muito necessária, os suporte escritos são um complemento. Em relação aos meios audiovisuais considero-os pouco interactivos.**

- Considera os meios audiovisuais complementos válidos em relação ao suporte escrito, concretamente em conteúdos multimédia via Internet, em contexto de sala de aula? **Sim, sem qualquer dúvida. Existem algumas limitações a nível de recursos tecnológicos que limitam estas abordagens (disponibilidade e velocidade da internet, ...)**

- Considera relevante a ideia conceito que foi testada? Pensa que será uma mais valia para a sua actividade como professor, utilizar a proposta deste projeto, sem perder o rigor científico? **Sim, pode motivar para a visita, durante ou consolidar no pós-visita ou permitir percursos de investigação autónoma.**

- Na sua opinião, poderá esta estratégia contribuir para um maior envolvimento dos alunos com a temática da Botânica e ciências associadas? **Sim, como mais uma estratégia que vai de encontro as características de alguns, como foi visível na sessão**

- Na sua visão, o formato i-doc poderá ser de maior utilidade aos alunos a nível individual ou colectivo? Tem alguma sugestão nesse sentido? **Como**

vi

ANNEX IV - EMAILS RECEIVED FROM JOSÉ MAIA AND PAULO BALA, TWO COLLEAGUES THAT I MET ON JUNE 2017 IN A INOVA MEDIA LAB TRAINING, WITH FEEDBACK ABOUT MY CONCEPT PROJECT

josé maia <jgmaia@gmail.com>
para mim
24/11/17

Olá Maria João

Estive a ler o teu projecto, acho-o ambicioso sem dúvida, mas relembro-te que o timing para um trabalho de projecto de um mestrado profissionalizante é curto, muito curto mesmo…facto pelo qual um projecto desta dimensão tem de ser implementado por fases, ou seja abordado como uma pizza…primeiramente a base, sólida e funcional e, depois, gradualmente os ingredientes. A fase de planeamento, ou seja ideia está bastante avançada, falta no entanto o estabelecimento de um cronograma de desenvolvimento e isto não cabe num semestre…
Assim deves começar por definir:

- PLANEAMENTO
 a) etapas
 b) cronograma

- DESIGN

a) um produto desta natureza requer um investimento substancial no design e isto vai levar tempo, um bom levantamento fotográfico, tratamento das Marcas associadas, selecção de cores, UI design.

- AUTORIA
a) Colocar as coisas a funcionar

- TESTES e Validação

Com este cronograma vais ter claramente uma ideia mais clara de como articular e temporizar as coisas, sem derrapagens a nível temporal e sem passar por aquela fase de saturação dos projectos, onde os mesmos se tornam effectivamente um fardo.

Bem em termos de Jogos HTML5, ou seja para páginas web, há uns anos usávamos o flash actualmente o flash chama-se Adobe Animate e permite fazer os jogos por exemplo em Canvas ou webGL, no entanto é um software com curva de aprendizagem muito acentuada, aí seria possível certamente executar isso. Em termos de frameworks HTML5 há o Phaser (http://phaser.io) com alguns conhecimentos de JS a coisa resolve-se, Há outra solução o Construct2 (https://www.scirra.com/) que te permite criar jogos sem programação.
O vídeo 360 para web com hotspots, aqui vai uma solução: https://www.omnivirt.com/blog/360-interactive-video/. Envio-te também um script que faz isso (HTML e PHP, pois é para web coloca-o num servidor que corre), está aqui : https://meocloud.pt/link/4222cd72-1c89-42e2-b2e7-cfd269a73fed/VR-View-360-Video-with-Hotspot-Navigation-1.1.zip/

Paulo Bala <paulo.bala@gmail.com>
para mim
29/11/17

Olá Maria João

Já tive a ver os teus documentos e eu de certeza que tenho cegueira botânica 😊

Fiquei com algumas duvidas em relação as plataformas para qual estas a pensar desenvolver pq para mim isso é um elemento que vai pesar muito a escolha de software e o tipo de interacções que estás a pensar usar.

A ideia que fiquei era que seria um website (que acedes através de um computador, tablet ou mobile), e que irás ter aquela interface de mapa do jardim onde depois tu escolhes os elementos (agua, pedra, plantas), que dão acesso a uma fotogalerias, jogos, video 360º, etc. Os conteúdos que queres (fotos, videos, jogos) parecem-me fáceis de programar/fazer, acho que a complexidade que não estás a espera é a quantidade de plataformas que queres atingir.

Opção A)
Por exemplo, o Unity é um game engine que é muito bom se quiseres fazer uma aplicação android, conteúdo VR ou jogos mesmo para computador, porque serve como uma camada de abstracção daquelas funcionalidades mais detalhadas das plataformas (por exemplo, ele oferece VR support que ira suportar diferentes plataformas sem que o teu código fique um bicho de sete cabeças). Contudo, ele é horrível para aplicações que sejam para web em webgl/html5 pq embora permita faze-las, o Unity não é desenhada com esse tipo de aplicações em mente (no passado era, agora eles concentram-se mais em outras plataformas); não sei bem como tá agora, mas até pouco tempo o unity nem suportava o chrome.

Opção B)
Existem plataformas mesmo para web documentaries como o Klynt http://www.klynt.net/ ou o korsakow http://korsakow.com/, mas acho que vão ser um pouco simplistas para aquilo que queres pq tens jogos, videos 360, etc, e normalmente estas plataformas tão só desenhadas para videos. Existe o http://www.wondavr.com/ , que acho que eles tem algum tipo de parceria com o Klynt, que dá para conteúdo VR mas penso que vai ser um pouco limitado se quiseres a parte de jogos. Este tipo de plataformas como são dirigidas mais para criadores, simplificam o processo através de interfaces wysiwyg (what you see is what you get), só que vais ter problemas se quiseres estender a plataforma e ter conteúdo mais custom.

Opção C)
Portanto se queres mesmo a situação de ser um website com conteúdos VR e tal, acho que vais precisar de procurar por bibliotecas javascript que sirvam como suporte para o site e depois usar bibliotecas separadas para as funcionalidades como os videos 360º e os jogos. Claro, que usar várias bibliotecas vai aumentar um pouco a complexidade de programação.
algumas bibliotecas que te podiam interessar seriam:
https://html5gameengine.com/ -> bibliotecas js para jogos
https://aframe.io/ -> para conteúdo WebVR, sendo compatível com Vive, GearVR, Cardboard, Rift, desktop, etc
https://facebook.github.io/react-vr/index.html -> tb para webVR

Cenjor

Certificado de Qualificações

Formação Modular

(Portaria nº 283/2011, de 24 de outubro)

Certifica-se que Maria João Horta Parreira, natural de Portugal, nascida em 08/03/1974, com o N.º de Cartão de Cidadão 10107879 0ZZ3 válido até 11/03/2018, concluiu com aproveitamento, em 26/02/2018, no(a) CENJOR - Centro Protocolar de Formação Profissional para Jornalistas, a(s) seguinte(s) unidade(s) de formação de curta duração do Catálogo Nacional de Qualificações, com início em 29/01/2018.

Componente de Formação	Código	Unidades de Formação de Curta Duração	Carga horária
Tecnológica	9298	Técnicas de escrita jornalística	25
	9309	Modos de comunicar	50

Lisboa, 06 de março de 2018

O(A) Responsável pelo(a) CENJOR - Centro Protocolar de Formação Profissional para Jornalistas

Deolinda Almeida

(Assinatura e selo branco ou carimbo)

Certificado n.º 19/2018

REPÚBLICA PORTUGUESA

ANNEX VI - PRINT SCREEN OF SOME PROTOTYPE WEBSITE INTERFACES WWW.XPLOREDESIGN4SCICOMM.WORDPRESS.COM

X

Browser window 1 (top):

Caixa de entrada (13 097 ×   Jogos Botânicos   ×   Maria João

← → C   Seguro | https://xploredesign4scicomm.wordpress.com/jogos-botanicos/

Aplicações   ★ Bookmarks   HD Livre-se da queda de   Novo separador   G imagens de cristo na   cartaz explicacoes - P   Bondfaro - Pesquise   Capturar referência   »   Outros marcadores

Assim, clique nos óculos para abrir os jogos e divirta-se! Mais abaixo está disponível um jogo tradicional, uma Sopa de Letras com os nomes de várias famílias de plantas existentes na colecção botânica do JBA (no futuro poderá ser interactiva).

A **Sopa de Letras - Famílias da Plantas da colecção do JBA** pode ser descarregada **aqui**.

E a respectiva solução neste link.

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articulate 360

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FOLLOW

Este projecto está a ser desenvolvido no **iNOVA Media Lab**, um laboratório de investigação aplicada na FCSH-NOVA e o meu orientador é o professor Paulo Nuno Vicente.

Este é o **link** da minha página pessoal.

Uma experiência audiovisual no JBA

Slideshow de fotos

Browser window 2 (bottom):

Caixa de entrada (13 097   Prova de Conceito   ×   Maria João

← → C   Seguro | https://xploredesign4scicomm.wordpress.com/prova-de-conceito/

Aplicações   ★ Bookmarks   HD Livre-se da queda de   Novo separador   G imagens de cristo na   cartaz explicacoes - P   Bondfaro - Pesquise   Capturar referência   »   Outros marcadores

Prova de Conceito

Follow
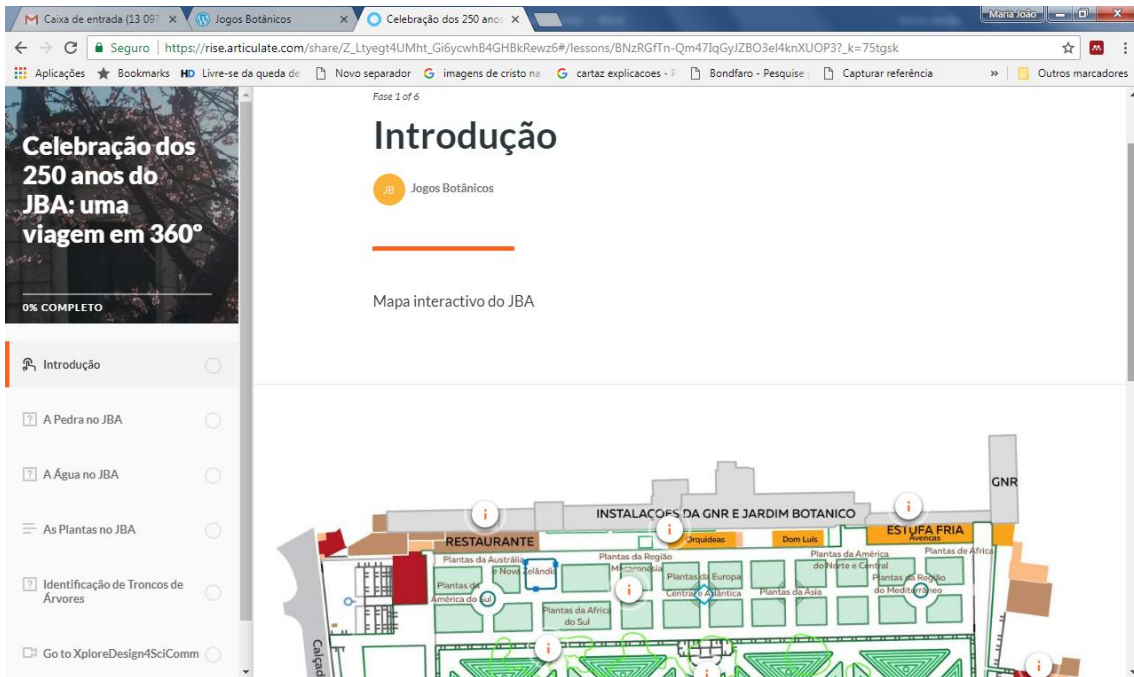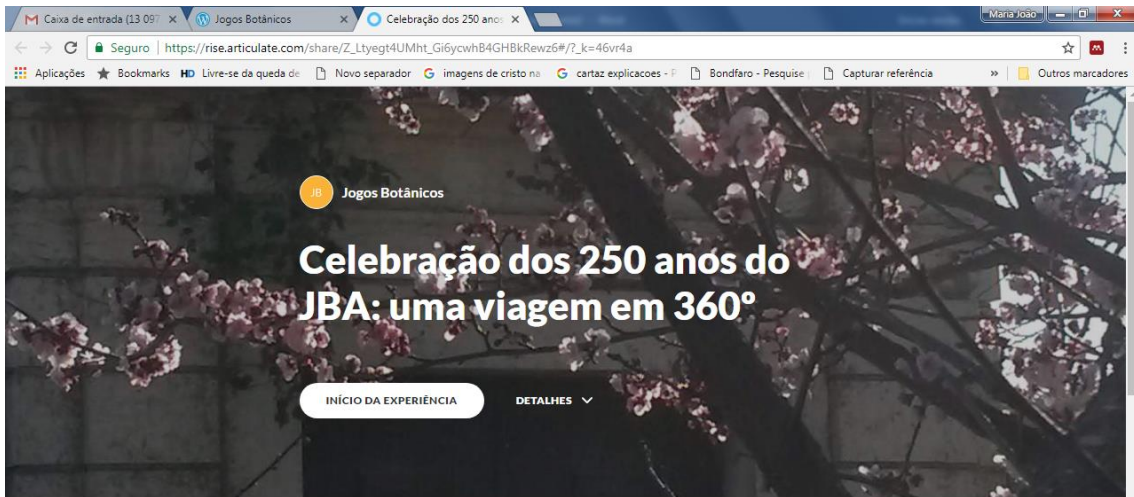
A imagem abaixo representa um resumo do processo *Design Thinking* desenvolvido neste projecto. Esta é uma fase *Test* ! Para realizar esta fase, deve seguir estes dois passos:

1. **Clique na imagem** "We are all DESIGNERS!"para abrir o protótipo do i-doc híbrido a testar!
2. **Clique na outra imagem, mais abaixo**, para abrir o guião complementar!

We are all DESIGNERS!

EMPATHIZE

DEFINE

IDEATE

PROTOTYPE

TEST

Learn about the audience for whom you are designing, by observation and inteview. *Who is my user? What matters to this person?*

Create a point of view that is based on user needs and insights.

Brainstorm and come up with as many creative solutions as possible. *Wild ideas encouraged!*

Build a representation of one or more of your ideas to show to others. *How can I show my idea? Remember: A prototype is just a rough draft!*

Share your prototyped idea with your original user for feedback. *What worked? What didn't?*

Google Translate

Seleccionar idioma ▼

Tecnologia do Google Tradutor

Autora do Projecto

Este projecto está a ser desenvolvido no **iNOVA Media Lab**, um laboratório de investigação aplicada na FCSH-NOVA e o meu orientador é o professor Paulo Nuno Vicente.
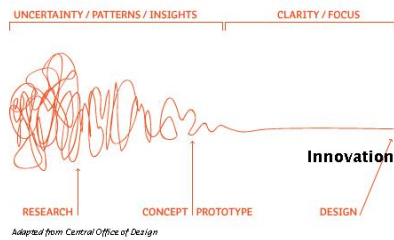
Um pavão a voar no JBA !

O voo e o canto do ...

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UNCERTAINTY / PATTERNS / INSIGHTS   CLARITY / FOCUS

Innovation

RESEARCH   CONCEPT PROTOTYPE   DESIGN

Adapted from Central Office of Design

Uma experiência audiovisual no JBA

Slideshow de fotos

Depois de observados os conteúdos passamos à fase dos inquéritos, cada turma deverá responder a 2 breves inquéritos:

- **TURMA 11º ANO BIOLOGIA E GEOLOGIA | ESCOLA SECUNDÁRIA AZAMBUJA:**

7 Março 2018

Questionário Turma Biologia e Geologia do 11º ano – clique para ver os Resultados

Inquérito System Usability Scale (SUS) – clique para ver os Resultados

ANNEX VII - SCRIPT ABOUT TECHNIQUES USED IN PROOF OF CONCEPT

GUIÃO: técnicas utilizadas na prova de conceito

O objectivo é testar a viabilidade da ideia, se a proposta em questão acrescenta valor e utilidade, antes de qualquer implementação, para minimizar erros e custos desnecessários e adaptar com maior sucesso às necessidades dos principais utilizadores. Serão utilizados diferentes métodos e técnicas para potenciar a fiabilidade dos resultados (online e presencialmente). Em caso afirmativo será considerada a implementação futura de um protótipo funcional com base nos principais resultados obtidos no teste do conceito.

O foco estará na avaliação de usabilidade do protótipo inicial, que será realizada através de:

- **Focus Group, Questionários e Entrevistas (semiestruturadas)**

Eficácia – o ideal será que as tarefas propostas sejam realizadas com o mínimo de assistência

Eficiência – o ideal será que as tarefas propostas e os recursos utilizados sejam optimizados entre si

- **System Usability Scale (SUS)**

Satisfação – averiguada através do **inquérito SUS e Focus Group** (verbalizações dos participantes)

- **Entrevistas semi-estruturadas**

com os **Professores** das 2 turmas a realizar a avaliação do protótipo: verificar a adequabilidade da ideia a cada contexto e explorar a opinião e sugestões, nomeadamente em contexto de ensino de Biologia e Geologia (ao nível do ensino secundário – 11º ano) e em contexto de ensino de Jornalismo (ao nível do ensino superior, mestrado) (entrevista será diferenciada para cada contexto)

Alunos - Procedimentos em sala de aula:

O teste em sala de aula será realizado em **duas fases**, uma relativa à avaliação do protótipo inicial e, uma segunda fase, exploratória, em que se pretende desafiar os alunos a

procurar possíveis soluções de melhoria para a sua aprendizagem e envolvimento com a temática Botânica.

1ª Fase:

- Início da sessão: realizar uma introdução explicativa do contexto e do propósito da acção, reforçando a ideia que o que estará a ser testado e avaliado é a ideia central do projecto, manifestada através do protótipo, e não os participantes. (se necessário proceder aos procedimentos relativos aos termos de confidencialidade, consentimento informado e de responsabilidade, pois durante a sessão poderão ser recolhidos alguns materiais, como fotografias). Fazer uma breve introdução ao documentário interactivo e das possibilidades associadas, com foco em contexto escolar, muitas ainda por explorar. (tempo estimado: 10 minutos)

- Partilhar o **site desenvolvido para a prova de conceito** e especificar as tarefas que deverão ser realizadas com os conteúdos propostos nos respectivos separadores: algumas <u>reflexões e questões em aberto</u> sobre a importância da botânica e dos jardins botânicos e do seu potencial como espaços de comunicação de ciência, que poderão ser explorados em contexto escolar complementando as temáticas em estudo, <u>jogos botânicos</u>, e, após essa abordagem <u>observarem e analisarem o protótipo inicial (no guião: doc+ ppt)</u> que simula as interfaces e dinâmicas associadas ao planeamento e concepção do documentário interactivo proposto. No decorrer da observação:

- Os participantes podem interagir com o moderador, colocar questões ou pedir ajuda

- Cada participante estará a observar o protótipo no seu lugar, mas o moderador partilhará em simultâneo para a turma e irá explicando o objectivo de cada interface e dinâmica associada para reforçar a funcionalidade do sistema proposto e agilizar o processo

(tempo estimado: 20 minutos)

- Realizar de seguida o inquérito SUS, via presencial em folha (tempo estimado: 5 minutos)

10 perguntas – resposta na escala de Lykert 1 a 5

(1- Discordo totalmente, 5- Concordo totalmente)

Identificação no início (apenas com género e idade)

1. Penso que gostaria de utilizar este sistema nas aulas

2. Acho o sistema desnecessariamente complexo

3. Acho o sistema fácil de usar

4. Penso que precisaria de apoio para utilizar o sistema

5. Acho que as várias funções do sistema estão bem integradas

6. Acho que há demasiadas inconsistências no sistema

7. Penso que a maioria das pessoas aprenderá a utilizar facilmente este sistema

8. Penso que o sistema será incómodo de usar

9. Penso que será motivante utilizar este sistema

10. Penso que o esforço para utilizar o sistema será mínimo

Nas perguntas ímpares retira-se 1 valor ao valor indicado pelo utilizador para obter o valor final da resposta, nas perguntas pares o valor da resposta será 5 menos o valor indicado pelo utilizador. O resultado final será igual à soma de todas as contribuições das 10 perguntas multiplicado por 2.5. O valor de referência do SUS é de 68 pontos, abaixo desse valor é uma indicação de que a usabilidade do sistema está aquém do esperado. Este valor não é uma percentagem, apenas clarifica a facilidade de utilização do sistema em teste.

- Responder presencialmente ao questionário online (tempo estimado: 5 minutos)

Questionário online:

Turma 11º ano Biologia e Geologia

Identificação: género e idade

- Considera-se receptivo ao uso de novas tecnologias? Sim/Não

- Quais as categorias relativas a conteúdos audiovisuais online que mais procura (indique os 3 mais frequentes): música, notícias, redes sociais, ciência, entretenimento, informação em geral

- Costuma jogar videojogos? S/N

- Já tinha experienciado um documentário interactivo via Internet? Sim/Não

- Já tinha visualizado conteúdos em vídeo360? E com realidade virtual? E realidade aumentada? Sim/Não

- A observação do protótipo contribuiu para conhecer o JBA e promover um maior envolvimento com a temática (1-discordo totalmente/5-concordo totalmente)

- Considero que este formato será uma mais valia para desenvolver conteúdos inovadores que complementem as aulas de Botânica e ciências associadas, facilitando a compreensão dos conteúdos curriculares (1-discordo totalmente/5-concordo totalmente)

- Associar aos meios tradicionais utilizados nas aulas conteúdos audiovisuais interactivos será estimulante e potenciador da aprendizagem (1-discordo totalmente/5-concordo totalmente)

- Gostei da experiência (1-discordo totalmente/5-concordo totalmente)

- Gostava de vivenciar outras experiências deste género nas aulas, nesta e noutras disciplinas (1-discordo totalmente/5-concordo totalmente)

- Considero que os alunos para além de estudantes são cidadãos e podem participar de um modo activo, autónomo e responsável na construção de melhores oportunidades, em contexto escolar e na sociedade (1-discordo totalmente/5-concordo totalmente)

- Gostava de produzir com a minha turma e com o professor um documentário interactivo experimental sobre uma temática relativa aos conteúdos da disciplina Biologia e Geologia (1-discordo totalmente/5-concordo totalmente)

Turma mestrado em Jornalismo

Identificação: género e idade

- Considera relevante a ideia conceito que foi testada na sua turma de mestrado em Jornalismo? (1-discordo totalmente/5-concordo totalmente)

- Esta abordagem poderá acrescentar valor ao nível dos desafios e oportunidades que o Jornalismo e o seu ensino atravessa na actualidade? (1-discordo totalmente/5-concordo totalmente)

- Essa proposta poderá contribuir para um maior envolvimento com a temática da Botânica e ciências associadas? (1-discordo totalmente/5-concordo totalmente)

- Considera vantajosa a inclusão de interactividade nos conteúdos audiovisuais online?

- Já visualizou documentários interactivos via Internet? Sim/Não

- Já visualizou conteúdos em vídeo360? E com realidade virtual? E realidade aumentada? Sim/Não

- A observação do protótipo contribuiu para conhecer o JBA e promover um maior envolvimento com a temática (1-discordo totalmente/5-concordo totalmente)

- Considero que no contexto da ideia testada, explorar o documentário interactivo será uma mais valia para desenvolver conteúdos inovadores que promovam um jornalismo diferenciador e multidisciplinar (1-discordo totalmente/5-concordo totalmente)

- No contexto deste projecto, o documentário interactivo mais do que um suporte ou canal mediático digital, que representa a realidade, pode ser interpretado como um construtor e potenciador de conhecimento (acção epistemológica)?

- Considera o Design como essencial à planificação das relações comunicativas entre as pessoas e os objectos digitais emergentes? (1-discordo totalmente/5-concordo totalmente)

- Considera importante a responsabilidade do Jornalismo na Educação Ambiental e nas problemáticas associadas? (1-discordo totalmente/5-concordo totalmente)

- O conceito do projecto testado, no âmbito do Jornalismo, promove a cidadania como um motor importante na manutenção/recuperação das memórias que fazem parte da nossa história e cultura (1-discordo totalmente/5-concordo totalmente)

- No contexto da Educação para os Media, os media digitais para além de recursos pedagógicos são objectos de estudo que permitem compreender e interrogar as formas de construção do sentido que originam (1-discordo totalmente/5-concordo totalmente)

- Já produziu algum documentário interactivo online? Sim/Não

- Na sua opinião, qual seria a melhor forma de produzir um documentário interactivo? Implementação de código puro/Ferramentas online/NS-NR

Tempo total estimado para a 1ª sessão com alunos: cerca de **45 minutos**

Intervalo

2ª Fase: Focus Group

Tempo estimado: cerca de 45 minutos

Utilizando a teoria "Cegueira Botânica" é pretendido discutir esta temática com a turma e explorar a criação de ideias, aplicando o Design Thinking com a

premissa "Design thinking is basically a problem-solving approach to achieve creative solutions".

Este pode ser um problema importante, até crítico, quando várias pessoas na sociedade são afectadas de um modo muito negativo (vejamos por exemplo o problema recorrente dos fogos no nosso país, com diversas causas, entre elas as tensões associadas às plantas escolhidas para as diversas áreas florestais e à sua manutenção).

Pode também ser um problema negligenciado, não porque está a ser ignorado pela sociedade, porque até existem pessoas que têm actuado no âmbito, mas porque ainda não se obtiveram resultados satisfatórios.

A tentativa de conhecer as causas deste problema pode ser de grande utilidade e ter impacto ao nível da percepção de outros problemas associados, o que será de grande utilidade.
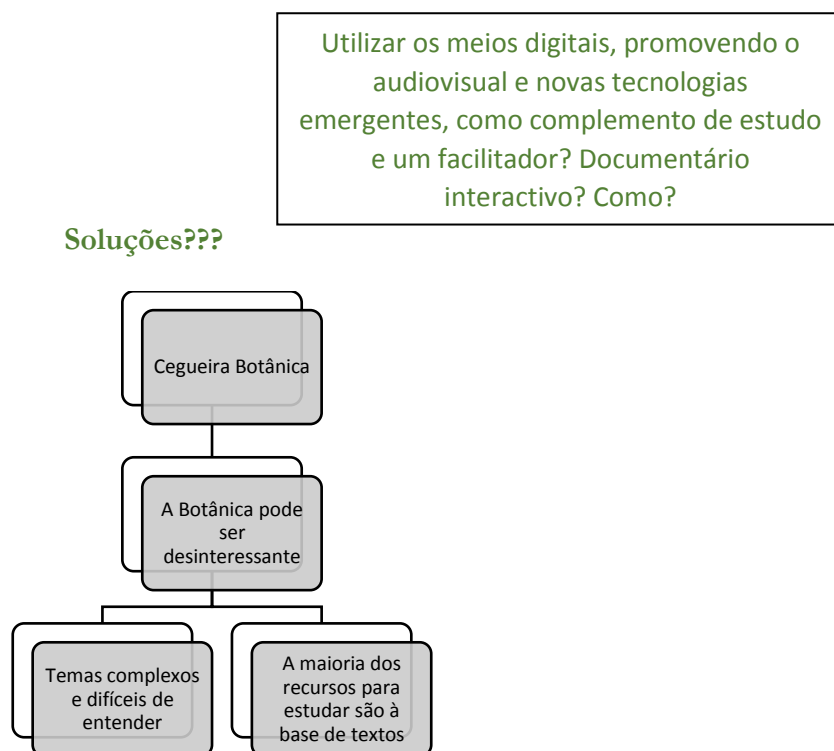
Objectivo: Reduzir a Cegueira Botânica

Como criar valor para a Sociedade? (adaptar ao contexto de cada turma, por exemplo na de 11º ano, como criar valor nas aulas sobre botânica? Quais as limitações e desafios? Na turma de jornalismo, como desenvolver conteúdos inovadores que possam promover uma maior consciência sobre esta problemática? Quais as limitações e desafios?)

O objectivo será desenvolver uma árvore exploratória, com as:

- possíveis **causas** associadas ao problema central, para que seja possível discernir uma visão mais aguçada desse problema e permitir discutir entre todos uma proposta de valor a criar com uma estratégia alternativa.

- possíveis **soluções ou vias**, olhando para a base (as causas) e transformando em propostas de acção. Neste processo, tendo como um meio alternativo o híbrido a testar, será interessante ter abertura para a identificação de outros meios identificados nas dinâmicas que possam estar relacionados e ser considerados no futuro. Na transformação da árvore dos problemas em árvore de objectivos os elementos negativos são transformados positivamente.

Para facilitar o processo, será exemplificado o pretendido com um exemplo prático relativo ao problema, será partilhada uma imagem com o início de um exemplo para uma árvore do problema relativo à Cegueira Botânica, como indicado abaixo, a ideia é ir ramificando do problema central (Cegueira Botânica), para baixo os problemas e para cima as possíveis soluções:

> Utilizar os meios digitais, promovendo o audiovisual e novas tecnologias emergentes, como complemento de estudo e um facilitador? Documentário interactivo? Como?

Soluções???

```
        Cegueira Botânica
              |
      A Botânica pode ser
        desinteressante
         /           \
Temas complexos   A maioria dos
e difíceis de     recursos para
entender          estudar são à
                  base de textos
```

Serão disponibilizados post-its de cores diferentes:

- Para os problemas: post-it vermelhos

- Para as possíveis soluções: post-it verdes

Serão distribuídos os post-it para os alunos escreverem as suas ideias e o moderador no quadro da sala vai compondo árvores com os post-it recolhidos.

Guião base para entrevista para o professor turma 11º ano:

- Esta actividade contribuiu para conhecer o Jardim Botânico da Ajuda e as potencialidades na utilização do espaço para complementar as suas aulas?

- Já desenvolveu alguma aula num jardim botânico ou noutro espaço verde? Considera apelativa essa abordagem, física ou virtualmente?

- Costuma utilizar material multimédia e audiovisual nas suas aulas de Biologia/Geologia ou utiliza com maior frequência os suportes escritos?

- Considera os meios audiovisuais complementos válidos em relação ao suporte escrito, concretamente em conteúdos multimédia via Internet, em contexto de sala de aula?

- Considera relevante a ideia conceito que foi testada? Pensa que será uma mais valia para a sua actividade como professor, utilizar a proposta deste projecto, sem perder o rigor científico?

- Na sua opinião, poderá esta estratégia contribuir para um maior envolvimento dos alunos com a temática da Botânica e ciências associadas?

- Na sua visão, o formato i-doc poderá ser de maior utilidade aos alunos a nível individual ou colectivo? Tem alguma sugestão nesse sentido?

- Considera interessante promover este conceito junto dos alunos e professores, criando condições na escola para que possam produzir novas experiências de um modo autónomo, promovendo a educação para os media e enriquecendo os conteúdos escolares?

- Ou ter um intermediário nesse processo poderá facilitar, isto é, articulando os conteúdos a leccionar com esse agente especializado em tecnologias emergentes, poderão ser produzidos conteúdos "por medida" e partilhados com a comunidade escolar?

Guião base para entrevista para o professor na turma do mestrado em Jornalismo:

- Considera relevante a ideia conceito que foi testada na turma de mestrado em Jornalismo?

- Na sua opinião, qual o valor que pode ser criado com esta proposta ao nível dos desafios e oportunidades que o Jornalismo atravessa na actualidade?

- Poderá esta estratégia, por um lado, contribuir para um maior envolvimento dos alunos com a temática da Botânica e ciências associadas e por outro, salientar o papel social do Jornalista em Educação Ambiental?

- No contexto deste projecto, o documentário interactivo mais do que um suporte ou canal mediático digital, que representa a realidade, pode ser interpretado como um construtor e potenciador de conhecimento (acção epistemológica)?

- Considera o Design como essencial à planificação das relações comunicativas entre as pessoas e os objectos digitais emergentes?

- Na sua opinião, existem diferenças marcantes entre a narrativa audiovisual e a narrativa científica que condicionam o processo de transposição?

- Será que a escolha do suporte a utilizar para comunicar ciência é condicionada à partida pela complexidade da temática e pelo grau de conhecimentos e exigência de informação do público (pensando na mediação entre texto e audiovisual)?

- Considera que esta abordagem será benéfica para a promoção da Educação para os Media, na intersecção da comunicação de ciência, do jornalismo e da exploração de novos objectos e tecnologias digitais?

ANNEX VIII - PICTURES OF SOME POST-IT WRITTEN IN CLASSROOMS DURING PROOF OF CONCEPT