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# Education beyond the pandemic: The interactive documentary as a hybrid learning opportunity

## *Educación más allá de la pandemia: el documental interactivo como oportunidad de aprendizaje híbrida*

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This exploratory research applies a transdisciplinary perspective between the fields of education, science communication, design, journalism, and emergent technologies, exploring the interactive documentary (i-doc) as a proposal to open horizons for new techniques and practices that can improve education and the planning of communicative relations between people, digital objects, and real life. Articulating storytelling, gaming, and multimodality, one prototype is produced, and its respective proof of concept is carried out in two classes: Biology and Geology students from a regular secondary school and Journalism students from the university level, being the respective teachers involved in the process. Action-research is applied within several techniques as bibliographic review, questionnaires, semi-structured interviews, participation observation and focus group, to test and evaluate the inherent proposal. The results 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 the opportunities in the intersection between science, technology, and art, which stimulate the production and usefulness of hybrid learning opportunities.

**Keywords:**
education, interactive documentary, hybrid learning opportunities, technological challenges

*Esta investigación se realizó desde una perspectiva transdisciplinaria que comprende el campo de la educación, la comunicación científica, el diseño, el periodismo y las tecnologías emergentes. Se analiza el documental interactivo (i-doc) como una propuesta para abrir horizontes a nuevas técnicas y prácticas que puedan mejorar la educación y la planificación de las relaciones comunicativas entre personas, objetos digitales y la vida real. Se articula la narración, el juego y la multimodalidad para producir un prototipo, que fue aplicado en dos clases: una, con estudiantes de biología y geología de secundaria regular y otra con estudiantes de periodismo en nivel universitario; los profesores fueron involucrados también en el proceso. Las técnicas utilizadas para probar y evaluar la propuesta fueron la revisión bibliográfica, cuestionarios, entrevistas semiestructuradas, observación participativa y grupos de enfoque. Los resultados confirman la utilidad y viabilidad de la propuesta, que podría explorarse de manera más sistemática para comprender mejor las oportunidades de la intersección entre ciencia, tecnología y arte que estimulan la producción y utilidad de oportunidades de aprendizaje híbridas.*

***Palabras clave:***
*educación, documental interactiva, aprendizaje híbrido, oportunidades, retos tecnológicos*

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## Introduction

This research intersects education, art, and technology, aiming to build an active relational communication between people and digital tools, techniques, and practices, where design is a root language of the whole process to communicate science and improve education. Da Silva (2018) explores the topic of transdisciplinary design, opening horizons for the social process of research in design, education, and practices, researching the potentiality of design to other areas of human activity within the transfer of knowledge, beyond the domain of design as a discipline. 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). At this point, more than developing a final product the main idea is to give life to an iterative dynamic that can improve a social transformation, with focus in education, in a long term.

In this work, the interactivity, participation, and immersion are key engines, 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. 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 pointing out, in general, a "botanical indifference" or even blindness from the society (Salatino & Buckeridge, 2016). In this context, those researchers stress 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 traditional classrooms, the use and experimentation of innovative formats, which promote the stimulation of the senses and the motivation for discovery, can enhance interest in Botany and related sciences. In that point of view, i-doc can be applied as a valuable tool to be used in contextualized classroom´s activities, promoting the school success and awareness to environment issues in a long-term vision. 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, n.d.). 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).

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).

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). In an analysis of the future possibilities of the documentary in a historical perspective, Uricchio 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, Gaudenzi & Rose, 2017, p. 203). 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).

> 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).

Gyori & Charles (2017) 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. 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 out 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).

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 and to advancing conservation practices and outcomes (Bennett et al., 2017). Several authors highlight that museum is excellent place to develop new educational and citizenship approaches:

> 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).

Thinking about specific social problems and associating with education contexts, this project aims to contribute to the creation of better communicational practices and, more than treat the symptoms of the "plant blindness" problem, it is intended to investigate its causes trying to achieve some possible solutions. In 2018, the oldest botanic garden in Portugal, the Ajuda Botanical Garden (ABG) celebrated 250 years, being the main scenario to produce one i-doc prototype, simulating one hybrid digital object. Indeed, making is one productive form of science teaching and learning, that explores design, construction, testing and revision of a wide variety of objects, integrating different disciplines as art, engineering and science, being more and more urgent to shift pedagogical strategies to support more reciprocal and less hierarchical ways of investigation (Bevan, 2017). Interconnect doing and thinking can be a valuable proposal in that meaning.

In the context of environmental education, Edgar Morin´s theory of complexity can be better explored as a theoretical tool, where the involved actors produce knowledge, in a collaborative and participative way. It may be understood as a strategy to stimulate 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 et al., 2017).

This project uses plant blindness theory to promote one reflection and a call for action, in the context of school communities, to identify possible paths for new environment learning opportunities and improve education and citizenship, pillars for raising awareness about key issues to the human species and ecosystems. The aims of the strategic action are:

- Developing familiarity with the topic of plant blindness, associating it to botanical gardens and their importance to society, putting into practice responsible research and innovative.
- 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 the plant blindness problem, with focus in a case study in ABG, exploring interactivity and participation within innovative digital media, in classrooms of different levels of education.

The research questions are:

- Can the proposal for the multimedia hybrid be a valid medium to promote awareness for plant blindness and science education, specifically botany and geology sciences?
- Does the observation of the hybrid contribute to inform and alert to the importance of botanical gardens, particularly to the recognition of the ABG?

▪What are the main causes of plant blindness, particularly in the regular teaching of botany and geology sciences?

In addition, the objectives are:

▪To explore how to use the interactive documentary to promote Botany and Geology educational activities in a differentiated approach.

▪To promote Botany and Geology 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 explore how innovative journalistic techniques and practices may reinforce a social responsibility for environmental education.

▪To design innovative strategies to improve science communication and education activities, specifically in Botany and Geology educational contexts, using a case study in ABG and testing the main idea in natural context (the proof of concept).

Summing up, this work intends to clarify the subject under study, since it is an area yet to be consolidated, and, regarding the nature of the problem, has a qualitative approach. 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. Below, the table 1 summarizes the action research developed in this work.

Table 1. Adopted research design

| | |
|---|---|
| Approach | Qualitative |
| Objective | Exploratory |
| Procedures / Techniques | Bibliographical review<br>Interviews<br>Questionnaires<br>Focus group<br>Participation observation |

## Methodology

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 figure 1 summarizes the main phases of the study, developed between September 2017 and March 2018, and table 2 sums up the three key work packages (WP) associated to the work.

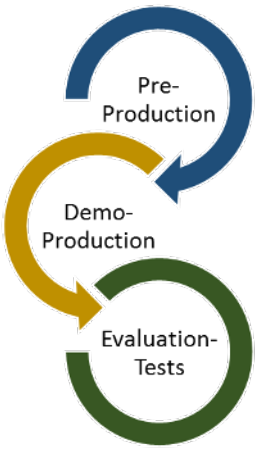


Figure 1. Main phases of the study.

Table 2. Key work packages

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

Next, for each WP it will be exposed a description of the key involved tasks.

*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 actions. A bibliographical review was vital 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 Geology, and the communicative and educational processes.

The author participated in different meetings at iNOVA Media Lab and XR Immersive Media Portugal, which is a regular event in Portugal created by iNOVA Media Lab, NowHere Media, and *Chicas Poderosas*. Those meetings were very important to open horizons and to learn about the possibilities within the emergent technologies, which are being more and more explored.

On November, the author produced and shared via Facebook, a pilot questionnaire about botanical gardens in Portugal, focusing on ABG, to explore the acknowledgment of the oldest botanical garden in Portugal. At the same time, she looks via online for examples of i-docs, which may serve as a reference to help to simulate the digital object to be tested. Below, there are three i-doc examples, which inspired the creative process:

- https://interactive.aljazeera.com/aje/2014/piratefishingdoc/
- http://hollowdocumentary.com/
- http://avespaixaoeuropeia.wixsite.com/webdocumentarioaves

The choice of the two classes to carry out the proof of concept 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. In addition, being a student at FCSH-NOVA and developing her master project at iNOVA Media Lab also facilitated the choice of the master´s class in Journalism to participate in the proof of concept.

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. The model for producing an interactive documentary in 7 steps was very useful to plan in more detail the initial idea of the project. Another important reference was the work "i-docs", a term coined by Gaudenzi, where is possible to explore several resources and trends in her site, as for instance looking for i-doc as a field to explore in education.

Portuguese academic theses about interactive documentaries were found, but the clear majority analyze and compare existing interactive documentaries, or explore the associated taxonomies and potentialities, without focusing the study on self-production for a specific purpose, including the audience in the initial process of the project (Correia, 2015; A. de L. C. Da Rocha, 2017; De Oliveira Marques, 2016; Ferreira, 2016; Guimarães, 2014; Quintas, 2015; Ribeiro, 2017; Rodrigues, 2013). This particularity is a differentiation path that this project aims to develop. 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, at the same time, reinforcing its social and educational role. Some academic works have taken into account in the audiovisual perspective (Dos Reis, 2015; Ferreira, 2016).

In online research about interactive documentaries, the author found two Portuguese works with that specific attribute. 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, and it is interesting to see some similarities with the i-doc format. The Portuguese documentaries accessed on YouTube about botanical gardens in Portugal, including ABG, are in the traditional format and so the author looks for a differentiation, exploring the field of interactive documentary as a proposal to improve the communication of these scientific museums. The project FCSH +Lisboa 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:

- To use evidence to understand the associated challenges and opportunities.
- To motivate and help to generate ideas for change.
- To work with others to clarify complex problems.

*Work package 2: Demo-production*

Sketching and paper prototyping was the beginning of the whole process. The prototype resulted from several attempts, using different free digital tools. First, the author wrote the script with the described specifications of the experience to be provided to the audience and develop the basic design of the user interfaces in PowerPoint, related to the imagined multimedia system (the i-doc). Later, the audiovisual experiences in the prototype were produced using a smartphone (Samsung, model GT-I9195, Android version 4.4.2) and the Cardboard Camera in Google Play to take 360 photos. She developed 360º photographs, texts, traditional photographs, games about botany and related sciences in Rise, one web-based e-learning tool in Articulate 360. Other formats, like audio design, virtual reality, 360º video and audio were presented only with practical examples of the associated possibilities. The history and the botanical games that she created were developed to introduce and facilitate the proposed dynamics in the prototype, gathering all the contents in one website, simulating the hybrid i-doc, which is available in this link: xploredesign4scicomm.wordpress.com

The choice of the developed content in the botanical games focused on the themes that the secondary classroom's teacher said he would be teaching in February and March. In the i-doc´s design, although the author adapted the web site's characteristics, she tried to achieve one format closest to the cinematographic view. The following table 3 summarizes the topic/subject, the platforms, and the user experience (UX) that were designed in this project.

Table 3. General characterization of the proposed i-doc in the author´s perspective

| | Topic/subject | Support/platform | User experience |
|---|---|---|---|
| Multimedia hybrid i-doc | Ecology and environment (focus on ABG and plant blindness theory)<br>Education, heritage, culture, and tourism | Web<br>Mobile<br>Multiplatform | Narrative<br>Hypertext<br>Game<br>Branched<br>Geolocation<br>Collaborative |

The proposed challenge to all users was to discover and reflect about their "plant blindness score" after experiencing the i-doc prototype, available in a site. For that general goal, the contents of the site 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 User Experience Design process by the Google´s Methodology one useful reference.

*Work package 3: Analysis*

Considering the good practices indicated by Ramona Pringle, the analysis of demo-production considers the following aspects (Aston, Gaudenzi & Rose, 2017):

- 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, Gaudenzi & Rose, 2017):

- Viewing frame
- Usability
- Sense-making processes

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 (Martins et al., 2013). These authors found that inquiry was the most 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 cohesive 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" (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 from both classrooms, and the used methods and respective techniques are:

- Test: Participant observation.
- Inquiry: Production of two questionnaires, using the Likert scale (from one to five). One general questionnaire about the observation of the prototype, adapted to each classroom, and the other, a System Usability Scale (SUS) questionnaire. Two semi-structured interviews were also adapted to the respective teachers of the two involved classrooms.
- Outline a focus group: With focus on the problem "plant blindness", proposed to each group to draw an "exploratory tree", with the possible causes of that

problem (the tree roots) and paths or ways that can minimize the problem (the tree branches), where the trunk is the plant blindness. It was delivered to each user two 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).

*Proof of concept (PoC): Evaluation in natural context*

In both classrooms, at the secondary school and university levels, PoC is conducted in two phases, with the respective teacher, which is also an active agent in the process. First, observing the initial prototype and answering the two questionnaires online, 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, drawing together an exploratory tree. 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 the proposed digital object and its potential to improve the success of educational communities.

In the beginning, it was explained that:

- Participants can interact with the moderator, sharing 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 the associated dynamics, reinforcing the functionality of the proposed object.

Before sharing the prototype, the author asked both classes to identify the oldest botanical garden in Portugal. In general, both groups did not know the ABG, but some mentioned the botanic garden from MUNHAC–Museum of the University of Lisbon. After that, they answered the two online questionnaires, available in the respective links of the site (the general questionnaire and the SUS questionnaire). Later, the author sent to both teachers, via email, a semi-structured interview.

Below are two tables, the table 4 and the table 5, with complementary information, each one representing the typology of the involved classes in this process and some information as the date of occurrence, number of participating students, classroom typology and duration of the event.

Table 4. Typology of the participating secondary classroom

| | 11º degree in Biology and Geology<br>Azambuja Secondary School |
|---|---|
| Date | 7 March 2018 |
| Number of students | 17 students |
| Classroom typology | Informatics' classroom with available 12 computers: 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 5. Typology of the participating master's classroom

| | Master in New Media and Journalism<br>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 used their smartphones or laptops |
| Duration | 1h00: starts at 06h00 p.m. until 07h00 p.m. |

## Results and considerations

*Pilot questionnaire about botanical gardens in Portugal*

In total, 293 participants answered the questionnaire about the botanical gardens in Portugal, 78,8% with a higher academic qualification, the dominant age group (59,8%) being between the ages of 30 and 59 years. Of these results, only 73 persons correctly answered the question: "What is the name of the first botanical garden in Portugal?" (ABG). They recognized 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 this work, the author believes that the botanical gardens, with focus on ABG, can improve their communication and cultural offer, contributing to their greater recognition and social importance.

*Questionnaires at classrooms: General and SUS*

In both groups, some students didn´t answer the two questionnaires online. The general questionnaires obtained 14 and 23 answers, and the SUS questionnaires obtained 11 and 20 answers, respectively in secondary and master's classrooms. Yet, the majority confirmed that the observation of the prototype helped to get to know the ABG (figures 2 and 3), also that the proposal associated with the digital object (the i-doc) 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 with the respective teachers, both opinions were also favorable to those considerations.

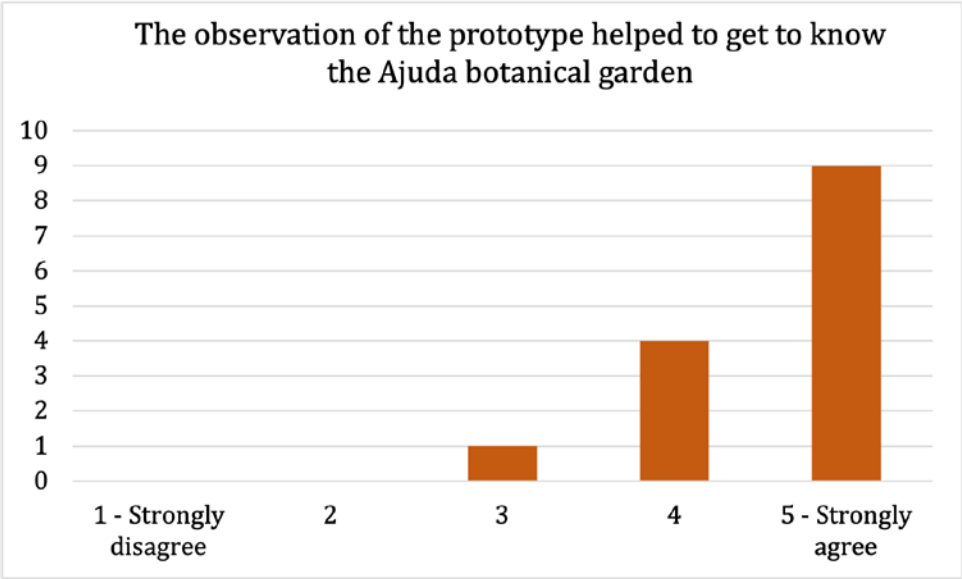


Figure 2. Answers from 14 students in the secondary classroom concerning the sentence "the observation of the prototype helped to get to know the Ajuda Botanical Garden".

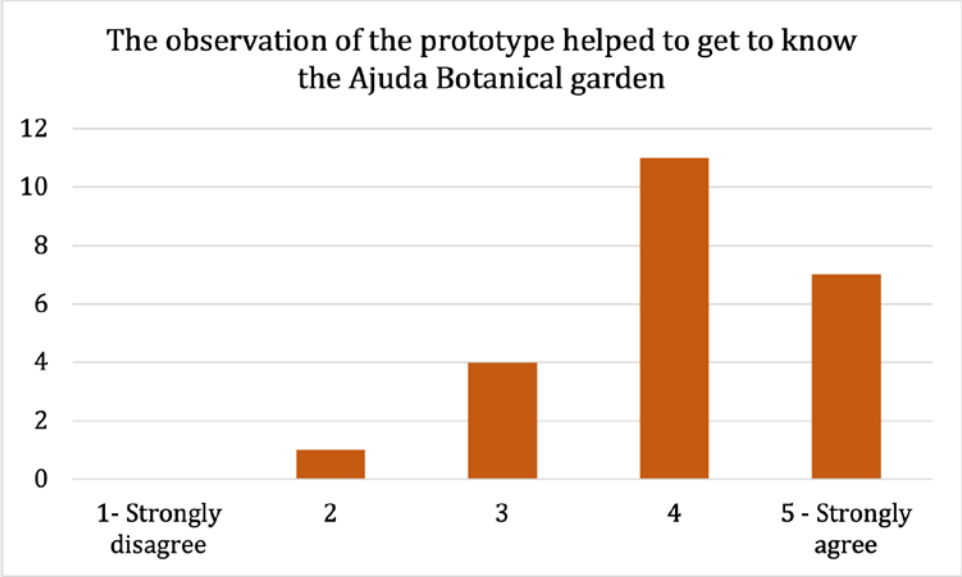


Figure 3. Answers from 23 students in the master's classroom concerning the sentence "the observation of the prototype helped to get to know the Ajuda Botanical Garden".

In the secondary classroom, most students strongly agreed that they would like to do other experiences of this kind in classes, also in other disciplines, emphasizing the premise that supplementing classes with interactive audiovisual content, as 360º videos, virtual reality and augmented reality experiences will be stimulating and motivating for learning and teaching experiences. The author thinks that, although the observation of her prototype contributes to get to know the ABG, to affirm that the proposal can be efficient to improve the learning of curricular contents, specifically in secondary level, there is a need of more evidence.

In the master's class, where the test was more focused on the journalistic activity, it was recognized that the i-doc 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 20 participants, 5 students expressed a neutral opinion, and one student did not agree with the use of i-doc in a journalistic differentiation, which indicates that it will be important to perceive this reality, in a more detailed way and with better questionnaires. The results show a less enthusiasm and a more critical opinion 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. However, it is necessary to investigate in a more targeted way. According to Gyori & Charles (2017), journalism students are used to telling stories in a traditional way (headline, beginning, middle, end), and, doing it in a different way requires a different planning, being imperative to become more engaged with new media design platforms. At the same time, the same authors stress that nowadays forward-thinking educators are beginning to focus on the creation of i-doc.

Teixeira (2015) states that the reference value for a SUS questionnaire is 68, and below this value it is a sign that the usability is reduced or that it should be improved. 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. The author thinks that the fact that master's class did not interact as much with the prototype´s contents, comparing with the secondary school group, was mainly due to the limitations of Internet access and shorter duration of the event, contributing to the difference obtained at both SUS levels. In addition, as in the i-doc design there was a greater focus on the curricular contents of the 11th grade class, that reality may have influenced the results, despite the author tried to have a general approach in the demonstrative exercise of the contents. However, to clarify these details it will be necessary to move forward in several iterations, to materialize new test phases, more adapted to each specific target group. In any case, the author considers the SUS results encouraging concerning the relevance of the proposal and the achievement of the inherent goals, although improvements are needed in future works.

*Focus group and interviews with teachers*

Concerning the contribution of this research proposal, the author presents below, in figures 4 and 5, the two exploratory trees obtained in the focus group with both groups. In those figures, it is expressed the voice of the targeted audience, one original manifesto, which reinforces the proposal of the project´s concept. In light brown, the roots of the tree, are listed the identified causes of the problem "plant blindness" by each group of students, and in green, the identified solutions that may attenuate the inherent problem.

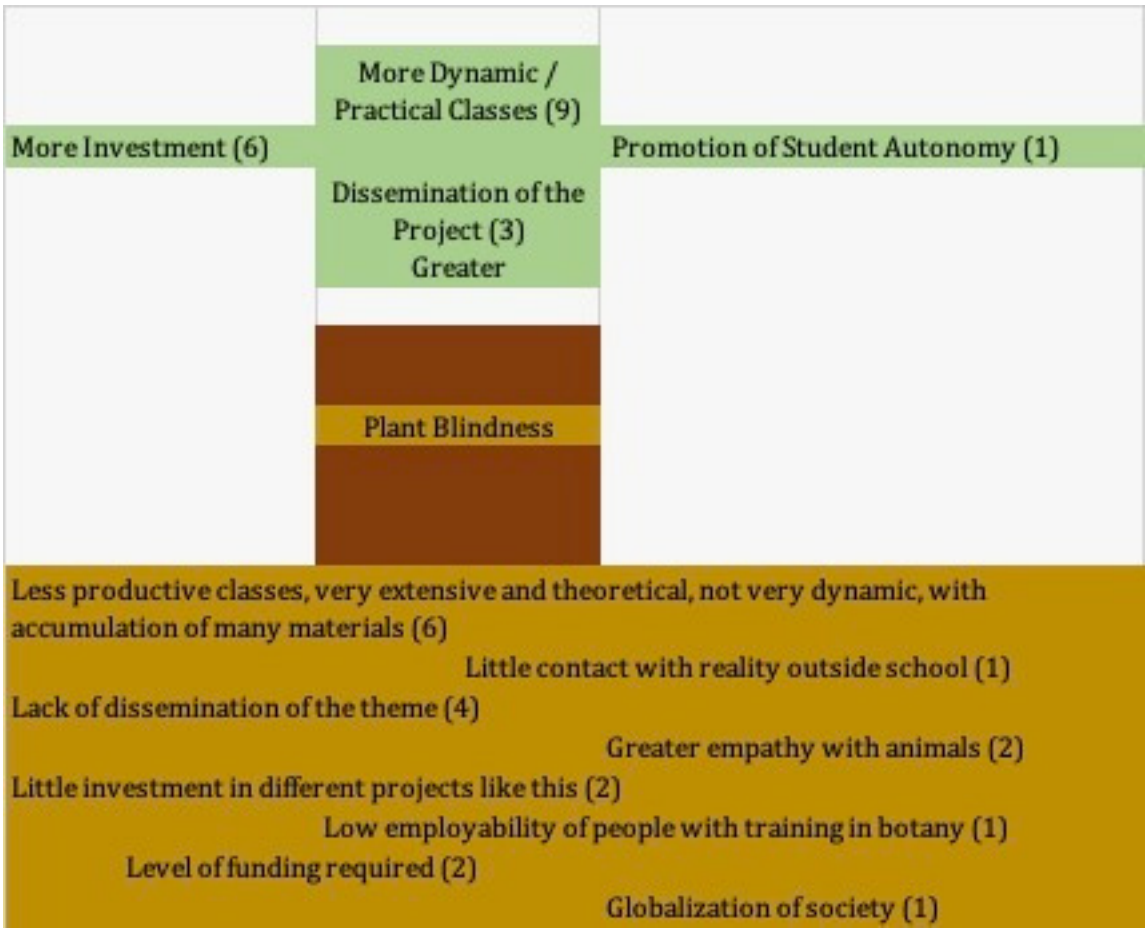


Figure 4. Exploratory tree in secondary classroom.

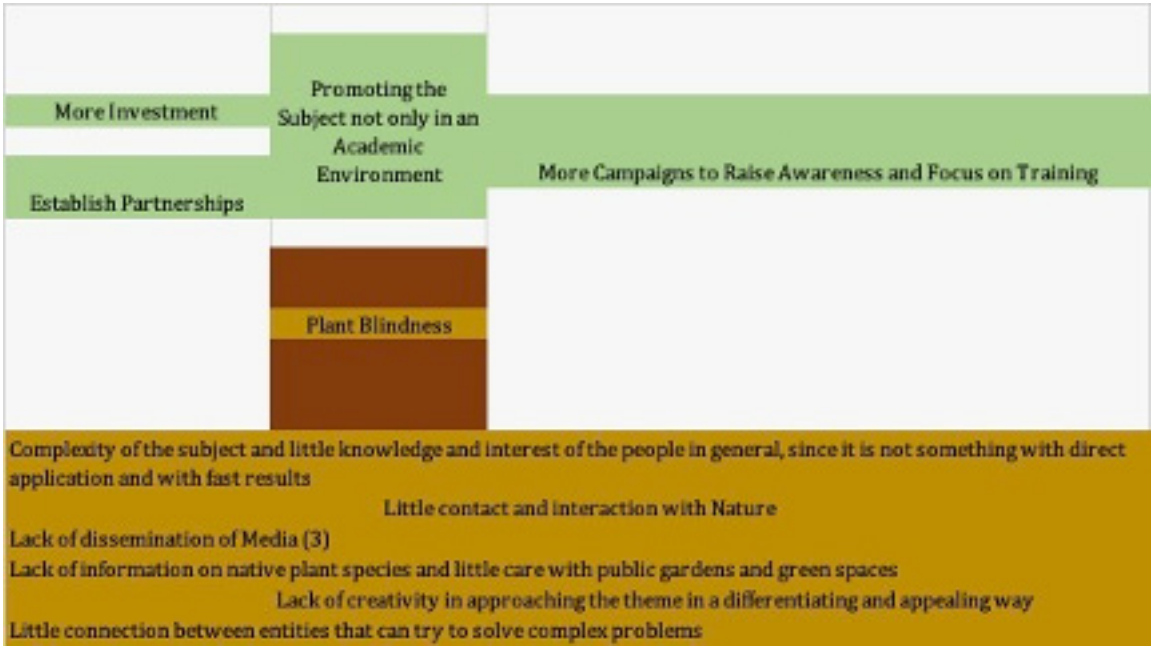


Figure 5. Exploratory tree in master classroom.

In the interview with the secondary classroom´s teacher, some constraints were stressed like the need for more adequate classrooms, better equipped and with better access to the Internet. On the other hand, the lack of time and the weak specific training of teachers in this field were other identified challenges. The professor of the master's classroom pointed out his concerns related with the required time and the associated costs to turn possible the effective development of one project like this one, reinforcing the external financial support as one critical factor to turn possible the implementation of such proposal. Although the inherent limitations, both teachers highlighted their interest in the proposal, using the i-doc as a tool to promote school success and to explore the responsibility of journalism in environmental education, in an innovative learning and teaching approach.

## Conclusions

The pilot questionnaire about botanical gardens in Portugal represents an exploratory approach and, although it is not representative of the Portuguese population, the author considers pertinent to look at the results. As ABG is a national reference, the author stress that it will be pertinent to consider new communicative approaches to increase its social recognition and promote actions that try to minimize the problem of plant blindness. The author highlights that it will be useful to develop research in this scope, with greater detail and dimension, contributing to a better knowledge of this reality, since there is little academic work in this area.

Focusing on the educational context, the author thinks that the results are auspicious and validate the concept of this project, in terms of interest and practical utility, from and for the involved students. The results are valid in the context in which they are obtained, and, given the reduced sample, they cannot be generalized. The author considers that it will be of extreme importance to replicate new studies with this approach and context, with transdisciplinary teams, in systematic studies to obtain more results and insights. There are no static formulas, and the interactive documentary format, alone, will not promote miracles. Nevertheless, 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 vital to allow favorable conditions and to invest in several resources. However, challenges remain, both in the education and journalism sectors, the time factor is a valuable resource, beyond the limitations, not only financial, but that also persist in the two areas of activity.

I-doc can be understood as a learning hybrid facilitator, not only in the educational processes but also as an intermediate booster, in the sense that may improve good and/or adaptive practices, innovation and resilience in the educational communities, both in formal, informal, and non-formal contexts. The results reinforce the potential of i-doc in the context it was tested. In this perspective, the author does believe that it will be pertinent to move forward in other proof of concepts in different educational communities, testing the usefulness of i-doc in different disciplines and educational realities as an enabler of knowledge co-construction with responsibility and creativity.

In the table 6, the author exposes a summary of her reflections, with the associated strengths and improvement suggestions for future actions.

Table 6. Brief review of the associated challenges in this work and future proposals

| 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 |

Facing the rise of complex challenges, such as those that have become noticeable with the COVID-19 pandemic, the author does believe her proposal is pertinent, both as a creative and useful means to build capacities for adaptation and transformation in school communities. The author highlights a general validation of the i-doc's proposal application and its respective potential, which can be tested and improved in other contexts of school communities, not only in the Botany and in Geology educational contexts. In complement, journalism and its innovative practices may be a great ally in the construction of citizenship and educational creative spaces. It is urgent to experiment and rethink new educational models and approaches, involving several social actors. It is in this sense that the author seeks to stimulate a dialogue about building and improving educational capabilities beyond the pandemic, in an inclusive and participatory path.

## References


Amorim, P. & Baldi, V. (2013). Ética e estética da representação no Web-documentário. *Culturas Midiáticas*, *6*(2).

Aston, J., Gaudenzi, S., & Rose, M. (2017). *I-Docs: The Evolving Practices of Interactive Documentary*. Columbia University Press.

Bennett, N. J., Roth, R., Klain, S. C., Chan, K., Clark, D. A., Cullman, G. &Teel, T. L. (2017). Mainstreaming the social sciences in conservation. *Conservation Biology*, *31*(1), 56-66.

Bevan, B. (2017). The promise and the promises of making in science education. *Studies in Science Education*, *53*(1), 75-103.

Casella, G. (2018). Remixing the archive. The use of webdoc format as a medium for science communication. *DOC On-Line* (2017SI).

Correia, D. A. R. (2015). Expressividade do Arquivo no documentário interativo.

Coutinho, C. P., Sousa, A., Dias, A., Bessa, F., Ferreira, M. J. R. C. & Vieira, S. R. (2009). *Investigação-acção: metodologia preferencial nas práticas educativas.*

Da Rocha, A. de L. C. (2017). *Design e desenvolvimento de narrativas interativas: O webdocumentário num jornal de pequena dimensão.*

Da Silva Vieira, S. L. (2018). Transdisciplinaridade do design: Niveis de realidade distintos. *Gestão & Tecnologia de Projetos*, *13*(1), 101-114.

De Jesus Pereira, A., Friede, R., Narduchi, F. & De Miranda, M. G. (2017). Educação ambiental e interdisciplinaridade saberes práticos e teóricos no processo de ensino-aprendizagem. *Semioses*, *11*(4), 8-15.

De Oliveira Marques, J. P. (2016). *Realidade virtual e jornalismo imersivo: Anotação dinâmica de peças noticiosas em vídeo 360o.*

Dos Reis Ramalho, A. R. M. (2015). *Jardim Botânico do Porto-A identidade visual como estratégica de dinamização*.

Ferreira, S. L. de M. G. (2016). *O audiovisual ao serviço da comunicação: O documentário como estratégia de comunicação-uma experiência no contexto museológico*.

García, C. L., Ortega, C. A. C. & Zednik, H. (n.d.). Realidade virtual e aumentada: Estratégias de metodologias ativas nas aulas sobre meio ambiente. *Informática Na Educação: Teoria & Prática*, *20*(1).

Gaudenzi, S. (2013a). The interactive documentary as a living documentary. *Doc On-Line: Revista Digital de Cinema Documentário*, (14), 9–31.

Gaudenzi, S. (2013b). *The Living Documentary: from representing reality to co-creating reality in digital interactive documentary*.

Guimarães, L. P. (2014). *Desenvolvendo um webdocumentário e um documentário linear sobre a perspetiva passional da criação de aves na Europa*.

Gyori, B. & Charles, M. (2017). Designing journalists: Teaching journalism students to think like web designers. *Journalism & Mass Communication Educator*, 1077695817713424.

Lamim-Guedes, V. (2018). Temática socioambiental em Museus de Ciências: educação ambiental e a educação científica. *Ambiente & Educação- Revista de Educação Ambiental*, *22*(1), 77-95.

Levin, T. (2015). Webdocumentário como um documentário feito de uma narrativa interativa, hopertextual e participativa. *Doc On-Line: Revista Digital de Cinema Documentário*, (19).

Martins, A. I., Queirós, A., Rocha, N. P. & Santos, B. S. (2013). Avaliação de usabilidade: Uma revisão sistemática da literatura. *RISTI-Revista Ibérica de Sistemas e Tecnologias de Informação*, (11), 31-43.

Miñana, R. G. (2017). Tesis doctoral–síntesis. El lenguaje de la utilidad: un análisis pragmático de las cosas. El diseño como planificador de las relaciones comunicativas entre personas y cosas. *Hipertext. Net: Revista Académica sobre Documentación Digital y Comunicación Interactiva*, (15), 100-106.

Mouchrek, N. (2017). Design-based approaches to engage youth in the transition to sustainability abordagens de design para engajar os jovens na transição para a sustentabilidade. *MIX Sustentável*, *3*(4), 135-147.

Nash, K., Hight, C. & Summerhayes, C. (2014). *New documentary ecologies: Emerging platforms, practices and discourses*. Springer.

Ouariachi, T., Olvera-Lobo, M. D. & Gutiérrez-Pérez, J. (2017). Analyzing climate change communication through online games: Development and Application of validated criteria. *Science Communication*, *39*(1), 10-44.

Penafria, M. (2014). A Web e o documentário: Uma dupla inseparável? *Aniki: Revista Portuguesa da Imagem em Movimento*, *1*(1), 22-32.

Ponte, C. & Silva, D. S. (2017). Tornar público o conhecimento científico, comunicar a cidade pelo jornalismo cultural digital. *CECS-Publicações/eBooks*, 447-460.

Quintas, C. E. de S. (2015). *Possibilidades interativas nos vídeos de comunicação de ciência*.

Ribeiro, V. A. M. H. C. (2017). *Documentário, espaço selvagem da experimentação*.

Rodrigues, P. F. V. A. (2013). *Processos narrativos e autoria em documentário interativo*.

Salatino, A. & Buckeridge, M. (2016). Mas de que te serve saber botânica? *Estudos Avançados*, *30*(87), 177-196.

Santos, F., Salvado, J. C. & De Carvalho, I. L. (2013). *Manual para transformar o mundo: da ideia inspiradora a implementação inovadora*. Fundação Calouste Gulbenkian.

Teixeira, F. (2015). *O que é o SUS (System Usability Scale) e como usá-lo em seu site.* https://brasil.uxdesign.cc/o-que-é-o-sus-system-usability-scale-e-como-usá-lo-em-seu-site-6d63224481c8

Tomaz, J. M. C. (2011). *Efeitos do nível de interactividade num recurso educativo digital: diferenças na satisfação e na aprendizagem*.