Joana Gândara Fernandes

Science Communication: a strategic approach to the International Iberian Nanotechnology Laboratory

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Universidade do Minho
Escola de Letras, Artes e Ciências Humanas

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Mestrado em Humanidades Digitais

Trabalho efetuado sob a orientação da
Professora Doutora Sílvia Araújo
Professora Doutora Teresa Ruão
e do
Professor Doutor António Vieira de Castro

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DIREITOS DE AUTOR E CONDIÇÕES DE UTILIZAÇÃO DO TRABALHO POR TERCEIROS

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knowledge in the area of Science Communication, and Strategic Science Communication, and for your cherished input.

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

RESUMO

Os alunos do ensino secundário veem as ciências como um assunto interessante e os cientistas como pessoas inestimáveis e, embora tenham uma perceção da ciência considerável, ainda mostram um entendimento público da ciência redutor. Assim, este projeto pretende promover uma maior familiarização com a ciência junto a esta comunidade de estudantes, através do desenvolvimento de uma visita virtual 360° ao Laboratório Ibérico Internacional de Nanotecnologia, ou INL, e tentar perceber se estes tipos de métodos interativos podem motivar os estudantes a seguir áreas científicas e tecnológicas na sua carreira académica.

Para concretizar este propósito, foi realizada pesquisa em Comunicação de Ciência e Comunicação Estratégica de Ciência, aprofundando-se na execução de um Plano Estratégico de Comunicação Científica, plano este que auxiliou na elaboração de um plano de comunicação para este projeto.

Para avaliar se a visita virtual é um dispositivo benéfico para a comunicação científica, foi criado um documento em Google Forms, com dois questionários dirigidos a uma amostra do público-alvo, alunos que frequentam do 8° ao 11° ano.

Os resultados foram analisados, o que nos permitiu concluir que métodos inovadores e interativos de comunicação científica são atrativos e capazes de motivar os alunos mais jovens para os campos científicos.

Palavras-chave: comunicação científica; comunicação estratégica; comunicação para públicos mais jovens; engajamento com a ciência; visita virtual

ABSTRACT

High school students view science as an interesting subject, and scientists as invaluable people, and although they have a considerable perception of science, they still show a reductive public understanding of science. Thus, this project aims to promote a greater familiarization with science within this community of students, by developing a 360° virtual visit to the International Iberian Nanotechnology Laboratory, or INL, and try to understand if such interactive methods can motivate students into pursuing scientific and technological areas in their academic career.

To execute this purpose, research was conducted on Science Communication and Strategic Science Communication, delving deeper in the execution of a Strategic Science Communication plan, and this plan aided in designing a communication plan for this project.

To assess if the virtual visit is a beneficial device for science communication, a document on Google Forms was created, with two questionnaires directed to a sample pool of the target audience, which consisted of students attending from the 8th to 11th grades.

The results were analysed, which allowed us to conclude that innovative and interactive methods of science communication are attractive and motivate younger students to scientific fields.

Keywords: science communication; strategic communication; communication to younger audiences; engagement with science; virtual tour

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1.1 – Introduction

In their study from 2015 titled "Science and Strategic Communication: How can universities attract high school students?", Ruão et al. reached the conclusion that high school students regard science as being interesting and valuable, view scientists as creative and helpful people and, in essence, that the students have a considerable perception of science. Still, students have also shown a reductive public understanding of science, being more oriented towards pure science, such as mathematics, physics, or chemistry. Once observed their Awareness of, and Interest in, science, one can expect other personal responses to be developed as well, like Enjoyment, Opinion, or Understanding, in such a way that they might even reach Interaction through activities of contact, and Action, which is seen as behaviours and attitudes.

A greater familiarization with scientific and technological matters will involve a more oriented communication of science, bringing it to students in a way that is recognizable to them and that they already practice during their academic career, such as an educational field trip. Seeing that education is a fundamental aspect in the growth of a person in society, and science and technology are vital to said society, it is vital that this acclimatization of young people, students, to science begins in this early stage of their education. In this way, they will be more likely to make informed decisions about matters of scientific and technological nature throughout their lives.

Considering this, this internship project aims to build a virtual tour of the International Iberian Nanotechnology Laboratory, building interactive content that will hopefully engage students with the theme.

This report consists of four parts. This first one offers an overview of the project, its goals, and the host institution for this internship, while also establishing that the project was carried out alongside my Master's colleague, Ana Sofia Marques, in her internship report "Planning a gamified and interactive virtual tour to a research centre as an educational resource – the International Iberian Nanotechnology Laboratory" thus I will be using the pronoun "we" in some parts during this report. The second part provides with a definition and context of science communication and strategic science communication and contextualizes in person field trips as a means of strategic science communication, highlighting its educational aspect. In the third part, the strategic plan will be addressed, presenting the definition of each one of its points and explaining what each one means in the specific context of this project, while also referring to the stages of the development of the virtual tour that dealt with the treatment of information and the bureaucratic aspects. Lastly, in the fourth part I shall proceed to present a sample of the target audience of this project, the questionnaires made and delivered to the sample, and an analysis of the results.

1.2 – Host institution: The International Iberian Nanotechnology Laboratory

The International Iberian Nanotechnology Laboratory - referred from now on as Nanotechnology Laboratory -, is a leading international organization in Europe in the fields of nanotechnology and nanoscience, and it was founded in cooperation by the governments of Portugal and Spain. Created in 2008 in Braga, Portugal, this intergovernmental organization fosters interdisciplinary research, develops a variety of projects based on pioneer research focused on six main areas that complement each other: Environment, Health, Energy, Food, Information and Communication Technology and Future Emerging Technologies. Scientists, engineers, and researchers from all over the world – approximately 40 countries – work in a highly interdisciplinary environment and strive to make the Nanotechnology Laboratory a world-wide hub for the deployment of nanotechnology addressing society's ambitious challenges.

The central idea of choosing the Nanotechnology Laboratory as the institution on which to base this project, originated in the group project developed during the second semester of the first year of the Masters of Digital Humanities. The project consisted of a game application for Android and iOS, based on the theme "Water Quality", and the investigators and scientists from this research group at the Nanotechnology Laboratory aided in providing us with information that was later analysed and gamified. Such activity set off interest in presenting science to younger audiences in diverse and interesting ways.

1.3 – Identifying the problem

A lack of interest in science has been noted in the way that not many students choose university degrees focusing on science and technology, or even consider career paths in those areas, due to several factors, whether it is the difficult school curriculum and an instability created by several reforms of the school curriculum throughout the years, a lack of vocational guidance, or because there is no familiarity with science that attracts students to follow this path (Carrapatoso, 2005). Even though there seems to exist a problem in motivating the students, there is also a possible solution. One needs to reach young people by supporting alternative learning spaces that incorporate activities with a stimulating sensory component by, for example, creating a strategic communication plan for science and technology that involves the use of an educational tool, in the case of this project, field trips, as a science communication device.

Regarding the organization of field trips, there are its own hindrances, such as monetary costs, and specifically regarding the Nanotechnology Laboratory that has its own restrictions when it comes to organizing study trips to their location, as it will be explained ahead in this report.

1.4 – Goals of this project

Through Science Communication the intent is to awaken at least one of the personal reactions to science, illustrated in the vowel analogy, by Burns et al., those being Awareness, Enjoyment, Interest, Opinion, and Understanding, along with Interaction, or contact activities, and Action, seen in behaviours and attitudes in students after their interaction with the virtual visit (Burns et al., 2003). With the help of Science Communication, specifically the Strategic Science Communication as a means, we aspire to present science and technology as engaging and alluring subjects, thus leading more students to scientific research fields, and to be interested in the nanotechnology Laboratory and perceive its researchers as real people working in a place that is also accessible to them.

By delineating a strategic communication plan, I will define the communication objectives, identify the target audience, plan the communication actions to follow, implement these actions and, finally, develop an assessment through a document on the platform Google Forms, with two questionnaires, one to be filled out prior to the students' interaction with the virtual visit, and the other to be filled out posteriorly, with the purpose of obtaining feedback from students regarding their thoughts on this type of communication. Ultimately, it is intended to increase the perception of science and scientific literacy in students, as well as to enhance a positive image of the Nanotechnology Laboratory and the work developed there after an interaction with the virtual visit and its contents.

PART 2 – STRATEGIC COMMUNICATION OF SCIENCE AS AN EDUCATIONAL TOOL

2.1 – Science Communication

Burns et al. (2003, p.183) presents a definition of Science Communication, "to produce one or more of the personal responses to science". These personal responses to science, or the Vowel Analogy, are Awareness, here understood and an acquaintanceship with new scientific aspects, Enjoyment, meaning all the affective response to science, its concepts and activities, Interest, or the voluntary involvement with scientific content, Opinion, that is the forming of new opinions on science and the critical analysis of our perceptions of science, and finally Understanding, a comprehension of science, its contents, processes and its essential role in society (p.196-198).

In the 2015 study "Science and the public: The public understanding of science and its measurements", Entradas (2015) asks us to consider:

> "How much science does the public need in order to understand Einstein's theory of relativity? Should the public understand it at all? In what way can having some understanding of science benefit a layperson? What should public involvement in science be like?" (p.72)

One of the earliest answers to these questions was introduced by the term "Scientific Literacy", first utilized in the 1950's in the United States of America, to describe the general public's understanding of science, along with its concepts and processes. Posteriorly, in 1983, Jon Miller elaborated on the concept of scientific literacy, in his article "Scientific Literacy: A Conceptual and Empirical Review", posted as an issue of the Journal of the American Academy of Arts and Science, or AASS, and offered a new definition of the concept. Miller explains that when we investigate the concept "literacy", we come up with two meanings: one, to be learned in a subject, and to be literate, in the most common sense of being able to read and write (Miller, 1983, p.29). When considering the second meaning, it can be suggested that scientific literacy refers to the ability to read about, comprehend and express an opinion on scientific matters with some level of knowledge (Miller, 1983, p. 30). According to Miller, there are strong motives for the expansion of scientific literacy in the population, such as political and cultural ones, and the most fruitful place to begin is in elementary and secondary education (Miller, 1983, p.46). In addition, Miller suggested that the following aspects should be included in scientific literacy: firstly, "a vocabulary of basic scientific constructs sufficient to read competing views in a newspaper or magazine", "an understanding of the process or nature of scientific inquiry" and finally "some level of understanding of the impact of science and technology on individuals and on society".

The primary objective of Science Communication is to increase Scientific Literacy in the collective public, or its Public Understanding of Science (PUS), (Burns et al., 2003, 186-187).

In 1983, the Royal Society of London released a report titled "The Public Understanding of Science", a work effort presided over by Walter Bodmer, who was, at the time, the publishing Director of Research for the Imperial Cancer Research Fund and Fellow of the Royal Society. This report argues that the public should have some understanding of science, its processes, and terms, under the premise that the more people know about it, the more people will support it. It also served as a plea for scientists to improve their communication skills and engage with the public, based on their own sense of public responsibility, given that scientific advancement is also dependent on public funding. One of the measures highlighted in the report are the surveys of public attitudes towards science, a subjective yet useful tool (Royal Society, 1985).

The main thesis behind this report was that it is important to raise the quality of public and private decision making, thus enriching the life of the individual, "(...) not because the "right" decision would be made, but because decisions made in the light of an adequate understanding of the issues are likely to be better than the decisions made in the absence of such understanding" (Bodmer, 2010). This understanding is defined as the comprehension of the nature of science activity and inquiry, and not just knowledge of some of the facts. It includes knowing the risks and advantages of a certain matter, an important part of many public policy issues or everyday personal decisions. Since science is an underlying aspect of our culture, it is fundamental that the concept of science, understood as more than a collection of facts, is explained in schools so it is ingrained in our students as they grow.

Public Understanding of Science is not only the understanding of concepts or scientific results, but also the perception and valuing of Science and Technology's contribution to the public's lives (Coutinho et al., 2004, 114). The public's understanding of science is of high importance considering we live in a society in permanent scientific and technological advancement, and the public should be able to make informed decisions and formulate opinions based on their scientific knowledge. One sees the effects of Public Understanding of Science not only in the individual's life, but in its participation in democratic matters of society as well.

Thomas and Durant (1987) state, in the paper "Why should we promote the public understanding of science", that the assimilation of science by the wider culture is fundamental for a science-based society. This idea merges in with the people's right to influence policymaking, in the sense that the public needs to understand the issues on the table and make informed decisions about them. This should be not only about matters that will affect them directly, such as vaccines and dietary choices, but also events of a larger scale, such as climate change.

Additionally, we faced a replacement of the “Cognitive Deficit model” to one “Interactive model” (Carvalho & Cabecinhas, 2004, p.7). The “Cognitive model” is based on the idea that if lay people knew what scientists did, they would support it. In this model, the communication flows linearly from the expert, or the scientist, to the community, which can be composed of experts of different fields or the lay public but obtain no feedback. An oversimplified version of the scientific event is communicated, making this the root problem of why numerous scientists are reluctant to share their research.

Coming as an evolution of the “Cognitive Deficit model”, the “Interactive model” is one where the scientists communicate with the community and gather feedback. There is a dialogue between the two parts, and the public has an active stance. This model acknowledges that the public’s knowledge is valuable when addressing complex matters, and this expertise can be used to improve the efficiency of the government, since we are talking about “a relationship that knows that there are certain gaps between two entities that are supposedly separated and require bridges” (Davies, 2013, p. 695). The concept comes from a combination of a top-down initiative and various local and down-up movements. (Bensaude Vincent, 2014, p.244).

Despite the fear of oversimplification of science, scientists do eventually find motivation to communicate science. To mention some of the reasons for this change in attitude, there were the dissemination and legitimation of science, as well as promoting a scientific culture with the purpose of attracting students towards scientific fields of study and captivating the public, bringing awareness to the importance of science and technology.

This is accompanied by a sense of accountability, on account of scientific research being funded by the population’s tax funds, creating the need for the community to be informed of their research pursuits and results. In this way, we can observe citizens becoming involved in the decision-making process when it pertains to the budget to be directed to science and technology, particularly in scientific and technologic questions that involve ethical values, cloning being an example (Oliveira & Carvalho, 2005, p.170-171).

Portugal's scientific and technological research has greatly progressed in the past two decades, due to the increasing number of researchers and the publication of scientific articles in international magazines. This progress was also supported by an increase in the number of professionals in scientific communication, and their activities of science communication in schools and science centres. This sort of scientific communication is more aligned with the "dissemination" of science, which, in essence, is a summary of a scientific matter offered to the general population by the scientists, motivated by their need of accountability, acknowledgement, and the purpose of sharing ideas.

In Portugal, Science Communication activities are mostly unidirectional, from the scientific community to the public, and indirect, being mediated by third parties (Coutinho et al., 2004, p.118), much like in the "Cognitive Deficit model".

The Portuguese National Agency for Scientific and Technological Culture, created in 1996, and whose mission is to promote the scientific and technological culture of the Portuguese population, is largely responsible for the public perception of science in Portugal. The promotion of public engagement in science in Portugal is moderate since it mostly depends on spreading awareness about the importance of science and technology, through actions of persuasion or simply informative actions. These public engagement activities seem to place themselves within the archetypes of scientific literacy and public understanding of science (Oliveira & Carvalho, 2005, p.168).

2.2 – Strategic Science Communication

Contemporary organizations appear to be urged to deal with a most varied array of publics, and different platforms of communication, thus the communication of science must be understood as a strategic process capable of promoting scientific work, as well as scientists' reputation and science's social worth. In his 2014 article "The power of strategic communication in organizational development", Falkheimer states that strategic communication can be perceived based on its effect on social change, to shape the public opinion or to promote ideas of democracy and culture.

Luís Barbeiro (2007, p.9) believes that it is in society's hands to determine science's course, as the communication of scientific activity is majorly important in maintaining the flow between the scientific community and society, or the public. Additionally, in an interview to the Portuguese Society of Biochemistry Magazine (Revista da Sociedade Portuguesa de Bioquímica), Fernandes (2006) suggests that only by communicating science can we rouse scientific callings.

If the activity of strategic science communication is developed through an online platform, the information is accessible to those with internet access, but it is dependent on each person's competences, personality, personal values, and social condition, how they handle all that information. Therefore, the strategic communication professional responsible for analysing and selecting the information available, acting as a mediator.

The strategic communication of science is, in essence, the planned-ahead use of key message mediums to increase the effect of a certain communication, thus influencing the public and reaching well defined goals set by an institution (Argenti et al., 2005). Although Pérez (2001) perceives strategic communication as a fundamental resource for a company, other authors such as Schultz et al. (1994) deny this reductionist view of strategic communication, pointing out the need to apply modern techniques of communication to the organization's demands.

The term "strategy" must be addressed along with two other concepts, "tactic" and "plan". One can think of "strategy" as a method to merge the long-term objectives of a communication plan and the decisions to make *a priori*, while anticipating possible scenarios or threats. The "tactic" as a communication tool is made up of all the decisions that should be made beforehand, but can be reoriented and reformulated over time, which is why "time", as a concept, should also be considered when developing a strategic communication plan. This strategy's purpose is to incite one, or more, of the personal responses to science, the vowel analogy.

In Oliveira and Carvalho's 2015 study "Public Engagement with Science and Technology: contributions for the concept's definition and the analysis of its implementation in the Portuguese context", the authors noted that several Portuguese scientific institutions acknowledge their connection to, and influence on society on their respective websites, and one of the key motivational factors for this connection it's their role in stimulating curiosity and interest on scientific pursuits in people of all ages.

2.3 – Strategic communication activities

As previously mentioned, a science communication activity serves the purpose of reaching the objectives of an organization, using predetermined key messages and mediums. These activities are varied, as illustrated in Entrada's study conducted in 2015 "Societal involvement of R&D Units in Portugal", 406 research and development units were inquired on their strategic communication activities. The most common activities registered are the unit's participation in public lectures, any article published in newspapers, or interviews conducted on radio or television. Additionally, the authors highlighted the unit's participation in workshops created by local organizations in their community, and open days at their own facilities.

Supplementary activities worth mentioning, are the holding of press releases, scientific or technological brochures, flyers, or publications, both on magazines and websites dedicated to the theme, the organization of debates, the unit's participation on "Ciência Viva" projects, the developing of projects of citizen science, and events such as "Semana da Ciência" and "European Researcher's Night".

Other activities take a different approach to their purpose, such as the one that took place in

Romania in cooperation with the Untold Music Festival.[1] In 2015, Romania was facing a severe blood shortage in medical facilities and action was needed to replenish the blood levels. With this problem presented, a Transylvanian music festival, the Untold Festival, took advantage of its mythical creature, Count Dracula, to create a campaign in collaboration with the Romanian Blood Transfusion Institute to encourage donors to donate their blood. The festival organizers set in motion the campaign, which would allow for people to access the festival free of charge if they donated blood, and made the phrase "Pay with blood" their slogan. Furthermore, the posters for the festival depicted Count Dracula with an intravenous tube attached to a blood bag. This link to the region's folklore and the campaign's goal to get more young people to donate their blood, resulted in a greater awareness of the cause.

Alternative strategic communication activities could come in the shape of a podcast. The National Aeronautics and Space Administration, or NASA, has multiple podcasts such as "NASA's Curious Universe" or "Houston, We Have a Podcast". This diverse portfolio[2] consists of interviews with elements, being them astronauts, engineers, and scientists, that in each episode will talk about technological and scientific developments and emerging technologies to be applied to space exploration.

In line with the project at hand, the one of communicating science, one can also mention the podcast "NanoCast - Communicating Science with an Accent"[3], produced by Carvalho (2021), developed as part of the PortLingE research project in partnership between the Iberian International Nanotechnology Laboratory and the School of Letters, Art, and Human Sciences of the University of Minho. Across 15 tracks, 15 scientists of different nationalities and backgrounds from the Nanotechnology Laboratory offer insight into their work at the laboratory, as well as answer a few questions in their native tongue. Their answers are transcribed in their own native language, such as Indonesian, Estonia, Danish, and Italian, to mention some. The personal nature of the questions is meant to bring scientists closer to the younger population, or the faction of society that is not familiar with scientists and their work. This possibility of proximity to scientists is what motivated the idea of inserting this podcast in the virtual tour of the Nanotechnology Laboratory, along with other material obtained that will be mentioned further ahead in this report.

2.3.1 - Field trips: tools for education and strategic science communication

Education has always been fundamental in such a manner that future generations can put into

[1] *Pay with blood: Transylvanian festival offers ticket discount for donors.* (2015, July 17). The Guardian. https://www.theguardian.com/world/2015/jul/17/pay-with-blood-transylvanian-festival-offers-ticket-discount-for-donors
[2] Loff, S. (2017, August 01). Podcasts. Retrieved from https://www.nasa.gov/podcasts
[3] NanoCast. (n.d.). Retrieved from http://ceh.ilch.uminho.pt/portlingue/?page_id=2990

practice the knowledge acquired by their predecessors. The practices have varied over the years evolving in methodological terms, however, a huge technological evolution and the widespread use of the internet in recent years significantly altered the way of teaching and learning. This allowed for a more digital and interactive experience for students to showcase their full potential in new learning environments.

According to Shakil et al. (2011), a field trip or study trip is a journey made by a group of people to a place away from their normal learning environment. The purpose of the trip is often observation for education, experimental or non-experimental research, or to provide students with experiences distinct from their everyday activities. Field trips provide the students an opportunity to experiment something new beyond the confines of their classroom, which is necessary for their educational level. Educational visits allow students to have real-world contact and different experiences, as well as increase the student's interest, knowledge, and motivation about the matter.

Researchers have investigated the way knowledge is obtained and the learning that occurs during field trips, and commonly, as referred by Nadelson and Jordan (2012), students who actively participate during a field trip experience develop a more positive attitude towards the core subject of the trip.

Robert and Swalwell (Ainsworth et al., 2013) define field trips as educational experiences that involve leaving the classroom to engage in activities related to learning. The purpose of these trips is for students to familiarize themselves and appreciate their communities and to construct new knowledge. Field trips are processes through which we can analyse constructivist theories of learning, as defended by constructivist philosopher John Dewey. Dewey's philosophy and methods of teaching were based on the principles of learning by doing activities, as he sees education as a lived experience, meaning that a person will experience learning with others. Hence why field trips are important, considering that throughout these activities we can gauge how students understand, contest, and reconstruct concepts, in addition to having a better understanding of how they make sense of the surroundings they are immersed in.

To prepare a field trip one must take into consideration the purpose of the visit, what is the main goal of taking a group of students to a certain location outside of their classroom. As some of the benefits of a field trip are hands-on, real-world experiences, quality of education, positive attitudes to science and motivation towards the subjects, the planning of a field trip must have some strategic thinking behind it.

2.3.2 – The limitations of physical field trips and a virtual alternative

Having seen what a field trip consists of, it is vital to state that they do not come without limitations and disadvantages, as they can be difficult to organize and supervise, as well as coming at a monetary cost from the student. Additionally, physical visits to the INL have their own impediments. They take place at the laboratory, meaning that students must travel there, at a preselected date during the school year. These visits are aimed at students in universities or high schools, and the students' field of study must be science and technology, from the 10th to the 12th grade. The visits are scheduled one month in advance and the age limit of the visitors must be at least 15 years old to attend. Moreover, there are some facilities within the laboratory that are not accessible to the general public and cannot be visited by students. Such spaces include the cleanroom, due to the high-level control of air circulation, and some of the underground laboratories. Another limitation is the fact that researchers from each of the areas developed in the laboratory are not always on the premises, so that they can explain to visiting students something about a particular research area. Distance also has its part in the limitations of face-to-face visits, since, for various reasons, it is not always possible for a student, or even a researcher interested in the Nanotechnology Laboratory, as a research place to develop their work, to move to the laboratory.

Adding to these limitations, we were recently faced with another unexpected one. The Covid-19 pandemic forced upon us a reality where institutions were closed, and we were confined to our homes. This was a main motivator for this project, since we learned that field trips to the Nanotechnology Laboratory had been put on hold.

Virtual tours, however, come as an alternative to these impediments. A virtual tour is a 360° visit of an interior or exterior space, that can be a building or an outdoor location. These visits are used by various industries such as tourism, culture, or real estate, and can include video conference calls, online interactive modules, and live broadcasts from a certain place. This multimedia content can be enriched with sound effects, such as voice-over audios that serve as a guide, videos, textual elements, or images, as well as more interactive content like games and quizzes.

These virtual tours help mitigate financial concerns, allowing for an easier planning and execution of a trip, guaranteeing greater accessibility which grants multiple visits taking place simultaneously.

Offering an example of these virtual tours, one can mention the Smithsonian National Museum of Natural History[4] who provides visits of their permanent, current, and past exhibitions, as well as narrated tours, narrated videos of the exhibitions. Throughout their virtual visits one can see hotspots of closeups of some pieces of the exhibitions, unfortunately there are no information hotspots, so all the information one might gather from their visit comes from what can be read on their information boards.

[4] *Virtual Tour | Smithsonian National Museum of Natural History.* (2020). Si.edu. https://naturalhistory.si.edu/visit/virtual-tour

Likewise, The Louvre Museum[5] has a variety of virtual visits to separate parts of the vast space, with hotspots of information in both French and English. Unlike the visits to the Smithsonian, the ones to the Louvre provide us with information hotspots, as well as closeups of the pieces of art.

The learning platform Discovery Education[6] presents daily curated content, tools, and resources to engage with students with virtual tour videos, podcasts, text, and interactive content.

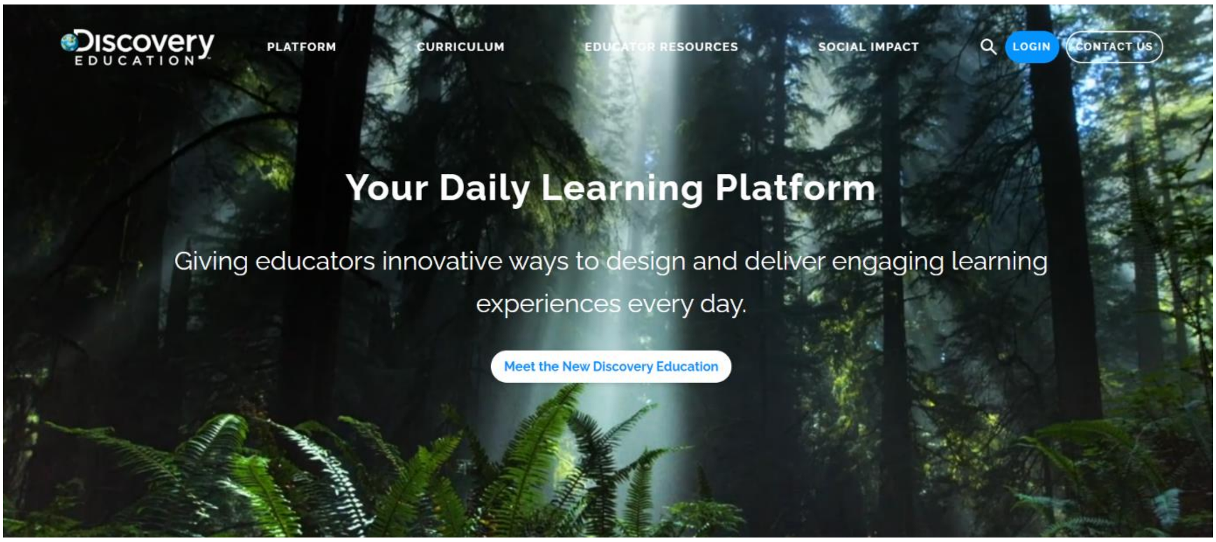

Figure 1 - Discovery Education's homepage

The Discovery Education Virtual Field Trips page allows the user to filter the content they are looking for by area. Some of the options are Health Wellness, Sports, Community Engagement, and Science/STEM/Exploration.

Once the topic and the Virtual Field Trip are picked, the user can watch the video as well as download the Companion Educator Guide PDF file, with an overview of the field trip. This makes possible that a professor or other educator is able to help students and engage with them in real time as they watch the field trip.

5 *Online tours*. (n.d.). Le Louvre. https://www.louvre.fr/en/online-tours

6 *Digital Textbooks and Educational Resources | Discovery Education*. (2019). Discoveryeducation.com; Discovery Education. https://www.discoveryeducation.com/

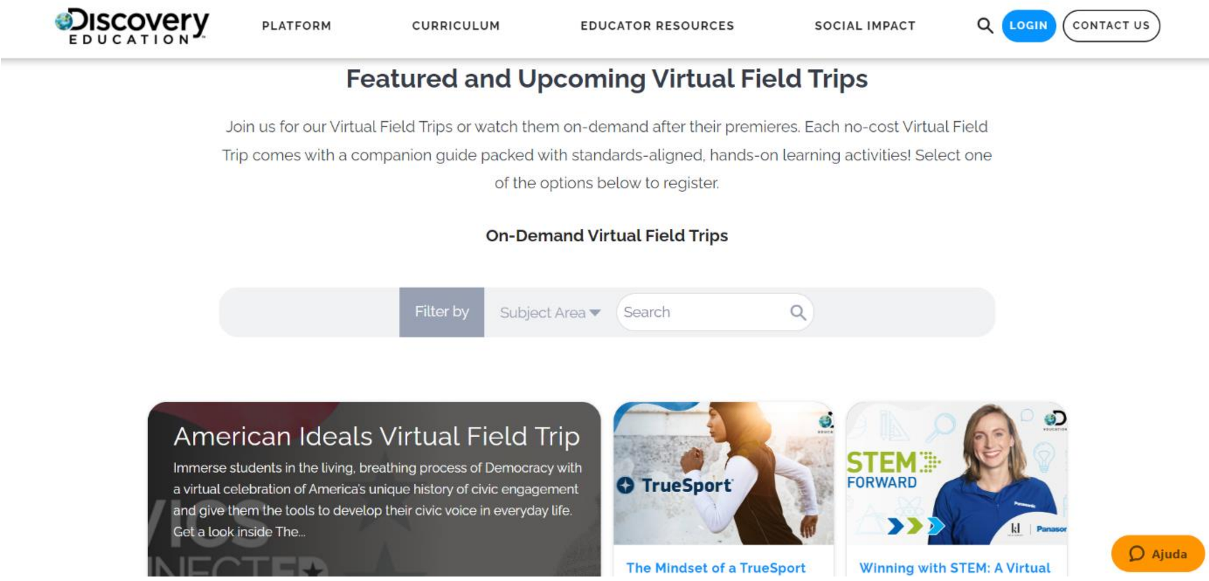

Figure 2 - The Virtual Field Trips page with a filter search bar

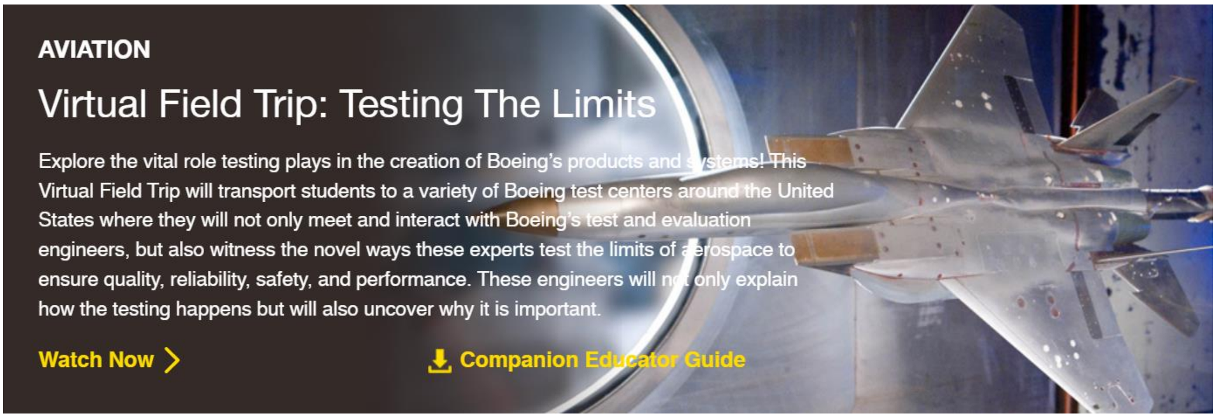

Figure 3 - A Virtual Field Trip with link to video and the PDF file Guide

PART 3 – STRATEGIC PLANNING

For Argenti et al. (2005), the process of strategic communication requires transparency and consistency, along with repetition. Furthermore, its effectiveness depends on the truth of the communication. The choice of the channel used for the communication is also vital, given that one should choose based on their target audience, while simultaneously acknowledging numerous audiences.

For Carrilho (2014), creating a strategy involves outlining a plan beforehand and, from there on, acting with the purpose of adjusting every decision it makes to the objectives established in the beginning of the planning. The first step in the creation of a strategy is knowing where we are heading to. The next step is to coordinate the actions and resources available, to choose the actions that are adequate for the route taken.

There are certain steps to a communication strategy, or a strategic planning. In this part, a definition of each step will be given, as well as how that will be translated in this project.

3.1 – Defining the communication goals

In the first place one must define the objectives of communication, that is what it is meant to be accomplished. At this point, we expect to bring awareness to the work developed at the Nanotechnology Laboratory and hopefully engage students with science and technology.

We expect that our target audience, primarily teenagers from 8^{th} to 11^{th} grades, will increase their interest in science and technology matters by learning about them in a nonconventional and entertaining way, while also making a real research centre and its scientists more easily approachable to the target audience.

Through science communication we expect to awaken, in our target audience and other publics, one or more of the personal responses to science or as it is referred to in the aforementioned vowel analogy: Awareness, Enjoyment, Interest, Opinion, and Understanding, as well as Interaction, or activities of contact, and Action, or behaviours and attitudes. Using specifically strategic science communication as a tool, we aim to present science and technology as a popular and attractive subject, thus drawing students to scientific fields of study, particularly the Nanotechnology Laboratory.

3.2 – The target audience

The following step is the identification of the target audience or audiences, or the people or groups to be addressed by the plan's activities. According to Brown University Science Center's Quick Guide to Science Communication (Brodsky, 2014), a target audience could be individual people or groups that share certain characteristics. Being able to discern who our audience is fundamental to communicate matters of science and technology, thus one must be aware of the more common types of target audiences. They are the policy makers, the media, and the lay public (2014, p. 5).

The communication between scientists and policy makers is essential to the discussion and understanding of matters of scientific nature that will have repercussions in decision making. Scientists can think about and propose solutions to problems concerning the impact said problems have on the decision maker's constituency (2014, p.7).

The media creates the bridge between scientists and the lay public. This is not a uniform audience, as it consists of journalists from newspapers, television, and radio, as well as documentary filmmakers, podcast, and video creators. Communication via media provides a wider access to information by policy makers, the public, and even other scientists (2014, p.6).

The lay public consists of all the individuals or groups who are not experts in a specialized field, whether they are the general public or experts of different fields. One must be aware that even within the same group of a target audience, each individual member is its own person, with unique characteristics, experiences and opinions, as a consequence it is critical to choose the channel that will accommodate the most common characteristics between the members of the target audience.

The target audience of this project are students within the approximate ages of 13 and 17, attending the 8^{th} and 11^{th} grades, on the grounds that these are the ages at which they should choose which course to attend in university. Having this in mind, we are also aware that this project will be accessible to other members of the lay public, including older people, or students of different areas.

Considering the public this project is aimed at, one must work on the storytelling portion of the narrative, since it is also a practical way to engage the public, and it can make the understanding of scientific and technological processes easier. When creating the narrative of a communication one must keep in mind that it needs to be simple while also recognizing the audience's pre-existing knowledge. It is also worth mentioning that jargon should be avoided and, when that is not possible, explained. In this project, a Glossary with terms specific to Nanotechnology, Science and Technology, was created. To make matters more understandable to the audience, it is also encouraged the use of analogies and visuals, such as the one of the wafers in the Nanotechnology Laboratory's Cleanroom.

Figure 4 - Image of a wafer used in Cleanroom processes compared to a wafer cookie

In the caption it reads: "All processes developed in the Cleanroom start with a silicon disk, which we refer to as wafers. Each of these disks can go through 20 to 30 processes.".

3.3 – Key message

Following the identification of our target audience we must produce an axis of communication, or key message, that is what we want to say, concisely. This message ought to answer questions such as "Why should I care?" so, when someone communicates science, they should frame their message in relatable terms that are relevant to the audience targeted. We are required to think about how the audience would approach the problem, and how their personal values align with it.

The message we want to convey is "Science and technology have a major role in our society", "Science and Technology improve our lives and environment", and that "The work developed at research centres greatly aids in improving our lives and environment", thus we must predict that our target audience will ask us "How are science and technology improving our lives and environment?", "Why are they important?" and "What exactly is the work developed at research centres?". In the interviews we conducted with the researchers of the Nanotechnology Laboratory, these same questions were asked. Some of the answers were as it follows:

Manuel Bañobre-López, Group Leader - Nanomedicine: "(...) contrast agents for magnetic resonance imaging, heat generating agents for applications in oncology and specific therapy to treat tumours, or agents - what we call drug delivery systems - to transport drugs to the place of interest and release there the drug in a more controlled way, thus avoiding more toxic effects and side effects that many drugs have.“; “Health is one of the main assets that our society has so, if we work to improve people's health condition to favour a quick recovery, less hospitalization (...) as the disease has to be treated, improving in early diagnosis, and favouring the most immediate possible treatment, in this way we are undoubtedly contributing to a better society.”

Begoña Espiña, Group Leader – Water Quality: “In our group, we have developed systems, for example, for monitoring water to be able to know when we have pollutants (...). We have also developed new treatments for water purification based on nanomaterials, such as selective adsorbents that remove pollutants from the water, or new materials that can degrade these same organic pollutants and disinfect the water of pathogens.”; “Our [research] area is contributing to, what we think, is one of the challenges for society, which is to achieve zero pollution. It is within the challenges identified in the European Union for the next 10 years. Also on the other hand, another challenge is trying to make the best possible use of water. As we all know there is a lot of water scarcity in many countries (...). So, we need new systems that make water use more efficient and allow us to reuse this water.”

Jérôme Borme, Staff Researcher – 2D Materials and Devices: “The sensors we manufacture here will make it possible in the future to detect diseases, much more quickly and practically than today. Allowing a better diagnosis, so that people are treated more appropriately to their health condition.”

Raquel Queiróz, Staff Researcher – Water Quality: “These devices make it possible to monitor water contamination in real time, and this makes it possible to provide real-time information to institutions or companies that manage water resources and take the necessary measures as soon as possible.”

Alejandro Garrido, Staff Researcher – Food Quality and Safety: “(...) to develop methods to detect, in my specific case, mainly pathogenic microorganisms such as Salmonella, Listeriosis, etc.”; “We can provide analytical methodologies to the laboratories of private companies, public organizations, to improve food safety, ensure authenticity for consumers, [and make sure] that there is no food fraud, which can pose a risk.

The interviews, and informative content throughout the virtual tour also provide more knowledge that can efficiently provide answers to these questions, and ideally transmit the messages we intend to.

3.4 – Communication Actions

The planning of communication actions comes next, and that is how we say what we want to say, and where to say it. In short, how we spread the key message. This "How?" is through a virtual field trip to the Nanotechnology Laboratory that has interactive content, videos, podcast, a glossary, and multiple hotspots of textual information throughout. In the sections below, I will explain the processes of the development of this virtual field trip. It is important to keep in mind that this project was developed along with my master's colleague, Ana Sofia Nogueira, and while her report describes the more technical parts of the virtual tour, such as software, image capture and stitching, I will illustrate the initial planning of the visit, the bureaucratic aspects and initial meetings with the Nanotechnology Laboratory, the processing of information for the hotspots, games and videos, as well as the elaboration of a glossary, and the interviews to the researchers.

3.4.1 - Development of the Virtual Tour

In these following topics there will be an explanation of the various steps of the development of this particular Virtual Tour, from the initial planning to the contents created to include in the Visit.

3.4.1.1 – Initial planning and bureaucratic issues

Seeing as this project was developed with the cooperation of an international organization, the Nanotechnology Laboratory, it was necessary to carry out preliminary meetings with the Communication Department to assess the possibility of conducting visits to the laboratory and obtain the necessary authorizations. The first meeting, provided by professor Sílvia Araújo, was with the then Corporate Communication and Marketing Manager of the Laboratory, Jorge Fiens, and in it we introduced him to the project, offering context to our motivation to work on the project, and the path we planned on taking. We were then introduced to Patrícia Barroso, the Corporate Communication and Marketing officer that aided us in every issue we encountered.

Throughout these initial meetings, the Communication Department provided us with fundamental elements for the planning of the visit, such as the blueprints of the building with important sites, and detailed information about the laboratories mentioned in these visits, as well as information on scientific and technological processes developed at the Laboratory.

It was also revealed how a physical field visit unfolds, and the script it follows. The visits begin in the auditorium, with a small introduction to the Laboratory and its background and establishing the visit's rules, as well as the students being confronted with the term "Nanotechnology" and a definition of the concept. Leaving the auditorium, the group follows through the Cleanroom's side corridor, allowing the students to look through the windows into the Cleanroom, since the facility itself is off-limits. The visit continues down the staircase to the level P–2, where the students get to see the High Accuracy

Laboratories and return to the P0 ground floor to visit the Open Space corridor, where investigators work independently. In the final part of the visit, the students ascend to the P1 first level, walk through the P1 Open Space corridor and, finally, get to see the Bio Laboratories facility.

When beginning this planning we had to keep in mind the limitations of a physical visit to the Nanotechnology Laboratory, so that we could bypass them in our visit, in particular the spaces that the students cannot visit, like the Cleanroom, and the fact that the presence of an expert in the area cannot be guaranteed at the time of a physical visit to the Laboratory. In this way, and after examining the material acquired during the meetings, we began the planning process of the visit and establish what kind of educational content would be produced and included in the platform, and with the help of Patrícia Barroso, we also proceeded to select the spaces to be mapped out and included in the visit.

3.4.1.2 – Processing the information and material

Following the meetings with the representatives of the Nanotechnology Laboratory, the next step was to analyse the information provided by them and try to predict what sort of content could be included in the visit.

The Nanotechnology Laboratory was divided, then, into five central locations which are the Nanofabrication Cleanroom, High Accuracy Laboratories, Dry Laboratories, Wet laboratories, and the Central Bio Laboratories, and each one of these places have specific points of interest that were highlighted.

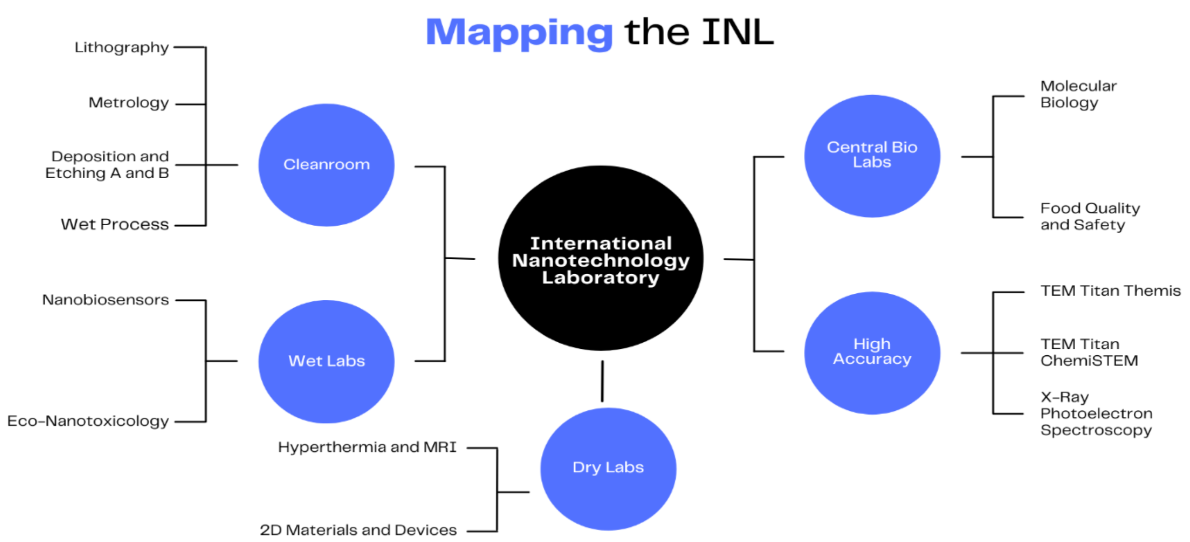

Figure 5 - Mapping the different areas of the INL

In the Nanofabrication Cleanroom, some of the focal points found were the high level of air purity, provided by the constant flow of air from the vents in the ceiling and the floor, controlled humidity, temperature, and pressure. At the entrance of the Cleanroom there is a dressing room where researchers must put on special "clean suits" and walk through a ventilation chamber that blows off as many particles of dirt as possible. The cleanroom is divided into several smaller laboratories, called "bays", and each bay serves a specific process. The first bay serves a process called Lithography, that is the creation of a pattern through transference on a sample surface, a silicon disc that goes by the name of wafer. The following bays contain equipment for deposition and etching of materials in various ways, whether it is electrical or chemical deposition, or physical etching. Finally, equipment that is used for measuring the physical properties of a sample can be found in the Metrology Bay. Most of the research developed in the cleanroom is focused on information and communication technology, with nanostructures, sensors, and more, being built here.

The High Accuracy Laboratories, or the Advanced Electron Microscopy Facility (AEMIS), are located on the P–2 level, and the reason they were specifically built underground is that the vibrations of the traffic and environmental commotion would not interfere with the procedures that take place in these laboratories. In this facility, one can find microscopes for processes such as Transmission Electron Microscopy (TEM), a tool for the structural characterization of materials, X-Ray Photoelectron Spectroscopy (XPS), which is a method of analysis of materials used, or produced, in different areas of nanotechnology, and Fourier Transform Infra-Red Spectroscopy (FTIR System), which is a technique applied in measuring how matter can absorb light, at different frequencies.

The Dry Laboratories consist of the Hyperthermia and Magnetic Resonance Imaging (MRI) Laboratory and the Laboratory of 2D Materials and Devices. Hyperthermia is a procedure in which magnetic particles are combined with an antibody and are placed near the place where the cancer is in a patient's body. These same magnetic particles can also be used as contrast agents in Magnetic Resonance Imaging. In the 2D Materials and Devices Laboratory, the investigators work with devices made with graphene that can be used to detect diseases, and use Raman Spectroscopy, a technique that uses a laser to measure the vibrations of atoms and molecules and can identify all chemical products.

The Wet Laboratories are generally used by biologists and chemists. The Water Quality research group focuses on using nanotechnology to create materials to aid in monitoring, detecting, and absorbing contaminants in the environment. The impact of nanomaterials in the water cycle and the environment is also a concern of this group. In these laboratories one can observe the creation of nano-biosensors, a device that converts a biological event, like a genetic disturbance or an infection, into a measurable signal.

Finally, in the Central Bio Laboratories, the focus is on molecular biology. There are two distinct areas, one deals with the manipulation of samples and extraction of nucleic acid, and another for sample analysis. The work made in these laboratories revolves mainly around the development of new methods with different types of applications, namely in the food industry, with the purpose of avoiding food fraud, detecting pathogenic microorganisms, and assuring food authenticity.

Given that it was necessary to transpose the aforementioned information to a digital resource, we proceeded to select a tool with the potential to fulfil this purpose in order to create this digital resource with interactive features, easy to access by the user and integrable in the virtual tour to be developed. For this purpose, we analysed several tools of content creation, and later chose Genial.ly.

Genial.ly is a platform that specializes in digital resources for content creation with a vast range of educational possibilities. Even though we can choose to begin our work from a blank slate, Genial.ly offers premade templates in several categories, such as Presentation, Training Materials, Gamification, Interactive Image, Horizontal and Vertical Infographic, Guide, and Video Presentation.

For this project in particular we used Presentation, which is similar to a PowerPoint presentation but with the possibility of inserting interactive elements, Gamification, which offers the possibility of presenting content in an innovative way such as in flashcards, as well as classic board games or in escape room format, Interactive Image, which very simply allows us to pick and image and add interactive buttons that open an informative video or text about a specific detail, Training Materials, for elaborating the quizzes, and Horizontal Infographics, that allow for the creating infographics in slide format with interactive elements.

Figure 6 - Interactive presentation on the Nanofabrication cleanroom

Figure 7 - A definition in the interactive presentation on the Nanofabrication cleanroom

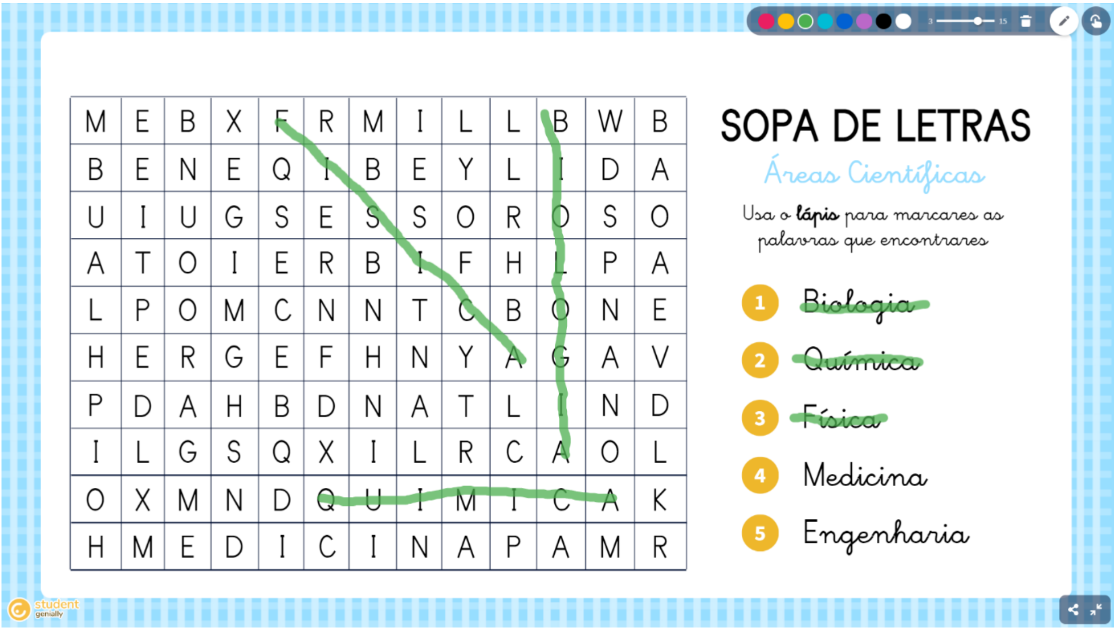

Figure 8 - Letter Soup game, created with the Gamification feature

Apart from the interactive content created on Genial.ly, the website Lapentor also allows for the in-site creation of hotspots, where we were able to provide with some information as well.

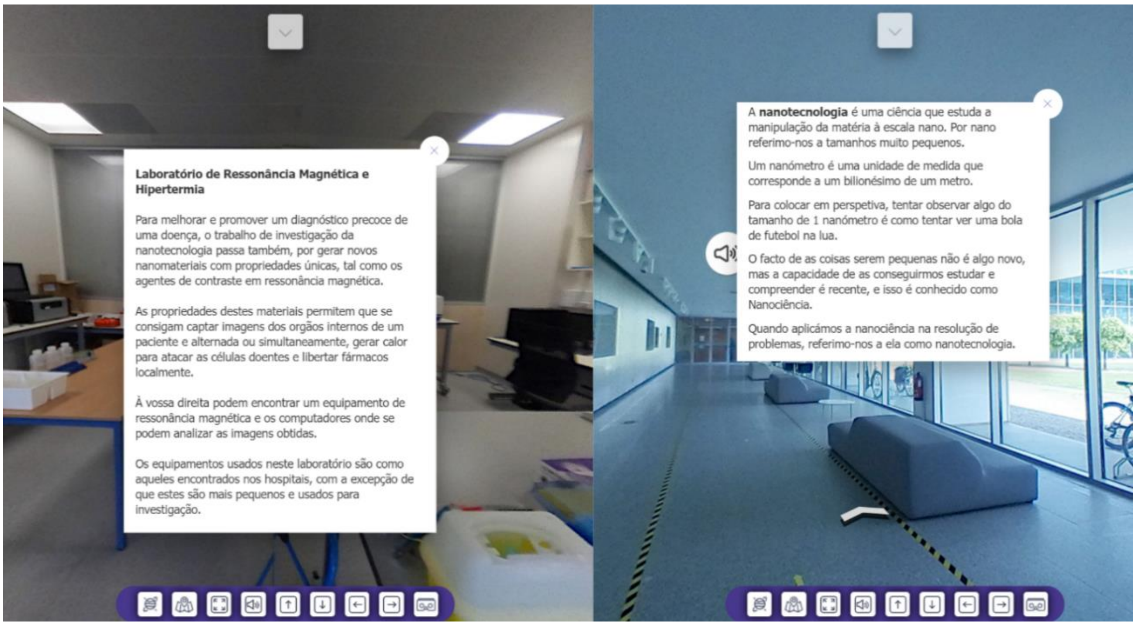

Figure 9 - Information hotspots available in the visit

3.4.1.4 – Glossary

When processing the information obtained from the interviews with the researchers, and the material the Laboratory provided, some of the terms were difficult to understand by someone who is an outsider to the subject, and still, without those concepts, the piece of information to be made into a hotspot would not become clear. Fearing an oversimplification of science by replacing those concepts with a simpler term, a choice was made to compile the more complex concepts and clarify them in an interactive Glossary[7]. A list of the main terms identified, is presented on the table below.

Term	Definition
Adsorbents	An adsorbent is an insoluble, porous solid surface capable of effecting the adhesion of insoluble molecules dispersed in a liquid or gaseous medium to its surface, the adsorbed agent. The interaction between these agents can be physical or chemical in nature.
Anode	Electrode through which positive charge enters a system.
Atom	Atom is the microscopic particle that is the basis of the formation of any substance. It is composed of a nucleus, where protons (positive particles) and neutrons (uncharged particles) are located, surrounded by a cloud of electrons (negative

[7] Found at https://view.genial.ly/6176be1d75e1d50d869fdbc8/interactive-content-glossario

	particles) called the electrosphere, which remains connected to the nucleus by electromagnetic force.
Biointerfaces	A biointerface is the region of contact between a biomolecule, cell, biological tissue or living organism or organic material considered to be alive with another biomaterial or inorganic/organic material.
Biomedicine	Biomedicine is a profession that focuses on the study of microorganisms and the behaviour of cells and tissues to create substances and procedures that treat and prevent pathologies. Biomedical professionals usually have laboratory practices, such as exams and clinical analyses, in their work routine.
Biosensors	Developed based on organic elements, biosensors are small devices, implantable or not, that use biological reactions to detect a particular target, facilitating the disease-identification interface, without losing diagnostic quality, such as sensitivity and specificity.
Cathode	Electrode of the negative end of an electrical conductor that collects or transfers a current when it is in contact with a medium.
Centrifugal force	It consists of an apparent force, of inertia, which manifests itself in rotating bodies and whose effect is to move the bodies away from the center of rotation. It is due to a rotation that continuously varies the direction of movement of the body, giving rise to an acceleration that can be interpreted as an inertia force that pushes it outwards.
Chemical vapor deposition	Several gases are injected into a chamber and these travel to the surface of a sample. The gases end up reacting and being deposited on the substrate, forming thin films.
Contrast agents	The contrast alters the tissue's ability to absorb ionizing radiation during the diagnostic procedure, in this case in Magnetic Resonance Imaging.
Drug delivery systems	Drug delivery systems are technologies designed for the targeted delivery and/or controlled release of therapeutic agents.
Electroplating	Deposition method where a cathode and an anode are immersed in an electrolyte solution through which an electric current passes.

	The metal ions from the anode dissolve in the solution and are carried to the cathode by the electric field, where the sample to be coated with this metal is.
Graphene	A monolayer of graphite, the material that pencils are made of. Graphene was isolated in 2013 by exfoliating graphite using tape.
Hydrophobia	Characteristic of a material or substance that does not absorb or mix with water.
Lift-off	Method of dissolving lithography resin together with a material deposited on top, often with the help of vibrations, namely ultrasound.
Lithography	A process where a design is created on a sample with light-sensitive resin, while other parts of the sample are not covered with resin.
Magnetic hyperthermia	Magnetic hyperthermia was introduced clinically as an alternative approach to the focal treatment of tumours. This process uses the heat generated by the magnetic nanoparticles when subjected to an alternating magnetic field.
Metrology	Measurement science and all its applications.
Microalgae	Microalgae are a diverse collection of microorganisms that drive photosynthesis that develops oxygen. Its biochemical diversity includes the production of a wide variety of carbohydrates, lipids and proteins that are commercially valuable.
Microelectronics	Branch of electronics, focused on the integration of electronic circuits, promoting a miniaturization of components on a microscopic scale.
Microfluidic systems	Microfluidic systems are any device that processes minute amounts of liquid. they have channels thinner than hairs through which fluids pass, and also tiny valves that can turn the flow on and off.
Molecular biology	Molecular biology is the area of biology that seeks to study organisms from a molecular point of view, focusing mainly on the basis for all organisms, the nucleic acids, which form RNAs and DNAs that later give rise to proteins.
MRI	MRI is a diagnostic method capable of showing the organs and tissues of the body in great detail.
Nanomedicine	Nanomedicine is the term used when nanotechnology intervenes in medicine. It consists of using nanoparticles or other structures similar in size, in order to treat diseases such as cancer or AIDS, diagnose and even prevent them.

Nanotoxicology	Nanotoxicology is the branch of toxicology that evaluates the toxicological profile of nanoparticles in organisms and ecosystems, studying the mechanisms of toxicity and cytotoxicity of particles in these.
Nucleic Acids	They are chemically linked chains of molecules that control cellular activity. There are two types of nucleic acids: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid).
Pathogens	Any organism capable of producing disease.
Photoelectron spectroscopy	Experimental technique used to determine the relative energies of electrons in atoms and molecules.
Photosensitive	Something sensitive to light or luminous radiation.
Plasma ashing	Removal process where within a chamber an oxygen plasma is formed on the surface of a sample. The resulting ion beams remove organic compounds on the surface of the substrate being processed.
Point of care testing	Type of testing that involves any type of diagnostic test that is not done in a laboratory. More specifically, this type of test is performed as close to the patient as possible.
Polymer	Polymers are macromolecules resulting from the union of many units of smaller molecules, monomers. There are natural and artificial polymers.
Raman spectroscopy	Molecular spectroscopy technique that uses the interaction of light with matter to determine the constitution or composition of a material, such as FTIR. The information provided by Raman spectroscopy is the result of a light diffusion process.
Reactive ion etching	Removal method where the sample is bombarded with ions formed by the excitation of a gas through a radiofrequency signal. The ions collide with the sample, removing the atoms on its surface.
Sensors	Device that responds to a physical or chemical stimulus in a specific way, producing a signal that can be transformed into another physical quantity for monitoring purposes.
Signal transducer	Parts of a measurement chain that transform a physical magnitude (temperature, pressure, air humidity) into an electrical signal.

Sputtering	Deposition method that consists of a target that is bombarded with a flow of ions from a plasma, generated from an inert gas. Target atoms are extracted from its surface and deposited in the sample. This method allows a controlled deposition of very thin films, at the nanometer scale.
Thermal cyclers	Laboratory apparatus most commonly used to amplify segments of DNA via the polymerase chain reaction.
Wafers	Silicon disks that serve as a sample in cleanroom processes.
Wet etching	Or immersion removal, is a process where the surface of a sample is corroded when placed in a solution that can be basic or acidic. This process is performed to remove exposed material after lithography.

Table 1 - Terms and definitions of the glossary

In Genial.ly, four pages were created, where the forty terms were displayed in two rows of five terms each, making it ten terms per page. By adding two arrows as interactive elements to the pages, it allows for an easier navigation in the glossary.

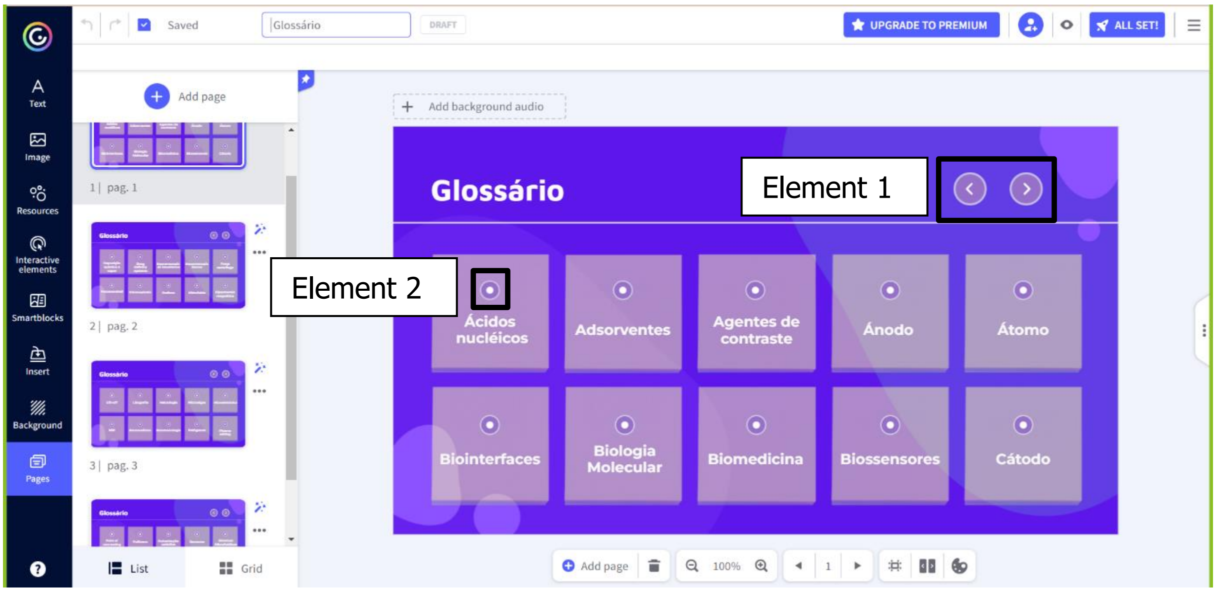

Figure 10 - Genial.ly's work panel

In the picture above, is Genial.ly's work panel. On the far right, dark blue bar, we can see all the tools this software has to produce content, such as text and image options, resources, and the interactive elements. Element 1 refers to the navigation arrows that allow the user to navigate back and forth in the glossary, while Element 2 is referring to the button to be clicked so the definition of the term appears in a text box.

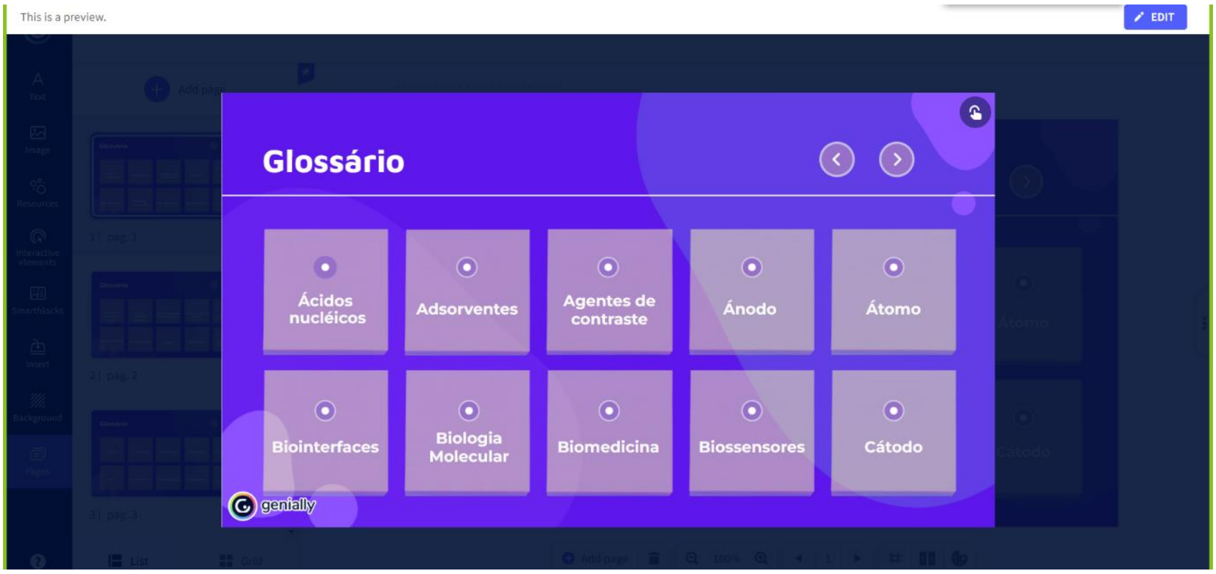

Figure 11 - A preview of the Glossary before publication

Each concept was inserted in a box to which an interactive element was added, and by clicking that element, a small circle, a window opens with the definition of said term.

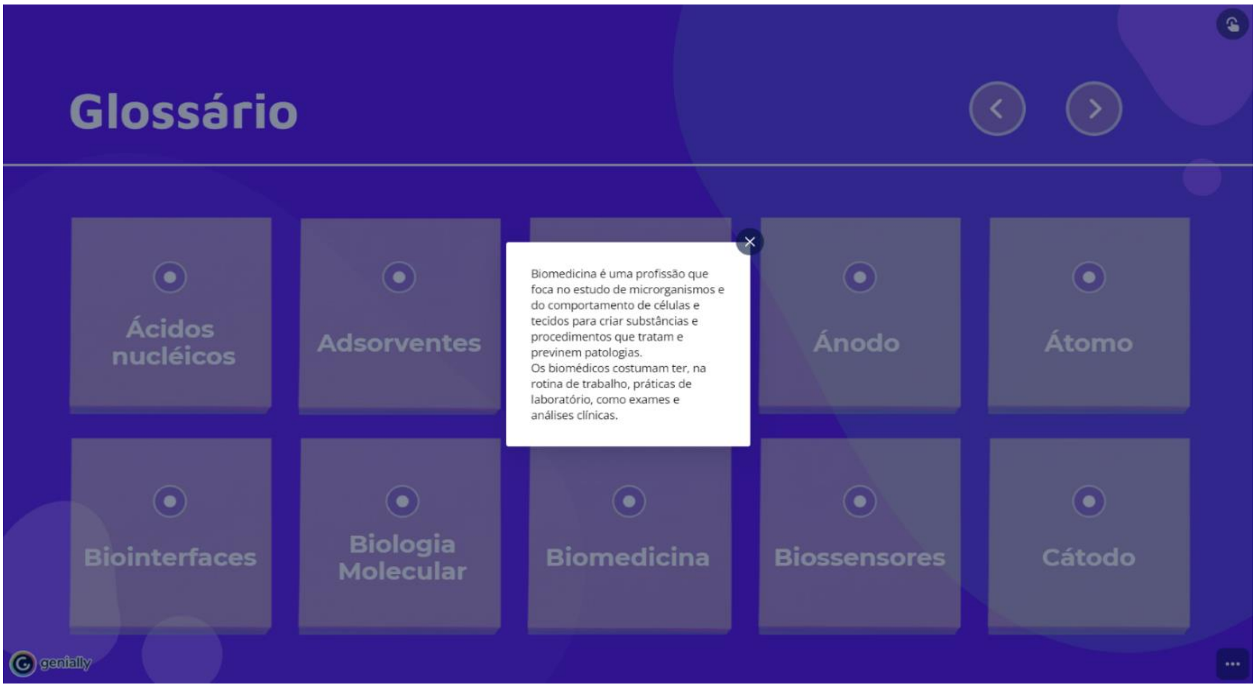

Figure 12 - A page of the glossary, with the window of the "Biomedicina" definition opened

Once finished, this glossary serves as a learning tool as well as prevent an oversimplification of the scientific message. The concepts were collected from both the interviews with the researchers, and the information documents provided by the Nanotechnology Laboratory, followed by the collection of definitions of each of the terms. In the end we have forty concepts that were ordered alphabetically.

3.4.1.4 – Interviews with the researchers

For the interviews with the investigators from the Laboratory it was asked that the ones selected were of different research groups, so the answers were as varied as possible. In the end, there were eight investigators selected to the interviews: Alec LaGrow and Alex Bondarchuck, Managers of the Advanced Electron Microscopy Facility (AEMIS), Group Leader Begoña Espiña and Staff Researcher Raquel Queiróz from the Water Quality research group, Jérôme Borme, Staff Researcher who handles 2D Materials and Devices, Alejandro Garrido, staff researcher from The Food Quality and Safety, José Fernandes, a research engineer from the Micro and Nanofabrication Facility, and Manuel Bañobre-López, Nanomedicine's Group Leader.

Before the interviews, the questions were sent to CC&M officer Patrícia Barroso, and then forwarded to each researcher, so this way they could prepare their answers. The day of the interviews, it was offered a brief explanation of the purpose of that activity right before each interview began. The interviews followed a set group of questions, the first three were specific to the investigator's area:

- "What is your research area, and what does it consist of?"
- "Can you give an example of what you do?"
- "How does this area contribute to a better society?"

The following five questions pertained to the investigators themselves while at the same time asking them to address our target audience, young students:

- "Did you always want to be a scientist, and if not, what did you want to be when you were a child?"
- "What led you to consider a scientific career?"
- "What is the best part of your job?"
- "In your opinion, what does it take to be a good scientist?"
- "What advice would you give a student who wants to pursue a scientific career?"

When elaborating this set of questions there was a concern in making them so that the answers would demystify the preconception that children and teenagers have of scientists and people that work in laboratories and research centres, the old man with dishevelled hair in a long white coat, surrounded by bubbling scientific instruments. Furthermore, one of the goals was to have researchers put in their own words their thought process of what made them choose this career path, and what, in their opinion, is necessary to be a scientist.

The interviews were filmed with the Canon EOS 2000D camera, and later edited on OpenShot Video Editor. This is a open-source video editing software that has an easy "drag and drop" work method, allowing an unlimited number of video and audio tracks as well as images. With OpenShot its is also possible to cut and move around pieces of the original video.

Figure 13 - Alex Bondachuk's interview before editing

This process began by uploading the video of the interview on the software. Then, through drag and drop, the video was moved on the track bellow, "Track 2". Since the interview has parts were our voices could be heard, we cut those bits and moved them to "Track 1", so they could be deleted later and replaced with Question Screens, that will be mentioned later.

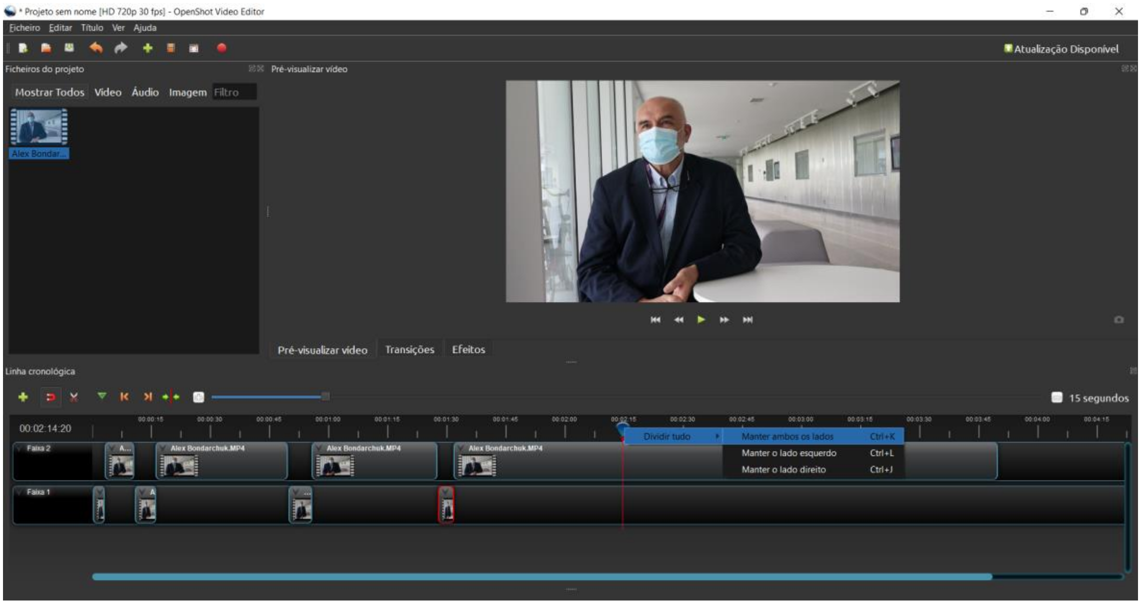

Figure 14 - Video cutting on OpenShot

After all we had were the parts where the investigator answered our questions, the Question Screens, as well as a background soundtrack, were uploaded.

Figure 15 - Video editing with Question Screens and Soundtrack

Once the video was fully edited and exported, it was uploaded on YouTube, since we would need a link to embed the video on Lapentor.

Following the uploading of the video, we had to proceed to the creation of subtitles, since the audio of the video was in English. Thus, we chose to insert the subtitles manually for a more accurate translation. This process was done by repeatedly listening to the video and writing the subtitles in the timeframe correspondent.

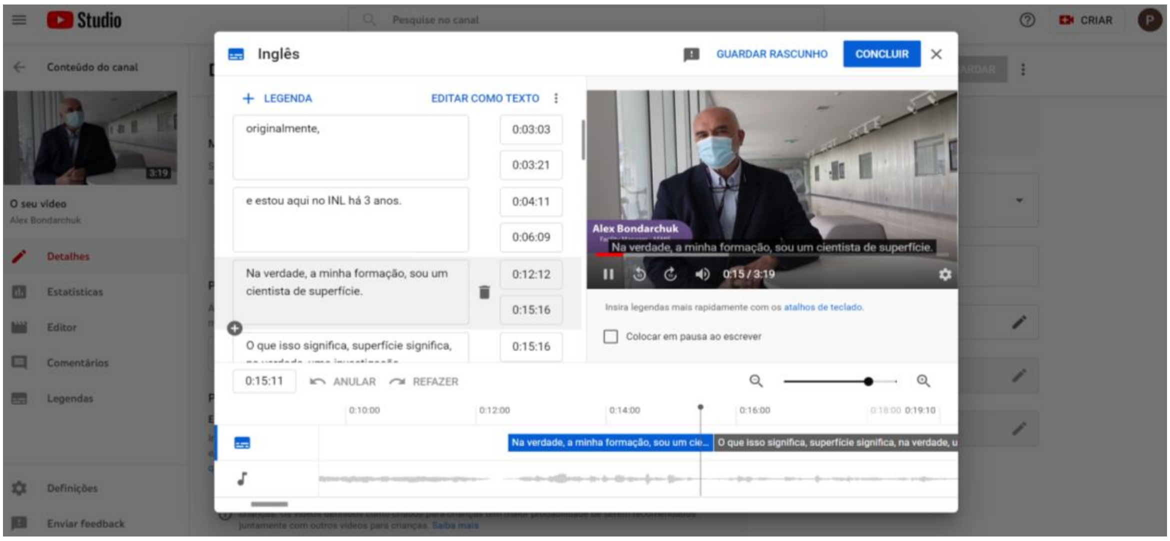

Figure 16 - Subtitling process on YouTube

Finally, the video was uploaded with the subtitles, and a link was generated to be embedded on the Virtual Field Trip. Below we can see what the final product of this edition looks like with the subtitles and Question Screens. This is what the user of the virtual visit can observe.

Figure 17 - Alex Bonarchuk's interview post-editing

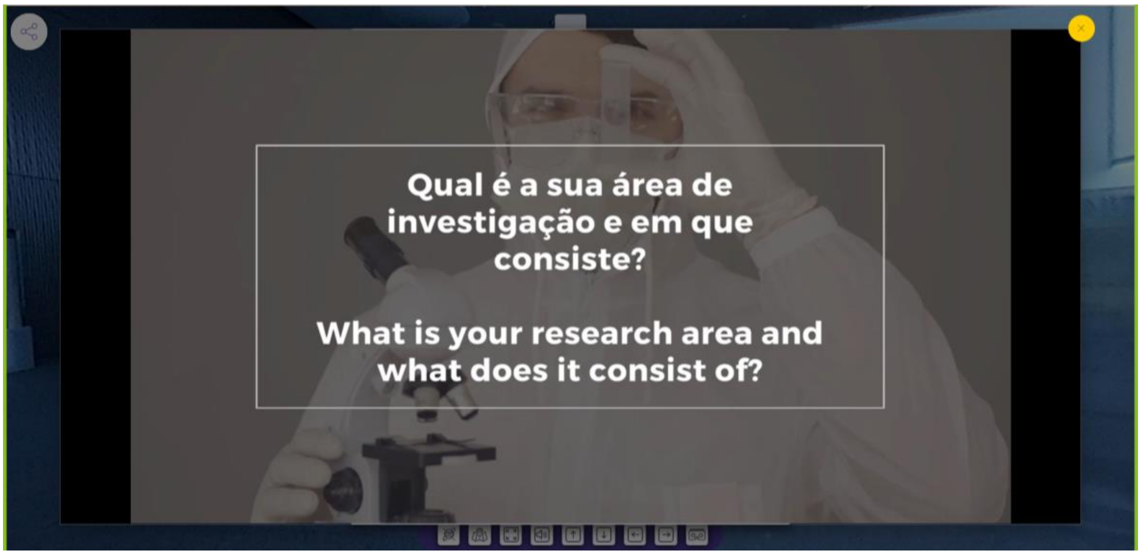

Figure 18 - A Question Screen on Alex Bondarchuk's interview

The Question Screen above was created on Canva, an online content creation tool, with a great variety of templates and content options. Since we wanted animated Screens, we chose the option of video, since it would allow for the creation of small cuts of video with animated images as the background.

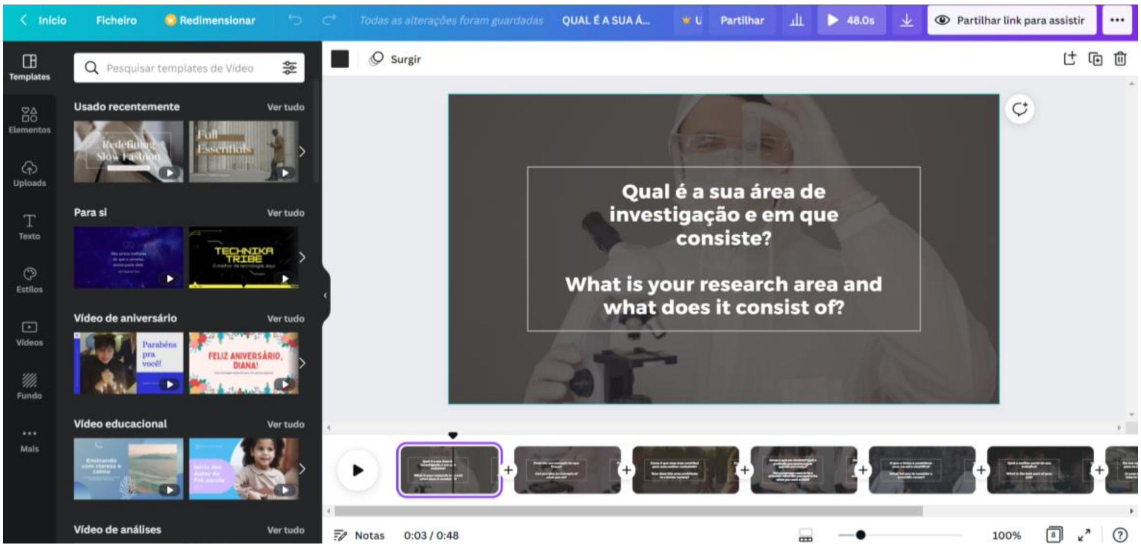

Figure 19 - Canva's work panel

3.5 – Implementation

The implementation of a project specifies the activities, the timeline, and the roles of all parts involved in the communication. The original plan of implementation of this virtual tour would consist of an in-person activity with at least one class of each year, from the 8th to 11th grades, from public and private schools in Braga. This way it would be possible for students to interact with the visit and provide us with real time feedback. However, due to the uncertainty that comes with planning events during a pandemic, and to avoid unnecessary contacts, another plan was drafted.

A questionnaire was made and divided into three sections, and it was released to students who are part of the target audience by professors who agreed to aid us in this part of the projects, but also teenagers of our inner circle. The content of the questionnaire will be elucidated in point 3.6 of this report, but in the second section of the questionnaire has a link to access the virtual tour, allowing the students the time they need to comfortably and comprehensively interact with the visit.

3.6 – Evaluation

The last step is the evaluation, or assessment, of the target audience's attitudes or changes in opinion about our message, which as the Royal Society's report highlighted, it is important to be done via surveys.

As a method for assessing the tour's results, we will evaluate the scientific literacy of our target audience by presenting, to a sample of those individuals, with one questionnaire with three different sections, as mentioned before. The first section of the questionnaire poses questions regarding the student's perception of science, their predilection of educational content in a classroom context, or the gamification of educational content, and their familiarity with the Nanotechnology Laboratory and the work developed there. The second section will allow for their interaction with the virtual tour via a link to the platform created on Lapentor[8], where they can explore the Laboratory and obtain information from the varied hotspots placed throughout the visit. Finally, the third and last section of the questionnaire will shed some light into whether the virtual field trip served its purpose as a strategic science communication means, as well as a substitute for physical educational visits when these are not possible. In this final section, it is also expected to gain some insight on the User Experience aspect of the visit and the knowledge of what can be improved. Feedback from the public determines the long-term success of a communication plan and specifically the successful implementation of the strategy.

Ideally, there would also be a separate questionnaire to be released to students who have previously participated in the physical visits to the Nanotechnology Laboratory, and these individuals would have the opportunity to interact with the virtual visit. This way, it would be possible to compare the two experiences by someone who tested both models and draw better conclusions about their differences. Be that as it may, at the time of writing this report this is not possible considering that the last physical visit of this sort to the Nanotechnology Laboratory was made in 2019, and due to privacy concerns the students cannot be reached.

[8] Found at https://app.lapentor.com/

PART 4 – ASSESSMENT OF THE RESULTS

4.1 – The study sample

The target audience of this project consists of individuals attending the years between, and including, the 8th and 11th grades, with ages ranging from thirteen to seventeen, both male and female.

As previously stated, the original plan would be to have an activity take place at schools, so that the students could interact with the visit, and to get their feedback as they were experimenting the platform. Faced with the inability to do this, the plan became to create a questionnaire on the platform Google Forms, and divide it into four sections, the first is a consent form, the second is an early assessment of our sample pool and the knowledge they have about science, technology and the INL, the third section gives students access to Lapentor, the platform where the Virtual Tour[9] is hosted, and finally a fourth section where the students can provide feedback on the visit, their perception of science and whether it changed or not, and also provide their opinion on what can be improved in the aspect of user experience and interface.

To approach the individuals that are part of our target audience, the link was shared through an e-mail sent to the University of Minho institutional e-mail. In this e-mail was requested that people who had siblings, other family members, or friends that fit into our target audience, that ask them to fill in the questionnaire and interact with the virtual tour.

4.2 – Data analysis

At the time the questionnaire was closed, 22 individuals had replied and interacted with the virtual visit. From this sample pool, 10 individuals were female, and 12 were male, aged from 13 to 17 years. Their answers were collected from November 9th of 2021 until December 12th of 2021. At the time the answers were collected, out of the 22 individuals, 1 person attended the 8th grade, 12 attended the 9th grade, 3 were in the 10th grade, and 6 in the 11th grade. While their gender, age, and school grade were not the focal point of this study, it helped in having a better understanding of the sample pool. The students currently attending the 8th and 9th grades, are, in their majority, considering pursuing courses in science and technology, with humanities, and professional courses having a minor representativity. The students from the 10th and 11th grades attend courses from areas of science and technology, visual arts, socioeconomic sciences, and professional courses.

[9] Link to Virtual Tour: https://app.lapentor.com/sphere/visita-virtual-inl

From their answers it was possible to draw valuable conclusions, on one hand about their perception of science and technology, as well as their importance for society, their learning experiences in a classroom context, and, on the other, conclusions about their experience with the virtual visit, if it improved their perception of science and technology in any significant way.

As aforementioned, the questionnaire that was sent is divided into sections, the first one being the term of consent, the second is the part before the interaction with the virtual tour, known as Part 1, the third section is the access to the virtual tour, and the fourth and final section is the post-visit questions, known as Part 2. Part 1 and Part 2 were planned according to a model of analysis in which the questions were divided into the five personal responses to science by Burns et al., which are Awareness, Enjoyment, Interest, Opinion, and Understanding, while also including Interaction and Action, as well as the User Experience and User interface, highlighting that these last two were applied in the fourth section, post-visit.

The results will be analysed by dividing the questions by dimension of the problem they address, and which part they are inserted, previously to the visit or posteriorly to the visit.

Dimension	**Number of the question**
Awareness	9, 25, 26, 27
Enjoyment	10
Interest	11, 30
Opinion	7, 8, 13, 31, 32
Understanding	32, 41
Interaction	33
Action	17, 18, 35, 36
UE/UI	37, 38, 39, 40
Information about the sample pool	2, 3, 4, 5, 6, 12, 14, 15, 16, 19, 20, 21, 22, 23, 24, 28, 29, 34, 42

Table 2 - Model of analysis of the questionnaire by problem dimension

It must be mentioned that the User Experience (UE) and User Interface (UI) dimensions will be analysed in the report "Planning a gamified and interactive virtual tour to a research centre as an educational resource – the International Iberian Nanotechnology Laboratory" written by Ana Sofia Nogueira, as previously mentioned.

Section of the questionnaire	Questions
Before experimenting the Virtual Tour	2 to 30
After experimenting the Virtual Tour	31 to 42

Table 3 - Distribution of the questions throughout the questionnaire

Despite the questions being identified by their number in the two tables above, a full, translated version of the questionnaire will be available in the appendix 1, as well as in the tables that will follow in this chapter.

4.2.1 – Before experimenting the Virtual Tour

In this section the dimensions to be addressed are Awareness, Enjoyment, Interest, Opinion, Action, and Information about the sample pool.

4.2.1.1 – The dimension of Awareness

Answer Option	Frequency
Classroom	18
Internet	19
News (TV)	10
Magazines and/or Newspapers	0
Field trips	10

Table 4 - Question 9: “Under what circumstances do you encounter science-related activities?”

The question above had multiple check boxes from where the students could pick their answers. Observing these results, we can conclude that the individuals obtain most of their information on science related matters through the internet and the content that can be found there, as well as in the classroom, while field trips and televised news come in third place in preference.

Answer Option	Frequency
Yes	12
No	10

Table 5 - Question 25: “Have you ever heard of the International Iberian Nanotechnology Laboratory?”

Following the question of the table above, question 26 asks “Have you ever visited the INL?”, to which every student inquired has replied “No”. This comes as no surprise, since we have previously established that physical visits to the Nanotechnology Laboratory are very strict and have not been carried out in the past two years.

Answer Option	Frequency
Yes	12
No	10

Table 6 - Question 27: ”Are you aware of the work developed at the INL?”

Following question 27, question 28 was raised. In this short answer question, the students that were aware of the work developed at the Laboratory, mentioned that their personal interest in scientific matters, in particular investigation in the field of microparticles, as well as computer science, which lead them to research about nanotechnology and eventually come across the Nanotechnology Laboratory.

4.2.1.2 – The dimension of Enjoyment

Answer Option	Frequency
Field trips	12
Laboratory activities	16
Visits to science centres[10]	5
None of the above	1

Table 7 - Question 10: “Which scientific activities do you like the most?”

Laboratory activities carried out at school, during class, are the preferred scientific activity by the students. Field trips to research centres or science centres are also an option that the students show

[10] These visits must be understood as the ones students make outside of a school context, the ones they go on themselves or with family or friends.

interest in, perhaps due to the opportunity of a change in environment that they present.

4.2.1.3 – The dimension of Interest

Answer option	Frequency
Yes	9
No	6
Maybe	7

Table 8 - Question 11: “Do you think you can have a profession in science or technology?”

Answer option	Frequency
Yes	6
No	8
Maybe	8

Table 9 - Question 30: “Do you consider the INL as a possible future workplace?”

From these two tables above, we can conclude that opinions on whether the individuals would consider a scientific career path are essentially balanced, with a considerable portion of the sample group still not being sure of it.

Although in this part of the questionnaire, these two questions were given a dimension of Interest, in the post-visit section they will have a dimension of Action.

4.2.1.4 – The dimension of Opinion

Answer Option	Frequency
Yes	22
No	0
Maybe	0

Table 10 - Question 7: “Do you think science is important to society?”

These results pertain to question number 7 of Part 1, however the results are the same for question number 31 in Part 2. The reason why the same question is in both parts is due to on one hand understand their initial thought on science, and on the other, see if their perception of the importance of science had improved post-visit. And by these results one can conclude that it remained the same.

Answer Option	Frequency
Improve our quality of life	14
Improve our knowledge of the world	17
Develop new medicines, cure for diseases, etc.	17
Developing technology	14

Table 11 - Question 8: “In your opinion, what is science’s role in society?”

Considering that in this study the object is a virtual tour of a research centre and its potential as an educational tool, in the options above only pure science was considered. Essentially, our sample believes that science’s role in society is to improve our knowledge of the world and develop new medicines and cures for diseases which, ultimately, improves our quality of life.

Answer Option	Frequency
More women	2
More men	9
As many women as men	11

Table 12 - Question 13: “Do you think there are more men or women in the scientific world?”

4.2.1.5 – The dimension of Action

Answer Option	Frequency
Yes	17
No	2
Maybe	3

Table 13 - Question 17: “Are you considering proceeding to higher education? (Universities, polytechnic institutes).”

Concerning the pursuit of a higher education, the great majority of students consider attending university or polytechnic institutes, and out of the 17 individuals that answered "Yes", almost half of them plan on following a scientific area.

Answer Option	Frequency
Yes	8
No	5
Maybe	4

Table 14 - Question 18: "If you answered "yes" to the question above, are you considering following a scientific area?"

Regarding the 17 students who stated in the previous question that they intended to go on to higher education, we found that 8 stated that they intended to pursue a scientific area and that 4 stated that they also considered this possibility.

4.2.1.6 – Information about the sample pool

Answer Option	Frequency
Yes	5
No	17

Table 15 - Question 4: "Do you have a family member that works in scientific areas?"

Although it is not of major importance to the results of this study, knowing if they have a family member working in scientific areas could help in the students' familiarity of science.

Question number 11 of the questionnaire asks, "Do you think you could have a profession in science or technology?". Out of the sample pool, 7 students replied with "Maybe", 6 with "No", and 9 students answered with "Yes". The later have justified this by mentioning their love for science and technology, the desire to discover things that are still unknown and to contribute to the evolution of science and the quality of life of future generations.

Out of our sample pool 21 in 22 students consider that the use of technology in the classroom is important, and 15 in 22 students would like to see more, and more varied, technological resources incorporated in the classroom, such as videos or movies based on the themes approached in their classes, digital manuals, and a more frequent use of computers. Following this line of inquiry, the great majority of the students consider they would be more motivated to learn if alternative methods were used during class to stimulate a learning environment.

On question 29, it was asked the students what sort of features they would prefer to interact with. The most picked options were Games, Videos, Information in hotspots or articles, and Quizzes, while there were lesser responses for Debates, a Ranking System, or a Glossary of terms.

4.2.2 – After experimenting the virtual tour

After the students had the opportunity to interact with the virtual tour on Lapentor, they provided some feedback on their experience. They still firmly agree that science is important to society, as it can be seen in question 32 – "Do you feel that your perception of science and what is developed in research centres has changed after seeing this visit? Give your opinion on what has changed, or not, from your perspective, before and after seeing the visit.". The dimension of the problem addressed in this question is of both opinion and understanding, as many of the students mentioned that the visit to the INL broadened and solidified the idea that they had about science and made them aware and understanding of the work developed at a research centre like the INL.

Answer Option	Frequency
Yes	6
No	5
Maybe	11

Table 16 - Question 33: "After seeing the visit, do you consider that you could have a profession in science or technology?"

The students that answered "Yes" in the question above, justified it by indicating the interest they have in science and technology matters, as they view these areas as the key to the future.

In question 35, and in line with this answer, 6 in 22 students would consider the INL as a possible future workplace.

Answer Option	Frequency
Yes	9
No	7
Maybe	6

Table 17 - Question 36: “Are you thinking of pursuing a scientific field of study?”

Regarding the virtual visit and the platform that hosts it, most of the students highlighted the positive aspects, being them the videos of the interviews with the researchers, the quizzes and games, the audios, as the students claimed they helped in understanding the visit, and specially that the visit allowed them to see the inside of a place they have never been to.

PART 5 – CONCLUSION AND FUTURE WORK

5.1 – Conclusion

After this journey of research, we can conclude that the reductive view that students still have about scientific and technological matters comes from a lack of interest or general lack of familiarization with these subjects. Therefore, a greater familiarization with scientific and technological matters also depends on a more oriented communication of science, bringing those matters students in a way that they recognize and practice during their academic career, such as an educational field trip.

Field trips with educational purposes are valuable learning tools. When faced with the limitations posed by physical trips, such as the difficulty in organizing and supervising or the monetary costs, as well as the limitations that a visit to the INL in particular has, an alternative based on technology was identified, and in result, the planning and creation of a virtual field trip to the Nanotechnology Laboratory and its contents was set in motion.

With the limitations of a physical visit in mind, it was possible to assess the main advantages of a digital version of an educational trip. When it comes to a visit of this sort, the most visible advantage that one can point out is that there are no constraints about scheduling dates or other issues that traveling generates, as well as all related expenses. A digital educational visit will also allow for the exclusive access to spaces that are not available to the public on a physical field trip, as one can virtually visit the backstage, as the Nanofabrication cleanroom and its bays.

The content created and available through the virtual visit – such as the text and audio information hotspots, interactive videos, the podcast, and the interviews to the scientists –, that can also allow room for details given by the very scientists that develop work in these areas. In essence, a virtual field trip of this sort will be accessible at any time and any place.

The results of the study, provided by the questionnaires, reveal that students find educational content, such as the virtual visit, to be an interesting, innovative, and entertaining way to learn about a new subject and to get to know things that otherwise would not be available or accessible to them, and they would like to see more content of this sort incorporated in their classrooms.

There are considerations to be made about the strategic plan that was created for this project. The communication goals of this project were achieved since it was possible to bring awareness to the Nanotechnology Laboratory and make it and its scientists more accessible to the general public. The answers obtained in the questionnaire also prove that the goal of stimulating at least one of the personal responses to science was achieved.

The target audience was significant in the framing of the storyline of the visit since its previous knowledge had to be kept in mind in order to not oversimplify the message. When it came to defining the key messages, there was an attempt at predicting the questions the target audience would pose, such as "Why should I care?", and the answers came straight from the mouths of the individuals that work at the INL and develop projects that definitely improve our lives and environment, occupying a major role in our society.

The spreading of the key messages was a core concern of the planning of communication actions. The development of the virtual visit consisted of several different steps, some more bureaucratic and other more in the field of content creation. Despite the impossibility of going forward with the original plan of implementation of the communication actions, the alternative that was found, revealed itself to be successful, since it was possible to present the virtual visit to our target audience and obtain feedback from them.

The evaluation is a fundamental part of the strategic communication plan, as established by the Royal Academy's report, and it is best done via surveys. The questionnaires allowed us to assess the familiarity of our target audience with science and technology, as well as their interest and opinion and understanding on the matters, as well as the changes they felt after interacting with the virtual visit in the second section of the questionnaire. Thus, it can be concluded that, as a whole, the strategic communication plan was a successful one.

Despite the success of the strategic communication plan, there were some limitations that must be considered. As mentioned before, there was the impossibility of following the original implementation plan that would allow for a hands-on activity for our target audience, where the virtual visit could be introduced to them and would also give space to a discussion on the visit. For the assessment part of the plan, it would be ideal to have a larger number of answers to the questionnaire, allowing richer feedback on the visit. Both situations were not possible due to the pandemic, which also impacted the amount of people the Google Forms document was spread.

It should be mentioned that an article titled "Planning a Virtual Tour to a Research Center as an Educational Resource"[11] was elaborated and submitted to the "ARTIIS 2021 – International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability", published with the DOI: 10.1007/978-3-030-90241-4_13.

During the elaboration of this project there was also an invite to be a part of the "SIIS – Social Innovation and Interactive Systems" research group, with the goal of producing scientific work in the area

[11] Found at https://link.springer.com/chapter/10.1007/978-3-030-90241-4_13

of social innovation projects.

5.2 – Future Work

The experience acquired in this project opens the door for more science communication activities with a focus on education. Turning the traditional educational materials into interactive and attractive new content, with the purpose of motivating students to engage with those subjects, as well as increasing their interest in pursuing careers in these areas. A closer familiarity with science and technology will incite other sentiments on these matters, and an overall increase of individual's science literacy, ultimately increasing society's science literacy.

There are also invites to participate in Workshops created by SIIS, as well as the presentation of scientific papers at conferences such as the ARTIIS 2022, ICITED´22 - The 2nd International Conference in Information Technology & Education, and the 6th International Workshop on Information and Knowledge in the Internet of Things (IKIT 2022) as well as the 22nd International Conference on Computational Science and Its Applications (ICCSA 2022).

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Appendix 1 – Questionnaire for the students translated from Portuguese to English

14/12/21, 18:47 Form on the perception of science and technology

2. Age *

3. Gender *

Marcar apenas uma oval.

- Female
- Male
- Non-binary
- Prefer not to say

4. Do you have a family member that works in scientific areas? *

Marcar apenas uma oval.

- Yes
- No

5. Father's occupation

6. Mother's occupation

7. Do you think science is important to society? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

8. In your opinion, what is science's role in society? *

Marcar tudo o que for aplicável.

- [ ] Improve our quality of life
- [ ] Improve our knowledge of the world
- [ ] Develop new medicines, cure for diseases, etc
- [ ] Developing technology

Outra: [ ] ______________________

9. Under what circumstances do you encounter science-related activities? *

Marcar tudo o que for aplicável.

- [ ] Classroom
- [ ] Internet
- [ ] News (TV)
- [ ] Magazines/Newspapers
- [ ] Field trips

Outra: [ ] ______________________

10. Which scientific activities do you like the most? *

Marcar tudo o que for aplicável.

- [ ] Field trips
- [ ] Laboratory activities
- [ ] Visits to science centres

Outra: [ ] ______________________

11. Do you think you can have a profession in science or technology? *

Examples: researcher, scientist, engineer, etc.

Marcar apenas uma oval.

- ( ) Yes
- ( ) No
- ( ) Maybe

12. If you answered “yes” to the question above, explain why.

13. Do you think there are more men or women in the scientific world? *

Marcar apenas uma oval.

- More women
- More men
- As many women as men

14. What is your school year at the moment? *

Marcar apenas uma oval.

- 8th
- 9th
- 10th
- 11th

15. If you ANSWERED 8th or 9th grade to the question above, what field of studies are you thinking of pursuing in high school? If you haven't, continue to the next question.

Marcar apenas uma oval.

- Science and Technology
- Socioeconomic Sciences
- Languages and Humanities
- Visual Arts
- Professional Course
- I still don't know

16. If you're a high school student, what field of study are you currently in?

Marcar apenas uma oval.

- Science and Technology
- Socioeconomic Sciences
- Languages and Humanities
- Visual Arts
- Professional Course

17. Are you considering proceeding to higher education? (Universities, polytechnic institutes) *

Marcar apenas uma oval.

- Yes
- No
- Maybe

18. If you answered “yes” to the question above, are you considering following a scientific area?

Marcar apenas uma oval.

- Yes
- No
- Maybe

19. Do you consider the use of technology in the classroom important? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

20. Would you like your classes to incorporate more technological resources? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

21. If you answered "Yes" to the question above, which technological features would you like to be incorporated?

22. What technological resources are commonly used in your classes?

Marcar tudo o que for aplicável.

- [ ] Computer
- [ ] Tablet
- [ ] Videos
- [ ] Movies
- [ ] PowerPoint presentations

Outra: [ ] ____________________

23. Would you be more motivated to learn if alternative methods were used to stimulate students during classes? *

Marcar apenas uma oval.

- ( ) Yes
- ( ) No
- ( ) Maybe

24. Do you use more digital games (mobile phone, computer, console) or non-digital (sports, board games, cards)? *

Marcar apenas uma oval.

- ( ) Digital games
- ( ) Non digital
- ( ) Both
- ( ) Opção 4

25. Have you ever heard of the International Iberian Nanotechnology Laboratory (INL)? *

Marcar apenas uma oval.

- ( ) Yes
- ( ) No

26. Have you ever visited the INL? *

Marcar apenas uma oval.

- Yes
- No

27. Are you aware of the work developed at the INL? *

Marcar apenas uma oval.

- Yes
- No

28. If you answered "yes" to the question above, how did you find out about that?
Se respondeste "sim" na questão de cima, como ficaste a saber disso?

29. On a Virtual Tour of the INL, what kind of features would you like to see? Choose at least 3. *

Marcar tudo o que for aplicável.

- [ ] Games
- [ ] Debates/Forums
- [ ] Scoring/Ranking
- [ ] Information
- [ ] Quizzes
- [ ] Glossary
- [ ] Videos

Outra: [ ]

30. Do you consider the INL as a possible future workplace? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

Interaction with the Virtual Visit

In this section you can interact with the Virtual Visit to the International Iberian Nanotechnology Laboratory (INL), following the link:
https://app.lapentor.com/sphere/visita-virtual-inl

During the visit you will find presentation videos of some of the scientists and the work they do there, as well as information hotspots and audios, quizzes, interactive presentations, a glossary and a podcast.

At the end of the visit, continue to answer the form.
Thanks!

Part 2

Now that you've interacted with the virtual tour, answer these simple questions about the platform's usability, and your opinion about the contents included in it.

Some questions will be repeated in order to check if your opinion has changed after you have seen the visit.

31. Do you think science is important to society? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

32. Do you feel that your perception of science and what is developed in research centres has changed after seeing this visit? Give your opinion on what has changed, or not, from your perspective, before and after seeing the visit. *

33. After seeing the visit, do you consider that you could have a profession in science or technology? *

Examples: researcher, scientist, engineer, etc.

Marcar apenas uma oval.

- Yes
- No
- Maybe

34. If you answered "yes" to the question above, explain why.

35. Do you consider the INL as a possible future workplace? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

36. Are you thinking of pursuing a scientific field of study? *

Marcar apenas uma oval.

- Yes
- No
- Maybe

Appendix 2 – Invites to future conferences: ARTIIS 2022, ICITED ’22, and IKIT 2022

ARTIIS 2022 Call for Paper Invitation, Santiago de Compostela, Spain Caixa de entrada ×

ARTIIS Team
para mim

terça, 22/02, 19:43 (há 5 dias)

| Deadline **June 5 2022** |

Call for Papers ARTIIS 2022

ARTIIS.ORG

Dear Researcher

We cordially invite you to participate in International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability (ARTIIS 2022), to be held on September 12-14, Santiago de Compostela, Spain.

The deadline will be on **June 5**, 2022.

Prospective authors are encouraged to submit papers for evaluation by the Scientific Committee. All papers will be subjected to a “double-blind review” by at least three members of the Scientific Committee, on the basis of relevance, originality, importance, and clarity. Authors must submit an original paper that has not previously been published.

It is planned to publish the proceedings with Springer in their Communications in Computer and Information Science series (CCIS) with Springer. CCIS is abstracted/indexed in DBLP, Google Scholar, EI-Compendex, SCImago, Scopus. CCIS volumes are also submitted for inclusion in ISI Proceedings.

Due to the uncertainty caused by the COVID-19 pandemic, we are prepared to offer online participation. In this context, the conference will be held in a hybrid format (in-Person and Virtual).

We are waiting for you!

For more information Artiis.org .

Kind Regards

ARTIIS Team

[CfP] ICITED'22 - The 2nd International Conference in Information Technology & Education - Rio de Janeiro, Brazil
Caixa de entrada ×

IADITI info@iaditi.org através de sendinblue.com
para mim

segunda, 14/02, 10:39 (há 13 dias)

inglês > português Traduzir mensagem   Desativar para mensagens em: inglês ×

Visualizar no navegador

ICITED´22 - The 2nd International Conference in Information Technology & Education
14 - 16 July 2022, Rio de Janeiro, Brazil,
Proceedings by Springer. Indexed by Scopus, ISI, among others. Face to face and virtual conference.
icited.org

You can submit an article until **April 15, 2022** at: http://submissionicited.iaditi.org/openconf.php

SCOPE
Multidisciplinary conference, transversal to all the sectors of activity that involve Information Technologies and systems in Educational area, namely: Higher Education Institutions, Research and Development, Business & Finance; Public Administration; Economics; Management Science; Information and Communications Technology.

GENERAL OBJETIVES

- Promote a collaborative environment between the academic community in search of improvement and attractiveness of innovation, research and investments;
- Promote dialogue between the scientific community and the main national and international Higher Education Institutions;
- Enable the digital transformation of Educational sector;
- Promote the integrated advancement of the different areas of science with a view to improving the quality of life of citizens and of society in general;
- Encourage young science talents to publish their work in the conference topics, especially in Latin countries;
- Present and debate results from different science and innovation groups in Education and/or Information Technologies and Systems, allowing the emergence of new doctoral candidates.

TOPICS

IKIT 2022 Call for Paper Invitation _ Malaga, Spain Caixa de entrada ×

Ikiit Infos <ikit.infos@gmail.com> quarta, 23/02, 15:52 (há 4 dias)

para Bcc:mim

inglês > português Traduzir mensagem Desativar para mensagens em: inglês ×

Dear Researcher

We cordially invite you to participate in the 6th International Workshop on Information and Knowledge in the Internet of Things (IKIT 2022) in conjunction with the 22nd International Conference on Computational Science and Its Applications (ICCSA 2022) will be held on July 4 - 7- 2022 in collaboration with the University of Malaga, Spain.

The deadline will be on **March 25, 2022.**

Prospective authors are encouraged to submit papers for evaluation by the Scientific Committee. All papers will be subjected to a "double-blind review" by at least three members of the Scientific Committee, on the basis of relevance, originality, importance, and clarity. Authors must submit an original paper that has not previously been published.

It is planned to publish the proceedings with Springer Lecture Notes in Computer Science (LNCS) series and indexed by Scopus, EI Engineering Index, Thomson Reuters Conference Proceedings Citation Index (included in ISI Web of Science), and several other indexing services. The papers will contain linked references, XML versions, and citable DOI numbers.

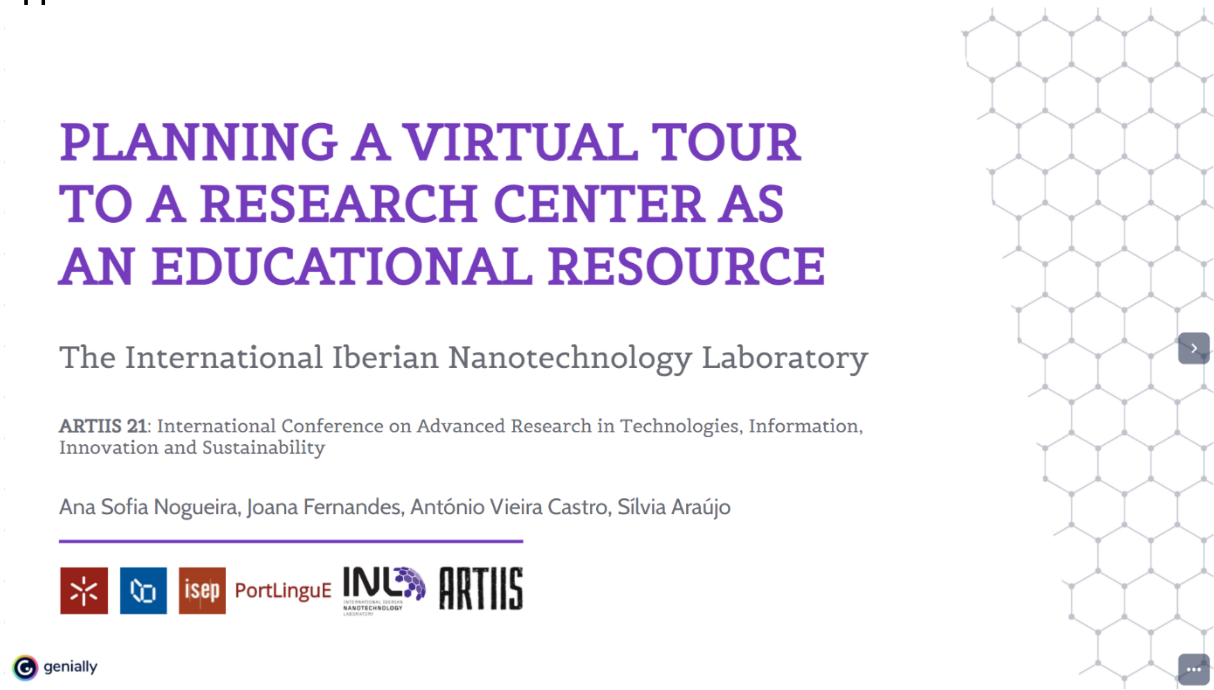
Due to the uncertainty caused by the COVID-19 pandemic, we are prepared to offer online participation. In this context, the conference will be held in a hybrid format (in-Person and Virtual).

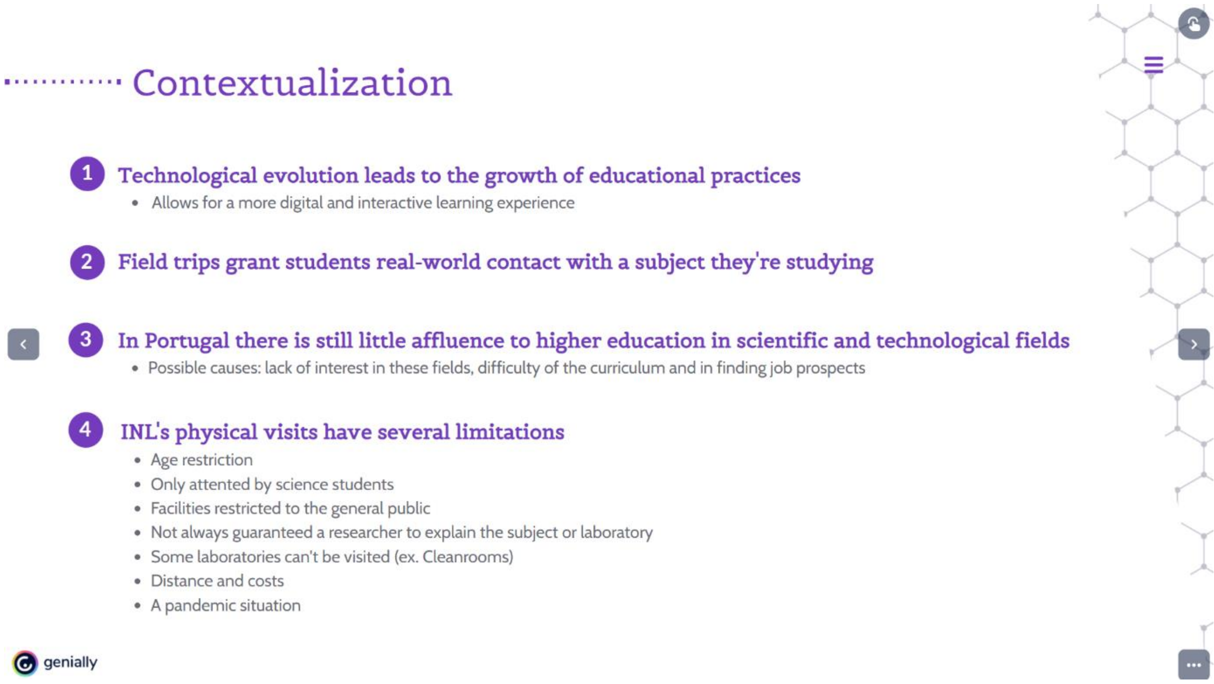
Best regards

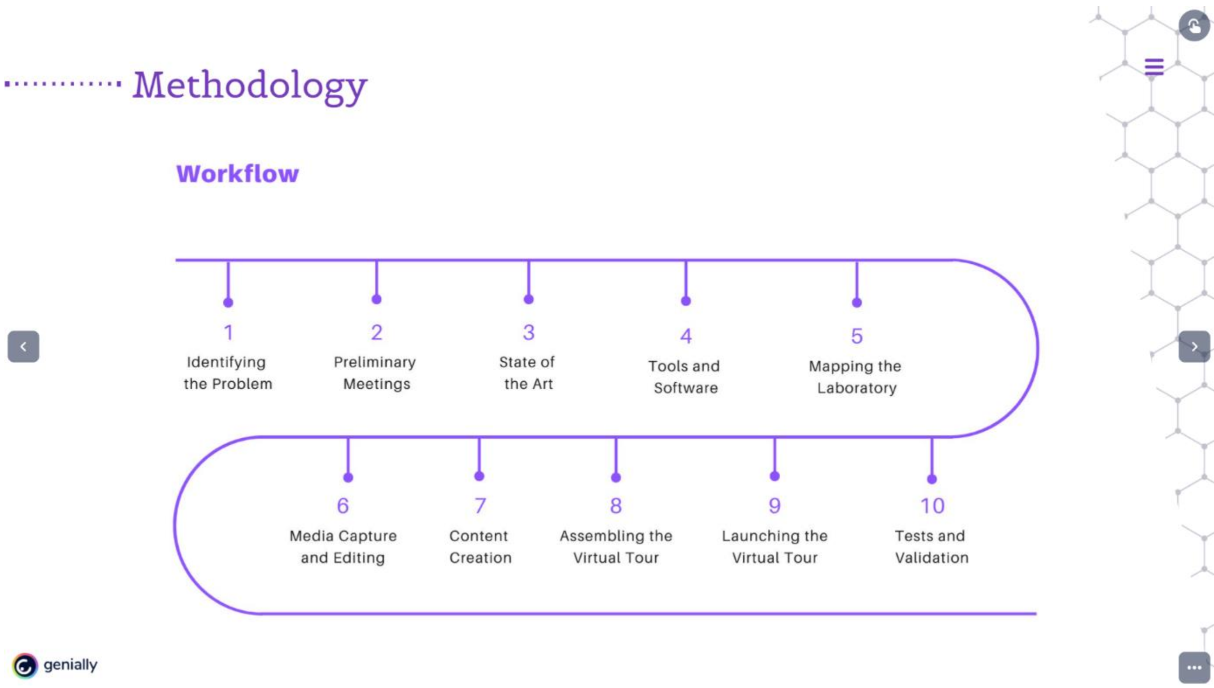
IKIT Team

ikit.info

Appendix 3 – ARTIIS 2021 Presentation






Methodology
Workflow
1 Identifying the Problem
2 Preliminary Meetings
3 State of the Art
4 Tools and Software
5 Mapping the Laboratory
6 Media Capture and Editing
7 Content Creation
8 Assembling the Virtual Tour
9 Launching the Virtual Tour
10 Tests and Validation
genially

Appendix 4 – Certificates of Presentation and Participation in ARTIIS 2021


ARTIIS

International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability

2021

CERTIFICATE

Joana Fernandes

Presented the article "Planning a Virtual Tour to a Research Center as an Educational Resource" in the **International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability (ARTIIS 2021)**, held at UPSE -Universidad Estatal Peninsula de Santa Elena, Ecuador, between the 25th and 27th of November 2021.

Teresa Guarda
General Chair

Maria Fernanda Augusto
Organizing Chair

Filipe Portela
General Chair

CIST Center for Research and Innovation in Systems and Telecommunications is a research unit of the Faculty of Systems and Telecommunications, State University Peninsula Santa Elena, Ecuador

Centro ALGORITMI is a research unit of the School of Engineering, of University of Minho, Guimarães, Portugal

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ARTIIS

International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability

2021

CERTIFICATE

Joana Fernandes

Participated in the **International Conference on Advanced Research in Technologies, Information, Innovation and Sustainability (ARTIIS 2021)**, held at UPSE -Universidad Estatal Peninsula de Santa Elena, Ecuador, between the 25th and 27th of November 2021.

Teresa Guarda
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