

Meeting a scientist: The experience and challenges of communicating science to preschool audiences

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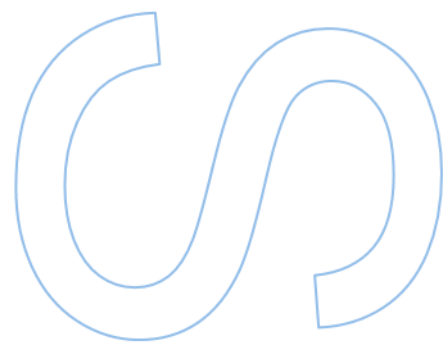
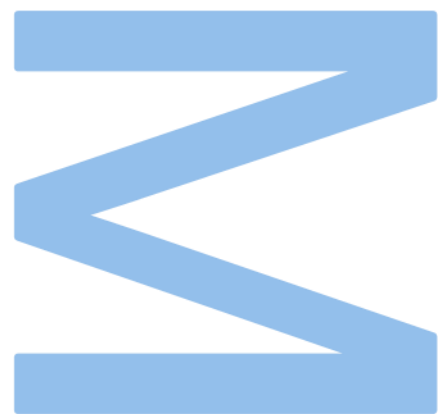
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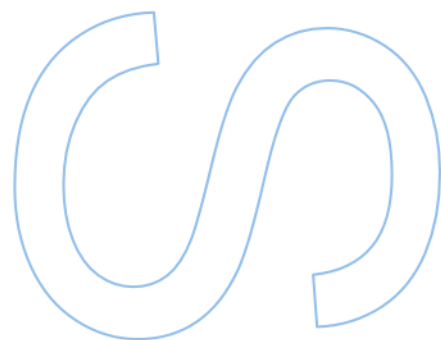
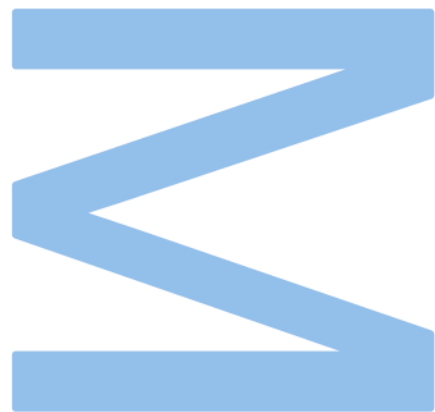
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Dedicated to my family

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Resumo

Existem muitos eventos de comunicação de ciência que envolvem a participação de cientistas, mas poucos são direcionados para o público pré-escolar. Ao mesmo tempo, existe uma lacuna na investigação sobre estes eventos e em particular focada no estudo das atividades desenvolvidas. Começar a partilhar informações relevantes sobre o estudo de tais eventos poderia fornecer no futuro uma estrutura de apoio aos cientistas, o que poderia permitir uma melhoria na eficácia e qualidade das atividades de comunicação de ciência para essas idades.

Esta dissertação investigou a atividade *Encontro com Cientista* dedicada ao público pré-escolar. Esta atividade integra-se na Escola Ciência Viva do UC Exploratório Centro Ciência Viva da Universidades de Coimbra, um programa de atividades dirigido a todos grupos de jardim de infância públicos do Município de Coimbra. O estudo incidiu em 8 sessões (atividades) de *Encontro com Cientista*, realizadas em diferentes semanas, e centrou-se em diferentes aspetos e características dos cientistas e da atividade que eles realizaram para o público pré-escolar. A investigação foi realizada em três fases (pré-atividades, durante a atividade e pós-atividade (reflexão)). A metodologia adotada foi mista (mix-methods), utilizando questionários, entrevistas e observação direta das atividades, para a recolha de dados quantitativos e qualitativos. Para além de estudar as características das atividades desenvolvidas e caracterizar os cientistas participantes, pretendeu-se também perspetivar sugestões e orientações para atividades futuras de comunicação de ciência para o público pré-escolar.

A investigação constatou que os cientistas que participaram estavam em diferentes níveis de carreira, a maioria deles com experiência anterior em comunicação de ciência. Os cientistas apreciavam a possibilidade de formação em comunicação de ciência se esta fosse específica para um determinado público. Mais de metade das sessões foram realizadas por um só cientista e a maioria das atividades não foi testada antes do dia da realização da atividade com as crianças. Em relação às características da atividade, não foi identificado um formato ou estilo específico comum das atividades em geral. Uma característica comum foi a satisfação, sendo que em geral os cientistas reconheceram a necessidade de empatia com o público construída durante a introdução (única parte comum da atividade entre todos). Os cientistas escolheram estilos de atividades que eles acreditavam que o público gostava e iria desfrutar. Alguns dos conselhos dados pelos cientistas a futuros cientistas interessados em participar foram o de usar

linguagem clara e com correção científica, transmitir mensagens simples, diversas vezes ao longo da atividade e ter atividades que interajam diretamente com o público.

Palavras-chave: Cientistas, Comunicação de Ciência, Reflexão, Formação, Educação não-formal, Pré-escolar, Centro Ciência Viva.

Abstract

There are a lot of science communication events that involve scientists' participation, but few involve preschool audiences. At the same time, there is a gap of published research on these events and in particular with focuses on the study of the activities. Beginning to share relevant information about such events could provide in the future a framework for support scientists, which could enable an improvement and quality of science communication activities for those audiences.

This dissertation researched the event *Meeting a Scientist* dedicated to a preschool audience. This event is part of the *Escola Ciência Viva* at UC Exploratório Centro Ciência Viva da Universidade de Coimbra, a program developed for all the public preschool groups of the municipality of Coimbra. The study took part over 8 *Meeting a Scientist* sessions (activities), in different weeks, and focused on the different aspects and characteristics of the scientists and the activity they performed for the preschool audience. The research had three phases (pre-activity, during the activity and post-activity (reflection)). It was used a mixed methods approach, with questionnaires, interviews and direct observation during the activities, for collecting quantitative and qualitative data. Besides understanding the characteristics of the activities and characterising the participating scientists, it was intended to set some possible guidelines for future science communication activities to preschool audiences.

The research found the scientists that participated were at different levels on their career, most of them having previous experience in science communication. The scientists appreciated the possibility of training in science communication if it was specific to a particular audience. Over half of the sessions were performed by an individual scientist. Most of the activities were not tested before the day of the activity with the children. In relation to the characteristics of the activity, a common objective was enjoyment, but it was not identified a common specific format or style of the activities overall. However, in general the scientists acknowledge the need for empathy with the audience built during the introduction (the only common part of the activity between all). The scientists chose styles of activities that they believed the audience liked and would enjoy. Some of the advice given by the scientists for future scientists were to use clear language and scientific correctness, to transmit simple messages several times along the activity and to have activities that interact directly with the audience.

Keywords: Scientists, Science communication, Reflection, Training, Non-formal Education, Preschool children, Ciência Viva science centre.

Table of Contents

List of Tables	vii
List of Figures	ix
List of Abbreviations	xi
Introduction	1
Outline of chapters	2
1. Aims of the research	3
1.1. Contextualisation of the research	6
2. Literature Review	8
2.1. Previous research on the experience of scientists in SciComm	8
2.2. Motivations and deterrents for researchers involved in SciComm	9
2.3. Aims and objectives in SciComm	10
2.4. Format and style of the activity	11
2.5. Preparation of the SciComm activity	11
2.6. Training for scientists in SciComm	12
3. Methodology	14
3.1. Paradigm	14
3.2. Design of the research	15
3.3. Methods	16
3.4. Ethics	25
4. Results and Discussion	26
4.1. Participants	26
4.2. General information about the scientists: Contextualisation/Situation	26
4.3. General information about the Sessions: Contextualisation/Situation	39
4.4. Preparation of the activity	40
4.5. Overall perception by the scientists	64
4.6. For the Future	70
Conclusions	77

Limitations of this research and perspective for the future	85
References	87
Appendix 1 – Introductory email.....	90
Appendix 2 – Other results and discussion	91
A2.1. Contextualisation of the scientists	91
A2.2. Contextualisation of the sessions	91
A2.3. Preparation of the activity	93
A2.4. Overall perception of the activity.....	100
Appendix 3 – Questionnaire Q1	103
Appendix 4 – Questionnaire Q2	114
Appendix 5 – Questionnaire Q3	119
Appendix 6 – Interview I1	125
Appendix 7 – Interview I2	130
Appendix 8 – Observation matrix	132

List of Tables

Table 1 – List of subtopics for the objectives and sub-research questions, with the corresponding data collection methods and the outcome measure.....	5
Table 2 - Stakeholders involved in the general view of the activity. Characteristics of the event.	6
Table 3 - Different factors that affect the activity and its outcomes.....	6
Table 4 - For each session, the number of scientists that participated during each stage of the data collection. And the total number of scientists for each stage (Q1, I1, Q2, I2, Q3).....	19
Table 5 – Example of some types of questions from the questionnaire Q1.....	20
Table 6 – Example of the type of question in the second questionnaire Q2.....	21
Table 7 – Example of some types of questions from Q3.....	22
Table 8 – Comments left by the scientists for other motivations.....	29
Table 9 – Aim and objectives of the activity at the different stages of the research, each line corresponds to the data of a session.	33
Table 10 – Summary of the key messages for each session answered at the different moments ³	38
Table 11 – Dedicated time for preparation of the activity.	41
Table 12 – Style of the activities, resources, setting and engagement.....	54
Table 13 - Data collected during the observation of the activity. Each column is a session. Duration of the different parts of the activity and description of the setting. M: morning, A: afternoon.....	58
Table 14 – Summary of the characteristics of each activity, a session per column.....	59
Table 15 – Interaction and engagement of the audience during the activity from the point of view of the scientists.	68
Table 16 – Favourite moments of the activity, from the perspective of the scientists per session.....	69
Table 17 – Preparation of the activity and changes for the future of the activity.	73
Table 18 – Reasons for wanting to be part of this event again.	74
Table 19 – Advice for anyone interested in taking part in a similar event with a similar audience (preschool).....	75
Table 20 – Summary of the keywords from all of the comments for advice, grouped by topics.....	76
Table 21 – Topics of the activities.....	91

Table 22 – Type of training scientists are interested in. (in brackets are comments from I1).....	97
Table 23 – Concerns about the activity.....	99
Table 24 – Level of engagement with the audience during the activity.	102

List of Figures

Figure 1 – Timeline around the activity day (Orange) where the scientists' participation was required for this research. Three phases pre-activity, during activity and post-activity. And the corresponding data collection methods for each phase.	17
Figure 2 – Scientists' position (data from Q1).....	27
Figure 3 – Experience in SciComm (data from Q1).....	27
Figure 4 – Motivations of the scientists.....	28
Figure 5 – Summary of the key words that represented the objectives of the activities (Q1 and I1) of all the answers. They are grouped as ² : green- emotional, blue- behaviour, gold- education, purple- practical/experience and yellow enjoyment with some educational.	30
Figure 6 – Summary of the keywords that represented the objectives achieved during the activity (I2 and Q3), of all the answers. They are grouped as ² : green- emotional, blue- behaviour, gold- education, purple- practical/experience and yellow enjoyment with some educational.	30
Figure 7 – Selection of keywords that represent the personal objectives ³	34
Figure 8 – Comments from scientists on the personal development objectives (Q1) ³	34
Figure 9 – a) Number of scientists per session (from observation O). b) First time participating in Encontro com Cientista.....	39
Figure 10 – a) First time participating in Encontro com Cientista. b) Sessions re-using materials.	39
Figure 11 - How much scientists considered some general parameters that could help in the preparation and running of an effective science communication activity.	43
Figure 12 – Who supported the scientists in the preparation of the activity.....	45
Figure 13 – How the scientists felt their level of preparation was after doing the activity and reflecting on it, data from Q3.....	49
Figure 14 – Did the scientists have any training in science communication?	51
Figure 15 – Are scientists interested in training in SciComm? a) data from Q1, b) is training relevant? data from Q3.....	52
Figure 16 – Keywords related to interaction and group according to: hands-on and experiences, Dialogue and Descriptive words.....	56
Figure 17 – Keywords related to the effects and grouped according to: Affective, Exploration and Enjoyment.	56
Figure 18 – Do the scientists had concerns or worries about the activity? (data from Q1).	60

Figure 19 – Level of satisfaction about how the activity was. Data from Q3..... 65

Figure 20 – Do scientists want to be part of this event again? Data from Q3..... 74

Figure 21 – Previous audience SciComm experience..... 91

Figure 22 – Perception of the scientists..... 92

Figure 23 – Do you have a Communication office?..... 93

Figure 24 – Need for additional support (I1). 94

Figure 25 – Individual ways of searching for information about science communication.
 98

Figure 26 – Data from Q3 that represent the answers about meeting the objectives and
 passing the key messages during the activity. 101

Figure 27 – Level of engagement with the audience during the activity. 101

List of Abbreviations

FCUP	FACULTY OF SCIENCES OF THE UNIVERSITY OF PORTO
UP	UNIVERSITY OF PORTO
CCV	CENTRO CIÊNCIA VIVA
I	INTERVIEW
O	OBSERVATION
Q	QUESTIONNAIRE
RQ	RESEARCH QUESTION
SCICOMM	SCIENCE COMMUNICATION
S	SESSION NUMBER

Introduction

In this section the research is introduced and contextualised. The research is based on the event *Meeting a scientist (Encontro com Cientista)* which is part of Escola Ciência Viva do UC Exploratório Centro Ciência Viva da Universidade de Coimbra (UC Exploratório Ciência Viva Coimbra, n.d.), in which preschool children (from 3 to 6 years old) participate. This study focuses on the scientists that take part in the science communication activity and the activity the scientists prepared. The research was divided into several topics, so as to provide a global perspective in order to answer the research questions. In the next chapter, the topics will be introduced with the relevant bibliography.

In Portugal, there are several Centros Ciência Viva (CCVs) around the country (Ciência Viva, n.d.), some of which run a Escola Ciência Viva, a full week educational project with a science education program, where, during the school year, for each week, a different school class spends five days in a CCV, together with their teachers, taking part in programmed activities about different subjects and in which, on one of the days, the activity is dedicated to *Encontro com Cientista*. The Exploratório of Coimbra was the first CCV with participants who were preschool children (UC Exploratório Ciência Viva Coimbra, n.d.), and recently O Pavilhão do Conhecimento de Lisboa (Pavilhão do Conhecimento, n.d.) also started a Escola Ciência Viva with a preschool audience. In addition, each CCV has its own particular way of how *Encontro com Cientista* runs, in terms of style, format, etc. There is no public study/report (known to me) that focuses on such an event, on the scientists that take part or the activity, and therefore in the following chapter, it will be contextualised from the perspective of other research that covers similar interests.

There is a lack of published research or reports in this area of science communication where scientists are involved in activities, for example in relation to the characteristics of the activities and in particular to studies where the audience was preschool children. Some of the published research focused on the contextualisation of scientists and general training, but little is studied on the activities themselves, or the particular needs of activities for particular audiences. Some of the later research, interested in supporting scientists when taking part in some science communication activity, had provided some important guidelines to consider for the scientists, but I felt they are general and lack the particularity for a specific science communication context, such as the one studied here, in a specific setting (CCV) and specific audience (preschool).

I felt the lack of (published) research on this event *Encontro com Cientista*, provides an opportunity to start a study that can serve as a base for future research on the event.

The interest of this dissertation was to understand the current situation of the scientists and the science communication activities performed by scientists, in a particular context, with a view in the future for this research to serve as a starting point, to obtain some possible guidelines to achieve effective (when the expected impact of the activity is achieved) and quality (good resources, materials, communication skills, ...) science communication activities.

Outline of chapters

The dissertation is divided into six chapters including this introduction.

In the first chapter (1. Aims of the research) a contextualisation of the research is presented, introducing the aim of the research and the research questions. As well, the general contextualisation and setting of the research is presented.

The following chapter (2. Literature review) provides an overview of the relevant literature for this research, contextualising some of the topics covered with respect to previous studies of interest.

In chapter three (3. Methodology) the methodology used in this research is presented. The research paradigm, the process of designing this research and the methods used, from data collection to data analyses, are described. This chapter also comments on the ethics followed in the research.

Chapter four (4. Results and discussion) presents and analyses the results obtained in this research. The chapter is divided into the several topics of interest, such as, contextualisation of the scientists, contextualisation of the activity, the preparation of the activity, the perception of the activity and the future of the activity.

To end, the last chapter shows the conclusions of this dissertation (Conclusions), where a summary of the main results of this research are presented and discussed with the previous findings in the literature. The conclusions about the three research questions are presented, as well as some of the limitations of this research and future directions for it.

1. Aims of the research

This research aims to develop an understanding of the science communication activities *Encontro com Cientista* and of the scientists that take part in them, as well as to propose some possible guidelines about science communication to preschool audiences.

There are three main objectives, each related to: the scientists, the activity itself and the guidelines for future activities. They are described more in detail as follows.

The objective in relation to the scientists that take part in the activities is to understand their context, their motivations, their needs and allow them to reflect on what happened in order to understand how they perceived the activity and how they see the future of these kind of activities.

The objective from the point of view of the activities performed by scientists with an audience of preschool children is to understand if there is anything/any characteristics in common overall between the activities, even though they are done by different scientists and are about different topics.

As well, this research aims to provide indications and suggestions, from the scientists that already participated in the event, to future scientists interested in being part of such an event.

These three main objectives are related to the three main research questions, which answers should fulfil the objectives of the research:

RQ1: What are the characteristics of the scientists that participate in the event *Encontro com Cientista*?

RQ2: What are the features of the activities for the event *Encontro com Cientista*?

RQ3: What is a possible set of guidelines for scientists that want to participate in an activity with a preschool audience?

A more detailed list of objectives can be found in Table 1. The objectives are separated by topics and subtopics and each has the corresponding sub-research questions, which all of them in conjunction serve to answer the main research questions. In Table 1 is also shown the data collection methods (questionnaires Q, interviews I, observation O) and the outcome measures for each sub question. The questionnaires and interviews followed the same line of thought as the sub-objectives.

RQ1 What are the characteristics of the scientists that participate in the event Encontro com Cientista?					
	Objectives	Q	Questions	Outcome measure	Data Collection
Scientists		Q	Who is taking part in the activities?		
	To Contextualise: the scientists (characteristics, experience in SciComm, ...)	RQ1a	What is the profile of the scientists involved in the activity?	Research status, topic, experience in SciComm,	Q1
	To understand: Motivations or deterrents to take part in the SciComm activity	RQ1b	What are the motivations to be involved in the activity?	Motivations	Q1
	To understand thoughts at different stages of the research: about training in SciComm	RQ1c	What is the interest of the scientists about training in SciComm?	Training in SciComm situation and interests	Q1, I1, Q3
	To view: External perception of scientist's participation in SciComm	RQ1d	How scientists feel their participation is valued ?	Feeling of value	Q1
RQ2 What are the features of the activities for the event Encontro com Cientista?					
Preparation of the activity		Q	How scientists prepare the activity?		
	To understand: the preparation for and of the activity	RQ2a	What are the needs of the scientists to prepare the activity?	Topic, Support, preparation time	Q1, I1
	To understand the thoughts: Aims, objectives and key messages of the activity	RQ2b	What are the aims and objectives of the activity?	Aim/Objectives, Key message of the activity	Q1, I1, O
	To understand: the level of testing of the activity	RQ2c	How are the activities practised and tested ?	Practise, test of the activity	I1
	To understand: Characteristics of the activity	RQ2d	What are the characteristics of the activity?	Format, style, scientific content, resources, interactions, engagement	Q1, I1, O
	To understand: Challenges of the activity	RQ2e	What are the challenges and issues faced?	Challenges, concerns, issues, barriers (topics, resources, audience interaction, engagement, ...)	Q1, I1
	To understand: the general consideration in the preparation	RQ2f	What are the guidelines the scientists consider important?		Q2
		Q	How scientists perceive what happened during the activity?		

Perception of the activity	To understand: Scientist's perception of what happen during the activity in general (scientists, audience, activity)	RQ2g	What is the overall feeling of the scientists when they finish the activity?	Satisfaction, enjoyment, favourite moment, interaction, engagement, scientists and audience	I2, Q3, O
	To understand: Scientist's perception of the fulfilment of objectives, transmission of messages and intended interaction	RQ2h	How aware are scientists about the fulfilment of the activity objectives ?	Objectives, key message, interaction, engagement	I2, Q3, O
	To understand: Scientist's perception of what happen during the activity to the practical part of the activity	RQ2i	How scientists viewed what happened to the specifics of the activity?	surprises, preparation, resources, materials	I2, Q3
Future of the activity		Q	How scientists see the future of the activity?		
	To understand: with respect to what happened, the suggested changes a future activity	RQ2j	What scientists think they should change if they repeat the activity?	Activity changes	I2, Q3
RQ3 What is a possible set of guidelines for scientists that want to participate in an activity with a preschool audience?					
Suggestions	To obtain a list with advice/suggestions for future scientists from the scientists that already participated.	RQ3a	What advice scientists think is important to have when participating in this event?	Advice and suggestions	Q3
	To identify a list of advice about the characteristics of the activity for preschool audiences	RQ3b	What are the common characteristics between the activities for a preschool audience?	Style, format, resources, setting, ...	O, Q3
	To identify a list of guidelines about the general considerations for scientists that want to take part in the activity for preschool audiences	RQ3c	What is the general process to consider when preparing an activity for Encontro com Cientista?	Considerations, objectives, motivations, preparation time, resources, ...	O, Q3

Table 1 – List of subtopics for the objectives and sub-research questions, with the corresponding data collection methods and the outcome measure.

1.1. Contextualisation of the research

In this part, it is shown a general view of the whole context of the research. The stakeholders' box (Table 2) shows everyone that was involved in any way at some point in the activity *Encontro com Cientista*. As well in Table 2 is shown the general characteristics of the event. Then, in Table 3 is shown several of the factors that could influence this research and the activity in itself, from the situation of the scientists on the day they took part on the research, to when they were doing the activity, as well as, the situation of the audience taking part on the activity and the possible outcomes of the activity, what the stakeholders expected or wanted to achieve from the activity or this research.

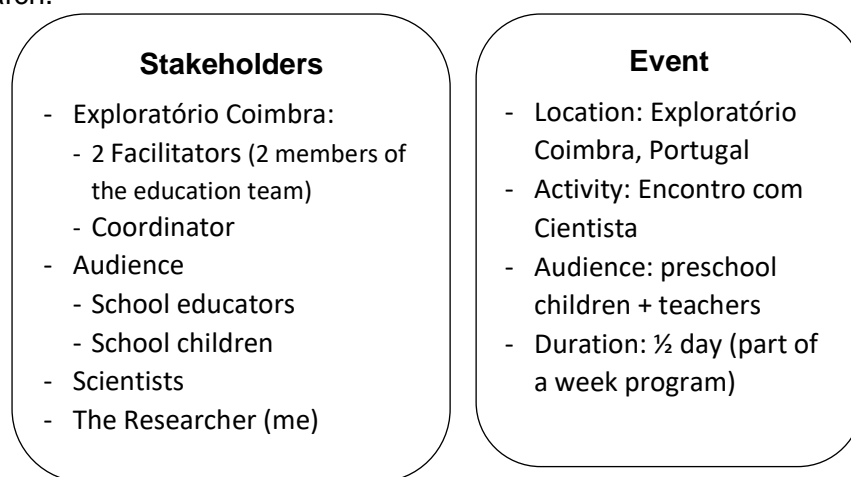


Table 2 - Stakeholders involved in the general view of the activity. Characteristics of the event.

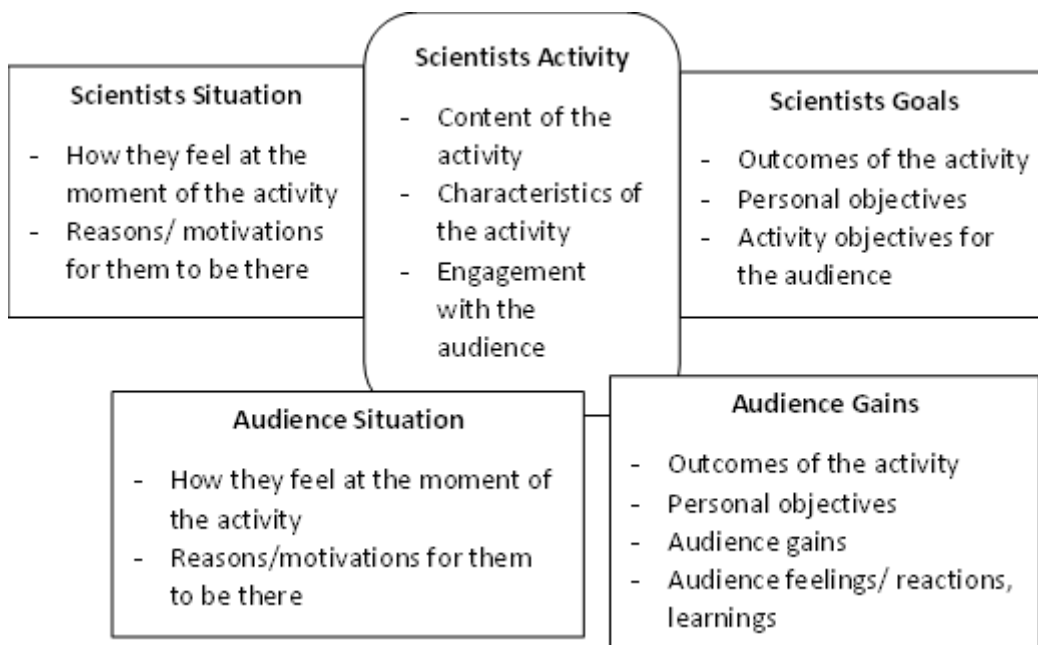


Table 3 - Different factors that affect the activity and its outcomes.

The interest of this research focused on the study of the scientists and the activity, but not on the audience, however, it could be an important point to consider in the general and broad view of the activity. This perception of the audience is covered from the personal perspective of the researcher as an observer during the activity and the perception of the scientists.

2. Literature Review

In this section, it is presented an overview of the relevant literature in science communication. There is a lack of published research or reports on the subject, although a huge number of SciComm events exist. For some of the research topics of interest in here, for example, we were not able to find anything related to them, such as, the characteristics of the activity and more in particular for activities where the audiences were preschool children.

The review covers some of the topics of interest related to this dissertation and it is divided in a similar way as the topics of research.

2.1. Previous research on the experience of scientists in SciComm

There is a study, performed by the Royal Society in 2006 (The Royal Society, 2006), that focused on examining the views and experience of UK scientists and engineers. It tried to obtain a general overview of what were the factors affecting science communication. The study showed the reasons for engagement, the situation with training, the support for scientists, etc, all these topics being similar to the ones touched on in this dissertation. A previous report by MORI in 2000 (MORI, 2000) looked at understanding how scientists perceive themselves and their involvement in SciComm around different aspects. They looked at who and why the scientists participated in SciComm, their attitudes towards communicating, what were the barriers for not participating and how they participated, as well as, what they thought was the image of a scientist perceived by non-scientists and a whole set of broad information from the scientists' perspective. The report concluded that better communication could have numerous personal and societal benefits, and it recognised several barriers to communication (time, training, support, etc.).

Olesk et al. (2021) provided a definition for quality as a property of SciComm content, i.e. the input by the communicator, while effectiveness describes the impact of the communication, i.e. the response the communication elicits in the public. Another definition for effectiveness was given by Besley et al. (2017), which says it is the ability of scientists to affect the behaviour of those with whom they communicate. There was one project, QUEST (QUEST, n.d.; Davies, 2021), which researched from a broad point of view in SciComm, but in specific scientific topics, the situation of SciComm in Europe, from the current practices, research and teaching in SciComm to social media and museums. They proposed tools as incentives toward quality SciComm for different stakeholders, providing a set of quality indicators for SciComm (Olesk, 2021), and

concluded that quality is a property reflecting the integrity of the framework, it is multi-dimensional, organised in three quality non-hierarchical dimensions which are, trustworthiness (scientific quality), presentation and style, and connection with society, with a total of 12 quality indicators. Some of their suggested tool kits (QUEST, 2021) served as the base for one of the questionnaires (Q2) in this project. Aligned with effective SciComm, in the research of Mercer-Mapstone & Kuchel (2017) about creating teaching resources, they provided a list of 12 core skills to consider.

2.2. Motivations and deterrents for researchers involved in SciComm

In order to contextualise the scientists that participate in events of SciComm, it is important to understand their motivations for participating, where motivation is defined as why the communicators are choosing to communicate (Lewenstein & Baram-Tsabari, 2022). There are some previous studies on the subject of motivation, for example the project RETHINK (RETHINK, n.d.), that analysed the working practices of current online science communication globally in seven countries (Portugal, Italy, the Netherlands, Poland, Serbia, Sweden and the UK). Previously, the RETHINK project had studied who communicates what to whom, how and why, what they called the SciComm ecosystem (RETHINK, 2021). Some of their conclusions mentioned “many scientists feel an intrinsic motivation and sense of responsibility to engage in science communication and want to democratise science”. The report of RETHINK (RETHINK, 2020) and published in the paper from Wilkinson et al. (2023), asked about the motivations and barriers, giving several options, and they found that it was an individual motivation rather than institutional, and the majority of respondents selected “enthusiastic about these topics”, “part of their job role” and “keen to educate others about science, technology and/or health”, with these answers connected to the intentions (aim) of the communication. They also studied the barriers, obtaining “lack of time” and “lack of resources” and “difficult to get others involved” as to what prevented respondents from being more involved, with academic actors also mentioning “lack of reward and recognition”. In the paper, Wilkinson et al. (2023) mentioned doing SciComm for a perceived personal benefit, such as career aspirations, personal enjoyment and satisfaction, also researchers can learn from the communication experiences and it can improve their teaching. Wilkinson et al. (2023) mentioned that a motivation for researchers/lecturers/professors was the opportunities to work with other organisations. In the QUEST project (Mannino et al., 2021), some of the study was about the obstacles faced by scientists, and they found

that scientists perceived SciComm to public audiences as an extra effort that brings great satisfaction, but which is very demanding in terms of time for preparation.

2.3. Aims and objectives in SciComm

It is important to define what aim/goal and objective mean, where the paper by Besly et al. (2017) says: communication goals are considered to be the long term, the desired outcomes of a plan of action, while communication objectives are short-term antecedents of goals, the objectives contribute towards achieving the goals. In a way, the objective is the direct effects of communication and the aim/goal is the ultimate outcomes that the communication wants to achieve. Another term used is the purpose, defined as what the science communicator is trying to achieve (Lewenstein & Baram-Tsabari, 2022).

The role of the scientists in this research is what the RETHINK project called conduits, “explaining or translating science from experts to non-specialists” (RETHINK, 2021). In this category, they found that the aim of the science communicator was to “inform” the public about science, or “educating” the public, because the motivation was to educate others about science, due to the thought that new research and scientific information and facts were the most important aspects of science to communicate. Another report from RETHINK (RETHINK, 2020) mentioned the same results, with “inform” the most mentioned answer for what they tried to achieve, followed by “educate” which suggests a deficit model of communication, however, value in dialogue was shown in the answer “create conversations between researchers and the public”. Some other answers reported were “inspire young people to pursue a career in science” or “entertain”.

Another study in relation to communication objectives, i.e. what scientists hope to achieve, (Dudo & Besley, 2016), mentioned 5 types of impacts, (informing /educate others about science, exciting others about science, ensuring others see scientists as trustworthy, framing messages to resonate with people’s existing views, and defending science from perceived misinformation). They selected excitement as a specific communication objective because it was shown that sparking interest and excitement can play a role in the future in stimulating public motivations to seek opportunities to learn about and engage with science. They concluded that “knowing your audience” means “thoughtful about what types of impacts we are hoping or expecting to have on those with whom we are communicating and the logic of how we think those impacts are most likely to occur” (Dudo & Besley, 2016, p.15).

Lewenstein & Baram-Tsabari, (2022) give some examples of goals or purposes intended by the science communication such as: entertain, to motivate and inspire, to inform, to persuade, to consult, to engage different audiences.

2.4. Format and style of the activity

Historically, there has been different styles of communication, starting with the one-way communication or transmission model, called the Deficit Model, which Lewenstein & Baram-Tsabari, (2022) defined as the intuitive belief that providing information will change science-related attitudes or behaviour, however, evidence suggested this model was not delivering. Later the bi-directional model, i.e. dialogue model, was introduced, with a contextual approach, where dialogue, discussion and debate are involved (Miller, 2001; Dudo & Besley, 2016). Evidence shows that a key role shaping views about science is the affective factor (Dudo & Besley, 2016; Bray, 2012), engaging scientists who are willing to listen and be likeable, because from high quality interactions stem positive beliefs about science and scientists. The communicators need to know the audience, Miller (2001) says: “why the facts being communicated are required by the listeners, what their implications may be for the people on the receiving end, what the receivers might feel about the way those facts were gleaned and where future research might lead” (Miller, 2001, p.118).

2.5. Preparation of the SciComm activity

Besley’s paper talks about “tactics” (Besley et al., 2019), where tactic is defined as a type of behaviour in order to build on well-established behaviour change theory, in the context of strategic communication, it is a set of choices communicators make when trying to achieve their communication objectives. The paper (Besley et al., 2019) suggests six specific tactics: the first one is the scientists’ willingness to dress in ways that help connect with audiences, with an expectation that could help achieve communication objectives related to shared identity, and because the challenges scientists seem to have to dress appropriately and how that plays a role in science stereotypes; the second is for scientists to share the pro-social motivations behind research, because the role played by the perception of caring (warmth) in how people view scientists; another is storytelling, narrative; another is meaningful two-way dialogue, audiences feel heard; deliver a common message, scientists working together to define and deliver impactful and consistent messages that resonate with desired audiences; and the sixth is about how to deal with opponents, those who disagree. These tactics are part of the theory used for strategic SciComm as planned behaviour to help science communicators achieve their short-term communication objectives and long-term behavioural goals.

2.6. Training for scientists in SciComm

A few studies analysed the situation of courses that train scientists in SciComm at different levels, analysing their curriculum around the world. Bray et al. (2012) suggested that due to the importance of affective communication, SciComm courses should focus on the audience and how to access their needs, priorities and imagination, therefore, the communicators should acquire skills that allow them to establish a strong, affective and honest connection with the audience, the course should encourage students to develop a broad knowledge (scientific and social), and not just focus on technical skills development. They suggested to explore interactive strategies rather than only technical media skills, using techniques such as role play, debates or case study analysis, in order to develop affective communication skills. A more recent paper about how to organise training, from Lewenstein & Baram-Tsabari (2022), studied the learning objectives at different levels, about what to teach to whom and why. It commented that more than learning skills was needed to learn how to communicate science, in order to develop an identity as a science communicator, such as affective aspects, content knowledge, methods and skills, reflective practices, actual participation and gaining hands-on experience. Based on learning theory, they drew different stages of training, the first is the key stages in learning, at this stage learning should include: audience-center communication (analyse the audience, who, context of communication, previous knowledge, seeking specific information for their needs, cultural and historical context, look from the audience perspective), deficit model vs. public engagement, co-production of science and society and trust. The next stage they mentioned is learning progression where the learners should identify foundation knowledge to help them improve their reasoning and understanding to finish the last stage with community practice, where the science communicator should develop an identity within the categories of SciComm community practice. They concluded with a classification of learning strands, divided between general and specific and identified essential and advanced learning objectives, with some general objectives versus ones that were specific for a SciComm environment.

Llorente & Revuelta (2023) paper identified the existing models of teaching SciComm to scientists, mentioned that most scientists have never been trained in science communication. They suggested that better quality SciComm could come from training scientists, which could help them become better communicators, providing them with tools to anticipate and overcome the barriers and problems currently holding back SciComm. They identified three models of the teaching of SciComm to scientists, with the objectives they pursue being complementary, practical (provided tools and skills to perform specific SciComm practices), reflective (provided background and theory on

SciComm and encouraged understanding of the relationship between SciComm and society) and disruptive models (based on instructing scientists in the structural changes currently taking place in the production of scientific knowledge, important when communicating controversy). In the paper they also analysed teaching SciComm as a profession, where they identified two models: professional model and research model.

From this introductory review of the relevant topics related to this research, it is possible to see that SciComm is very broad and complex and when it comes to SciComm research, there are diverse interpretations and approaches to the same topics, there is not one theory that explains one topic, it feels like each individual author aligns with their own approach and definitions. Science communication research is a field under development and a little body of research has been published. Therefore, this introduction serves as a base, presenting a brief summary of the relevant information that has a common interest with this research for this dissertation.

3. Methodology

In this section it is described the fundamentals of the process to design this research. The research was designed in order to answer the research questions (RQ), with a purpose of understanding an activity and finding why things were as such.

It should be noted that the way the researcher positioned to view this research and the epistemology had a personal influence on the research, due to the researcher's background and previous experiences in science communication. For a long time, the researcher was a scientist (physics) researcher that participated in SciComm activities (from the inside as the scientist), currently, the researcher is on the other side, being a science communication researcher and studying the SciComm activity done by scientists, now from the outside, therefore, in this research there was some influence from what the researcher had experienced. During this research, the researcher had no direct interaction, influence or was involved in anything related to the activity on itself, the only interaction was with the scientists via the questionnaires, interviews and during the observation on the day of the activity, and therefore, the researcher was always in an external position (non-participant). The questions, posed to the scientists in this research, did not have a right or wrong answers, they were exploratory, however, the researcher felt sometimes the scientists were worried about saying the right thing or if they have not thought about that in advance, if that was a problem. The researcher's only influence was in reformulating the question or giving examples when the given answers did not cover the topic the researcher was expected to discuss, although sometimes, this opened the researcher's view to other possible questions/topics that could have been of interest for the research topic.

A mixed methods research approach was used. There were some quantitative data to provide some general and more objective information, and qualitative data to provide a more in-depth information.

3.1. Paradigm

In here it is presented the support for the chosen paradigm that fit the purpose of this research. The way of looking at the research, the way of pursuing knowledge is defined as the paradigm (Cohen et al., 2018). There are many classifications of paradigms according to different authors. Considering the characteristics of this research project, the interpretivism paradigm is presented.

3.1.1. Interpretivism paradigm

In this paradigm, the ontological position recognises multiple realities, and a subjective and socially constructed epistemology. The researcher is an interpreter, trying to understand the situation through the eyes of the participants (from the point of view of the people that is being studied). At the end of the research theory could be built. It is associated mainly with qualitative methods and knowledge is contextual and specific.

The nature of research, then, is exploratory in nature, to investigate the interpretations of the situation made by the participants themselves, to understand their attitudes, behaviours and interactions.

The aim of scientific investigation for the interpretive researcher is to understand how this reality goes on at one time and in one place and compare it with what goes on in different times and places. Thus theory becomes sets of meaning which yield insight and understanding of people's behaviour. (Cohen et al., 2018, p.20)

The logic of such an interpretive research design is not to explain why something happens, but to explore or build up an understanding of something of which we have little or no knowledge. Through piecing together such an understanding, we eventually build up a theory (Henn et al., 2009, p.16).

I felt this paradigm fits this research, because:

- The research seems exploratory because: it tries to understand the situation of the scientists and the activity, in other to explain it from the researcher point of view, but to interpret the provided information by the scientists, about their experiences and perspectives;
- The meaning of the data could have a different meaning for different people.
- The research methods were chosen in order to best answer the research questions. They are a mix of methods that collect a mix of qualitative and quantitative data, to gather rich context-dependent data, with emphasis on depth, context and understanding reality.

3.2. Design of the research

A research proposal was submitted to UC Exploratório at the end of August 2022. The proposal included the purpose of the research, the research questions, the suggested methodology and the timeline.

The Escola Ciência Viva and the activity Encontro Com Cientista is organised by the coordinator from the UC Exploratório, which already had a calendar at the beginning of the school year, with the school that was participating in each week and the scientists taking part in the days of Encontro com Cientista. The researcher was not involved in any of the organisation of Encontro com Cientista and neither was involved in any preparation of the actual activities with the scientists. The researcher visited several times (between September and October 2022) the UC Exploratório in order to get a general understanding of the program Escola Ciência Viva and the activity Encontro Com Cientista. The researcher attended some sessions of Encontro Com Cientista, which allowed to adjust the research methods before the data collection officially occurred. This general contextualisation of the event and the participants helped to adjust the observation matrix and to finalise the set of questions for the questionnaires and interviews before starting the data collection in November 2022.

3.3. Methods

Mixed methods research was used, with the use of different data collection methods and a mix of qualitative and quantitative data. It was used in a development way, using one method questionnaire to inform the other method interview, with a mix of qualitative and quantitative data. This research consists of trying to understand, describe and explain the results and as well, to see if there were any patterns.

The data collection methods used to answer the research questions were: three survey questionnaires (Q) and two interviews (I) addressed to the participating scientists as well as one direct observation (O) of each session.

The questionnaires were written in English and the interviews conducted in Portuguese. The scientists were all Portuguese native speakers, therefore, since the research intended to get in-depth information, expressions, emotions and feelings, it was suggested for them to answer in Portuguese (to the questionnaires and interviews) so they could express easily and find the more appropriate words and easy to articulate their thoughts. However, this was not always the case when answering the questionnaires and therefore, there is a mix of languages in the data collected. Not wanting to lose the original meaning of the answers given by the scientists, it was decided to keep and show in here the answers without translating them into English, and therefore, the two languages are used in the data.

3.3.1. Data collection

The data collection followed different phases represented in Figure 1.

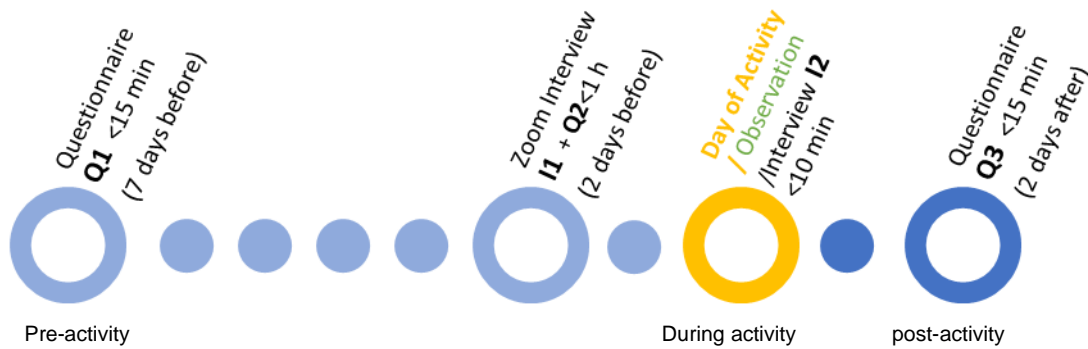


Figure 1 – Timeline around the activity day (Orange) where the scientists' participation was required for this research. Three phases pre-activity, during activity and post-activity. And the corresponding data collection methods for each phase.

As mentioned previously, it is mixed methods for data collection, because there were quantitative and qualitative methods to gather the data. The methods of data collection were survey by questionnaires and interviews, and direct observation. The interviews were conducted by the researcher alone.

The research was divided in three moments in time (Figure 1), the first one was pre-activity (light blue), second during activity (orange) and third post-activity, reflection period (dark blue). Because of the three periods in time, it could be said that it is a longitudinal study, however, it is a very short period of time, and not so many of the topics are followed along the time. These three moments of data collection were related to the objective's topics to answer the research questions. Pre-activity served to contextualise the scientists and the preparation of the activity, during the activity and post-activity to collect information about the perception of the activity, the future of the activity and the suggestions.

The study focused on the individual scientists or the group of scientists, that formed a session on the day when mentioned session, that participated on the activity *Encontro com Cientistas*. This event occurred at the UC Exploratório CCV de Coimbra, one half-day (morning or afternoon) once a week, as part of the event *Escola Ciência Viva*, from the months of September to June (school year). Due to time restrictions of the research project, the data collection only happened between the months of November 2022 to March 2023, corresponding to 8 sessions. The first questionnaire was sent on the 7th of November 2023 and the last questionnaire was answered on the 17th of March 2023.

3.3.2. Participants and setting

The research is focused on the scientists and the activity, and therefore, the research participants (the sampling for this research) are the group of scientists that take part in each of the days of the event *Encontro com Cientista*, called session (S), and the activity for each session.

The director and organiser of the programme, Escola Ciência Viva of the UC Exploratório Centro Ciência Viva da Universidade de Coimbra, was the gatekeeper, who provided the researcher access and the scientists' contact details, and who previously informed the scientists about the research and the researcher intention to contact them.

This was a non-probability sample, because it targeted a particular group, purposive sampling.

The researcher contacted, via email, all of the scientists who were known to participate on the event for each session, a week before their session. Sometimes, the contacted scientists were informing the researcher of other scientists that were also participating on their session and sending the researcher their contact to add them. This first contact (via email) with the scientists included an introductory letter, informing them about the research and asking for their consent to participate (see Appendix 1). Not all of the contacted scientists were able to take part in the research (due to external reasons) and not all of them follow throughout the several moments of data collection, for example, sometimes only took part in the first questionnaire and second interview. The number of scientists that participated in each stage is shown in Table 4 . In total, there were 16 scientists that participated in the event during the 8 sessions, this was the highest sample size of participants that occurred only at interview I2, because they were all present after the activity and all joined in for this presential conversation.

As previously mentioned, the purpose of the research was not to study anything related to the point of view of the audience that participated on the activities (the preschool children and teachers), therefore, the audience was not part of the sample.

Stage	Q1	I1	Q2	I2	Q3
Sessions	Nº of scientists to answer	Nº of scientists to answer	Nº of scientists to answer	Nº of scientists to answer	Nº of scientists to answer
8	1	1	1	1	1
7	2	2	2	2	1
6	-	-	1	1	1
5	2	1	2	4	1
4	1	1	1	1	1
3	1	1	1	1	1
2	5	5	5	5	3
1	1	1	1	1	1
Total Number of responses	Q1 = 13	I1=12	Q2 = 14	I2=16	Q3 = 10

Table 4 - For each session, the number of scientists that participated during each stage of the data collection. And the total number of scientists for each stage (Q1, I1, Q2, I2, Q3).

3.3.3. Questionnaire

The first and third questionnaire included closed-ended questions and open questions. The second questionnaire had only one closed-ended question. The questionnaires had some mandatory questions.

The reasons behind the open-ended questions were to get depth information, honest responses, and to add remarks of previous questions and explanations, mostly they were not mandatory questions. For the closed-ended questions there was a combination of several types.

The first questionnaire Q1 was submitted pre-activity. The purpose of Q1 was to contextualise the scientists, to generally understand how the preparation of the activity was happening and to understand the perception, from the scientists' point of view, about how the participation in SciComm activities is valued.

The first questionnaire Q1 had a combination of dichotomous questions, multiple-choice questions with single or multiple responses, when asking about general contextualising and rating scales in the type of Likert scales in order to gather more attitudinal responses. There was one skip question for a small section. An example of a few types of questions from Q1 is shown in Table 5. The full questionnaire Q1 can be seen in the Appendix 3.

Scientist context		
a) General information		
Question	Answers	Type of question
Number (the number assigned for this research):	.....	Open
Research topic:	.....	Open
What is the stage in your career as a researcher?	Master student / PhD / Postdoctoral researcher / Principal investigator / Group leader / Other	Multiple-choice question Single response mark only one
Experience in science communication		
Is your research topic the same topic you will present in the activity?	YES NO	Dichotomy
If the previous answer was NO, What is the topic of the activity and Why?	.....	Open
If so, Who were your audiences?	Pre-school children / 1 st cycle students / 2 nd cycle students / High school students / University students / Adults / Families / General / Un-known	Multiple-choice question Multiple response Free choice, tick all that apply
Are you re-using some of the materials previously used in other events?	YES / NO / Not sure Other:.....	Multiple-choice question Single response mark only one
...	...	
Could you rate by order of consideration, some of the reasons/ motivations for you to be involved in this initiative:	Very Important/ Important+/-/Not important/ Did not consider Funding requirement Interest / An experience, do something different / A favour because someone else asked you to (colleagues/institution) / Have a good time / Others	Rating scale, Likert scale mark only one per row/ multiple-choice grid Matrix layout
...	...	
e) Training		
Did you receive any science communication training?	YES (skip to Q..) NO (skip to Q..)	Dichotomy Skip
...	...	
3-Perception about the participation in science communication projects		
How do you think you taking part in the activity is seen/valued? By your colleagues (research group)	Positively / Not interested/ Negatively / Do not know	Rating scale, Likert scale mark only one per row
...	...	

Table 5 – Example of some types of questions from the questionnaire Q1.

The second questionnaire Q2 was submitted pre-activity, straight away after the first interview I1, with the link for it provided at the end of the interview via the ZOOM chat. The aim of this questionnaire was to find out about the preparation of the activity by the scientists and it was based on some guidelines for scientists that wanted to take part in science communication found in the literature (Olesk, 2020). The objective was to find what were the things the scientists considered during their preparation, by rating them in relation to their level of consideration. The reason to only send it to the scientists at that

particular moment was because of the proximity to the day of the activity, it was expected that the scientists had finished the preparation (or mostly finished) of the activity, and in that way, the information provided in this questionnaire had little or no influence on them in anyway.

The second questionnaire Q2 had the format of a matrix question, due to the layout and answering several questions in one. It had a rating scale type question with a Likert scale. An example some type of questions is shown in Table 6. The full questionnaire can be seen in the Appendix 4.

Question	Answers	Type of question
Number (the number assigned for this research):	.....	Open
When preparing the activity, have you considered/thought:	1- very important (top consideration), to 5- less important (last consideration) / 6- Did not consider at all / 7- you do not think there is any need to think about that to prepare an activity (no need)	Rating scale question Likert scale Matrix layout question (Tick the relevant boxes in order by level of consideration for you)
a. Why you want to do this topic and activity		
b. To allocate time as part of your everyday work for preparation		
c. Who is your audience		
...		

Table 6 – Example of the type of question in the second questionnaire Q2.

The purpose of the third questionnaire Q3 was to understand what happened during the activity after reflection by the scientists, to find if there were any changes in attitude respect some topics and to find advice from the scientists. The objectives were to see if things went as planned, if they met the objectives of the activity, to understand the feeling of the scientists, to perceive the future of the activity, to see the level of satisfaction in general, respect to the interaction with the audience or the level of interest. It also served to compare some of the answers after reflection on the activity with the answers given during the interview I2, straight away after the activity. Other objective was to see if there were any changes in attitude in relation to training in SciComm. Due to these objectives, the questionnaire was sent post-activity, a couple of days after the activity, so the scientists had time to reflect. The last objective was to gather a list of advice from the scientists to future scientists interested in future participation, after their experience in the activity.

The third questionnaire Q3 had a combination of open questions and closed-ended questions, in multiple-choice single response questions, see Table 7 for an overview. The full questionnaire can be found in the Appendix 5.

1- Reflection		
a) Satisfaction		
Question	Answers	Type of question
Number (the number assigned for this research):	.....	Open
Are you overall satisfied with how the activity ran?	Yes / mostly yes/ more or less/ mostly no/ No/ Other.....	Multichoice question, single answer Mark only one / Open
b) Objectives		
Have you met your objectives? If you could comment on which ones Yes or No and why if possible?	.....	Open
How do you rate the level of interaction/engagement?	1.Very positive 2.positive 3. neutral 4. negative 5. very negative	Rating scale, Likert scale
Could you develop in the reasons for your answer?	.....	Open
...	...	
d) Training		
How do you feel now about training in science communication?	It is relevant / I do not think it is relevant / I do not know / Other	Multichoice question, single answer Mark only one / Open
...	...	
2- Future		
b) Advice		
Could you leave some recommendations, advice or tips for scientists, in the future, that want to get involved in an activity with such an audience (pre-school children)?	.....	Open
...	...	

Table 7 – Example of some types of questions from Q3.

All of the questionnaires had at the end an open and optional question for the scientists to leave a comment in relation to anything related to the activity or this research.

3.3.4. Interview

Both interviews were semi-structured interviews, with open questions. The questions were set in advance and organised by themes, but flexibility was allowed in guiding the interview. For some of the sessions, where several scientists were participating, the interview was a group interview. Before recording, they were reminded about the consent to record and that if a name was mentioned, it was not going to be transcribed and an identifier was used. When pressed record they had to verbally confirm their consent.

The first interview I1, was an on-line interview via ZOOM, pre-activity. The interview had several objectives related to the different topics of interest. Some of the objectives were to deeper understand some of the topics asked during the first questionnaire, such as

the motivations and objectives or key messages of the activity, about understanding the preparation of the activity and to compared from the answer in Q1, in some cases, develop in the answers about training. Other objectives were to perceive the style and format of the activity, the level of practise of the activity and to understand the challenges, the worries about the activity.

The first interview I1, although kept the same format and covered the same topics and main questions for all, some of the questions were classified as optional, the interview was tailored to each interviewee. The interview was adapted and personalised for each session, following the responses given in the first questionnaire. The interview had space for flexibility in the way that allowed spontaneity, if the interviewees discussed or talked about something and there was a question related to that further on, when the interviewer arrived at the question, it would be omitted, as well, the interviewer could add questions to be able to complete answers or to get a deeper answer. Therefore, the interviewer was free to modify the sequence of questions when appropriate, and was free to change wording and to better explain or add to the questions. A guide of the interview I1 can be seen in the Appendix 6.

The second interview I2, occurred straight away after the activity post-activity. The purpose was to understand the perception of the scientists about what happened during the activity. The objectives were to understand the feeling of what happened, if the activity happened as planned, level of satisfaction, key moments for the scientists and the audience, if the scientists thought they met the objectives and passed the key messages, their level of preparation for the activity and the future of the activity.

The second interview I2 did not have optional questions since it had fewer questions than I1. A guide of the interview I2 can be seen in the Appendix 7.

3.3.5. Observation

Observation was done during the time the activity was happening in the room (closed natural setting). The observer was the researcher as a complete observer and overt, outside observer. The researcher's role there was only to observe and everyone was made aware of the researcher's presence and the reasons for me to be there. It was a structured observation, an observation matrix was created, adjusted and modified during some sessions before the official data collection, which also served as practised for entering the data in the categories, where to focus on and what to record, the possibility to move around the room, and how to code.

The categories of the observation were: the setting of the room (where does the activity take place?), positioning of the scientists and the audience (who is involved?), the format, structure, style, materials and resources of the activity (what resources are being used in the scene?), duration of the activity, the sequence of activities (how is time used?), what is taking place?, key messages and words, how the interaction happen, who is participating (who is talking and who is listening?), statuses and roles of the participants and anyone in the room (researchers, facilitators, teachers, audience)?, what non-verbal communication is taking place?, what people feel and how they express this. The information was collected on field notes in the style of jotting, short sketch notes and drawings at the moment of the observation, followed by reflection notes after the activity, Appendix 8.

The reflection notes intended to perceive the goals of the activity, from the point of view of the researcher). As well as, to add some extra notes, details or clarifications to the observations.

3.3.6. Procedure for data collection and analysis

The surveys were internet surveys, through two emails with a hyperlink to the self-completion (scientists filled the answers without the presence of the researcher) online questionnaires, designed using Google forms.

The interviews, the first one was done online via ZOOM. A couple of hours before the interview, a ZOOM link was sent via email. The second interview was face-to-face audio recorded with the researcher's phone at the location of the activity. The interview was always conducted by the researcher as the interviewer and the scientists as interviewees, and no one else present or nearby.

After the interviews, a verbatim transcript of them was manually done by the researcher, creating a word file for each interview. For group interviews, in the transcripts it was not differentiated who said who in the group, and the answers were analysed as the view of the whole group.

The analysis of the qualitative data was done using a thematic analysis. The codes decided to use were, the keywords, verbs and adjectives, that expressed the scientists' feelings in relation to the topic of the question, these selected words are **highlighted** along the data. The data included in here shows the verbatim conversations, reporting direct phrases (without translation) and it is organised and presented in correspondence to the questions.

For the observation, field notes were collected during the activity, as well as reflection notes after finishing the activity and interview (I2). The data was collected in the form of drawings, tick boxes and short sentences, that represented what was happening during the activity, in an observation matrix page for each of the parts of the activity (Appendix 8). The data was analysed according to each category of observation.

3.4. Ethics

All the scientists were contacted first via email with an introductory covering letter, explaining the research and the general considerations, see Appendix 1. When they replied, if they accepted and confirmed the participation in the research, they were contacted again with how to follow. All the participants (scientists) in the research had voluntarily decided to take part on it and gave informed consent at each stage of the data collection, written or orally. Throughout the research process, the anonymity of the participants was met by assigning an identifier, a number and a letter to each of them, which was used to fill in the questionnaires and to refer to in the interviews. As an extra precaution, for the data analysis and representation of it in here, those numbers were again changed, and the scientists do not know them. No email or identification details were collected when filling the questionnaires. During the ZOOM recording of the interview, the scientists were given the option to keep their cameras off, however, if they chose to have the camera on, any images recorded were not used, only voice recordings, and they were kept only in the researcher computer and not shared.

This research follows and respects the general guidelines for data protection GDPR (General Data Protection Regulation). The data collected is only used for the purposes of this research and the upcoming publications. The only people with access to the raw data (questionnaires and interviews transcript) is the researcher, Lara San Emeterio and her supervisor Aurora Moreira. The only person that knows the assigned number that corresponds to each scientist is the researcher, therefore, fulfilling confidentiality.

The scientists were able to communicate with the researcher at any stage via my email, which was provided from the very first contact, introductory letter. They were given a deadline with the option to withdraw from the research, without the need for any explanation, providing the assigned number to recognise the data so it could be removed.

When the research is completed, the scientists will be informed of the outcomes of the research.

4. Results and Discussion

In this section, it is shown the result of the analysis of the data collected. It is divided in several parts which corresponds to the different research questions topics.

4.1. Participants

We observed from Table 4 that, in the sessions where several scientists were involved, the answers, given during the surveys and interviews, were very similar between themselves as individuals and with the same intentions, which showed they worked as a group and were coordinated between themselves, and therefore, the answers were considered as a whole group and not as an individual.

From Table 4, it is possible to observe the number of responses for the last survey Q3 decreased to one per session, with the exception of 1 session.

During the interview I2, because it was done straight away after the activity, all of the scientists taking part on the activity, on the day (except on 1 case S2) were present for it, therefore, the number of scientists involved in I2 was larger than the number of scientists responses to the other surveys. It was not possible to identified who was who during the interviews, however, because they were all responding and agreeing with each other in the comments, the analysis was done as a group and not as an individual.

4.2. General information about the scientists: Contextualisation/Situation

The objectives of this section were to contextualise the scientists: understand their experience in science communication. Understand the motivations for taking part in the project of Escola Ciência Viva. Understand how they have thought about the activity and prepared it, if they considered the aim and objectives of the activity, what they wanted to achieve from it, why they were doing it, what they wanted the audience to get from attending the activity.

4.2.1. General information

These are the results from the data collected on the first survey Q1. This data shows the contextualization and the characteristics of the scientists that took part in the activity.

The first questionnaire Q1 was answered by 14 scientists, figure 2 shows that overall, there was a whole range in the position/stage of the scientists involved in the activities and for this study.

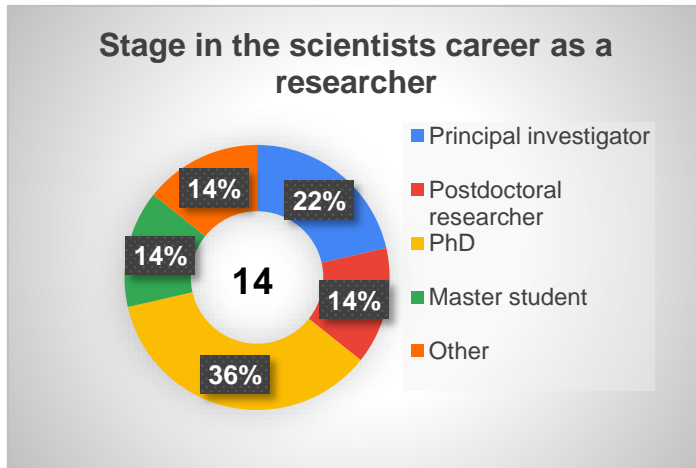


Figure 2 – Scientists' position (data from Q1).

Figure 2 shows that, the stage the scientist is in their career as a researcher does not seem to be a parameter that characterise the type of scientist that participates in this activity Encontro com Cientista.

4.2.2. Science Communication

In the first questionnaire Q1, they were asked: “Have you taken part in previous science communication activities?”.

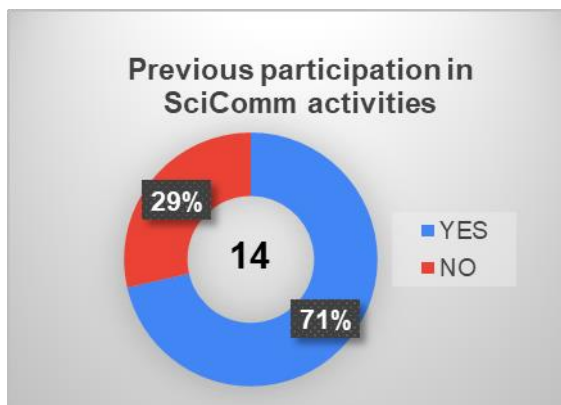


Figure 3 – Experience in SciComm (data from Q1).

Out of the 10 scientists with previous experience in science communication activities, only 5 had experience with preschool audiences.

It should be noted that, the 4 scientists who had no previous experience in science communication, they all belonged to the same group/session (S2), of the 5 scientists, only 1 had previous experience in activities related to science communication.

4.2.3. Motivations and expectations

In Q1, to find out some of the motivations behind scientists participating in the SciComm activity and in order to guide the scientists in their answers, they were provided with several general possible motivations and a rating of 5, from *very important* to *not important* and an option to say they *did not consider*, as well as, the freedom to answer something else with the option *other*.

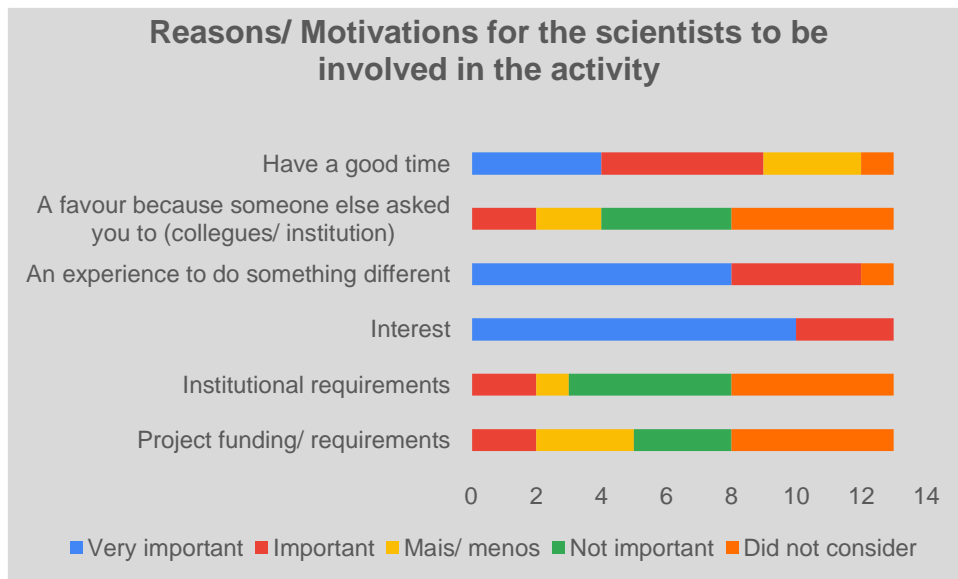


Figure 4 – Motivations of the scientists.

From this data, it is possible to see that the main motivations for the scientists to be part of the activity were: *Personal Interest* and *to have an experience* doing something different, followed by *having a good time*.

A comment left during the interview I1, one scientist mentioned:

... dá-nos bastante prazer fazer isto...

With the intention to leave the answers with an open option for them to interpret what could be their own motivations, it was also provided an option to tick *other* and for the scientists to leave a comment. Only two scientists left a comment, they were (Table 8):

Others:

- Important mission to **increase the scientific literacy** of younger audiences as a path for a better (and more **informed**) **society** in the future.
- **Share science** for children to contact sooner with it.

Table 8 – Comments left by the scientists for other motivations.¹

These were answers that represented, at the end of the day, what were the motivations of the activity with a longer view, it answered more the important question of “Why I am doing this activity? What impact I want the activity to have on the audience?”.

4.2.4. Aims and objectives of the activity

With the objective of understanding how they thought about the activity, about what is the aim of the activity and why they are doing it, during Q1 they were asked two questions: “Could you mention the aim and objectives of the activity?” and “could you mention your objectives in terms of your own personal development?”. The questions were followed at the interview I1 for them to develop on their answers. During the interview I2, with the objective to understand how the scientist perceived, if the activity run as planned and if they actually met the objectives, they were asked: “As a quick reflection of how the activity was, do you think you fulfilled your objectives?”. A similar question was asked during Q3 after reflecting on the activity: “Have you met your objectives? If you could comment on which ones Yes or No and Why if possible?”. A summary of all the answers is shown in Table 9.

Most of the sessions except one that doubted, mentioned during interview I2 that they fulfilled their objectives, but after reflecting in Q3, the same session said yes, it was only one scientist that said *more or less*. Some of the scientists developed more their answers in either I2 or Q3, not both, so it is not possible to do a comparison of their thoughts. One session mentioned during I1 but not during Q1, that their objectives were “to teach something and have fun at the same time”. Previous to the activity, no one else mentioned as an objective “enjoyment”, however, after the activity two more sessions mentioned that they had fun or enjoy as one of the fulfilled objectives. A comment left by a scientist summarised the idea:

¹ Highlighted text for analysis.

Objetivo de os envolver, divertindo-se ... ao mesmo tempo que se divertem, aprendem alguma coisa ...

There are some common objectives mentioned between the sessions, they can be classified according to the intentions² (Figure 5, Figure 6), such as educate, emotional, behaviour, enjoyment or experience. The emotional represents objectives that implies a future action of the audience and the behaviour represents either change in attitude or knowledge of awareness. Only one session mentioned enjoyment during Q1 or I1.

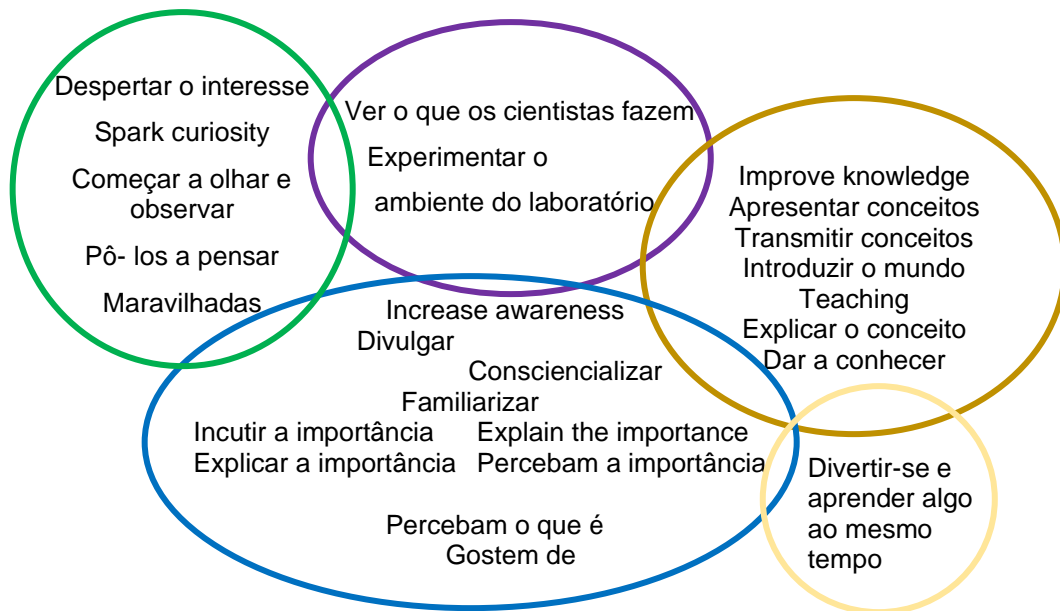


Figure 5 – Summary of the key words³ that represented the objectives of the activities (Q1 and I1) of all the answers. They are grouped as²: green- emotional, blue- behaviour, gold- education, purple- practical/experience and yellow enjoyment with some educational.

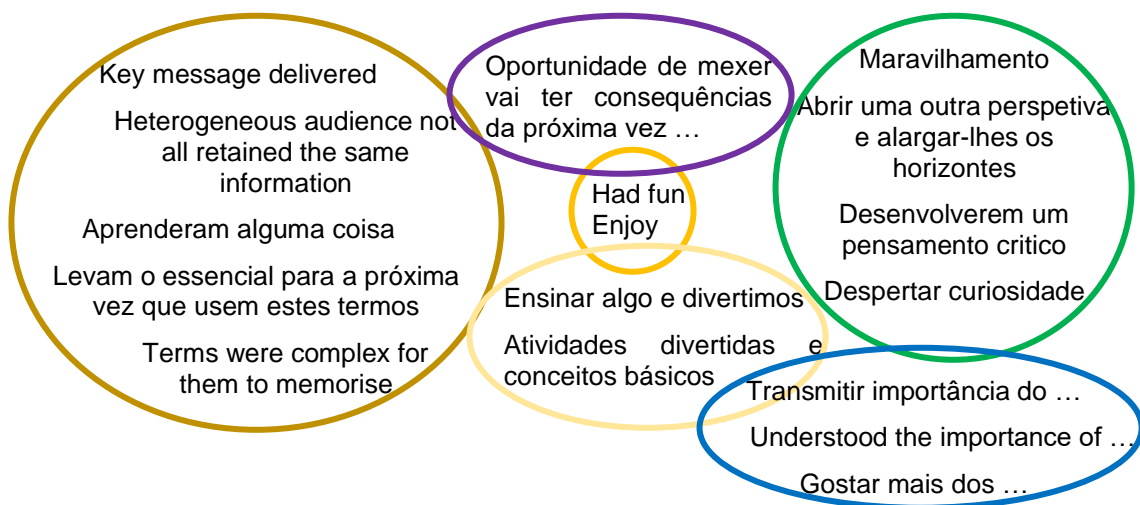


Figure 6 – Summary of the keywords that represented the objectives achieved during the activity (I2 and Q3), of all the answers. They are grouped as²: green- emotional, blue- behaviour, gold- education, purple- practical/experience and yellow enjoyment with some educational.

² Personal choice for classification.

³ Use of English and Portuguese words because shows direct wording by the scientists.

Could you mention the aim and objectives of the activity Q1	Could you explain the aim and objectives of the activity you are preparing? I1 (Q1)	As a quick reflection, do you think you fulfilled your objectives? I2	Have you met your objectives, comment on which ones Yes/No, and why? Q3
<p>Objetivo: Despertar o interesse das crianças pelos ribeiros e pela biodiversidade que albergam;</p> <p>Expectativa: que as crianças se sintam maravilhadas pela vida aquática e que isto contribua para que respeitem o meio ambiente.</p> <p>Ver o que os cientistas fazem; experimentalizar o ambiente de laboratório.</p>	<p>A minha atividade pretende dar a conhecer às crianças os insetos aquáticos, ... tento divulgar a biodiversidade que existe nos ribeiros ... gosto de introduzir as crianças a este outro grupo de organismos aquáticos dos macroinvertebrados e vou focar nos insetos aquáticos, ...</p> <p>O objetivo principal aqui vais ser levar as crianças ao rio sem sair da sala de aula e apresenta-las a estes invertebrados, a estes insetos aquáticos.</p>	<p>... Sim ... acho que crio aquela noção do maravilhamento. ... Deu-lhes oportunidade de mexer, trouxemos o rio quase até o laboratório e eles tiveram contato com os animais, acho que vai ter consequências da próxima vez que eles estiveram perto do meio aquática, vão pensar ...</p> <p>Abriu aqui um bocadinho uma outra perspectiva e alargou-lhes um bocadinho os horizontes.</p>	<p>Yes</p>
<p>Understand the knowledge of the audience on basic topics of human reproduction; improve their knowledge (accordingly) and eliminate possible wrong ideas and information that they might have (for example on how a baby is conceived), together with the use of scientific/correct terms (for example replacing the term "little seeds" by "gametes").</p>	<p>Transmitir conceitos básicos da biologia da reprodução, esclarecer alguns conceitos ... vamos falar um pouco da fertilização e passa por definir três conceitos básicos. ... usando sempre linguagem científica.</p>	<p>Sim, foram cumpridos, dois objetivos: Ensinar algo- que fiquem com alguma memória disso, mesmo pequena que seja. Divertirmos- estamos aqui, estamos a divertir.</p>	<p>Yes, we had fun and the key message was delivered.</p>
<p>To increase the awareness to healthy lifestyles to preserve the mitochondrial function.</p> <p>Apresentar o conceito de mitocôndria como a "fabrica de produção de energia" das nossas</p>	<p>Consciencializar ou alertar as crianças para a importância da mitocôndria no funcionamento celular e do próprio organismo, ...</p>	<p>Acho que sim</p>	<p>Yes for all</p>

Could you mention the aim and objectives of the activity Q1	Could you explain the aim and objectives of the activity you are preparing? I1 (Q1)	As a quick reflection, do you think you fulfilled your objectives? I2	Have you met your objectives, comment on which ones Yes/No, and why? Q3
<p>células e em como os nossos estilos de vida podem influenciar entre o bom e o mau funcionamento deste organelo</p>	<p>Familiarizar as pessoas, as crianças ... com um grupo de seres vivos ... e pô-los a pensar em seres vivos que são diferentes. Para eles perceberem que o corpo dos cogumelos que nós vemos são apenas frutos dos fungos, ... demonstração de como é que os cogumelos ganham as pintas, ... explorar a diversidade das formas dos cogumelos Três atividades cada uma em sequência, com os seus objetivos. Quando preparamos a atividade é sempre com objetivo de os envolver, divertindo-se, ... ao mesmo tempo que se divertem, aprendem alguma coisa, ... o meu principal intuito é que eles não fiquem aborrecidos. O principal objetivo é que não fiquem que chatice tão grande, que achem alguma graça ...</p>	<p>Acho que sim.</p>	<p>Sim, objetivo geral, despertar a curiosidade das crianças acerca dos fungos através de atividades divertidas e passar-lhes conceitos básicos acerca destes organismos.</p>
<p>Contactar com novos públicos e tentar incutir nos mais jovens a importância dos insetos nas nossas vidas.</p>	<p>Dar a conhecer mais a biodiversidade dos insetos, ... e que mais pessoas gostem dos insetos e que percebam a importância de eles, não são só insetos maus ... mas também são muito importantes para a nossa vida do dia a dia, ... alertar para a importância ... Vou tentar que eles conheçam um pouquinho por detrás da vida dos insetos e que começam</p>	<p>Cumpri os objetivos, não ... podia ter feito melhor ou ter corrido melhor, mas acho que consegui transmitir alguma importância dos insetos na nossa vida e que ache que eles aprenderam alguma coisa.</p>	<p>Sim, tenho a certeza que algumas crianças ficaram a gostar mais dos insetos, mas houve muita dispersão de muitos.</p>

Could you mention the aim and objectives of the activity Q1	Could you explain the aim and objectives of the activity you are preparing? I1 (Q1)	As a quick reflection, do you think you fulfilled your objectives? I2	Have you met your objectives, comment on which ones Yes/No, and why? Q3
<p>Teaching children about nutrients and how they differently affect us (different functions) O objetivo é explicar o conceito de nutriente e quais as funções dos vários tipos de nutrientes. As crianças compreenderem os diferentes nutrientes que existem e as suas funções biológicas Explicar o conceito de nutrientes bem como os diferentes tipos de nutrientes e as suas funções biológicas e celulares To teach the basic nutrients that constitute the food and to understand what is their function in the organism</p>	<p>a olhar na natureza e observar mais facilmente e transmitir também aos pais ... O primário seria conseguir explicar a estas crianças o que é o conceito de nutriente ... e explicar qual é o propósito no organismo do nutriente ...</p>	<p>Sim, achamos que cumpriu os objetivos, achamos que eles levam daqui, se calhar não tudo aquilo que nos queríamos transmitir, ... levam o essencial, para da próxima vez que usem estes termos eles já não acharem totalmente desconhecidos. Relativamente a parte dos ... ficou um pouco mais solido e a ideia e também eles desenvolverem um pouco um pensamento crítico sobre isso ou até a começarem a falar desses assuntos com os pais, olharem para os alimentos de uma forma diferente no seu dia-a-dia.</p>	<p>The activities were completed as expected ... one of the games was too extended for them, and the terms were complex for them to memorize. ... combined with a very long game in which they didn't have time to retain the information. Nonetheless, they did seem to enjoy it overall. - Yes, I had fun and gain skills to communicate with children. - Mais ou menos. Considero que a parte prática correu bastante bem, contudo poderíamos ter limitado um pouco a nossa ideia inicial, de forma a tornar os conceitos mais simples.</p>
<p>Explain the importance of bees and pollination for humans and spark curiosity about this topic.</p>	<p>É explicar ao publico qual é a importância das abelhas E entre outras coisas, fazer com que eles percebam o que é uma abelha, um pouquinho de ecologia, e depois os problemas que elas estão a enfrentar.</p>	<p>Sim, cumpri. Temos que ter também atenção que são crianças muito pequenas e tem um vocabulário ainda não muito desenvolvido, então também não é possível então introduzir muitos temas novos ou muita nomenclatura mais científica, mas penso que correu bem.</p>	<p>- Yes, I think the audience understood the importance of honeybees and pollinators for humans but also for the environment.</p>

Table 9 – Aim and objectives of the activity at the different stages of the research, each line corresponds to the data of a session⁴.

⁴ Highlighted text represents information for analysis.

4.2.5. Personal development Objectives

They were asked during Q1 to mention their objectives in terms of their own personal development. Some of the answers did not really answer the question as expected, but they are still presented on the table below as a comment (figure 8). Some of the verbs used were: Improve, challenge, desafiar-me, adquirir, aprender, desenvolver (develop) and treinar. A selection of related to the verb's objectives are shown in Figure 7.

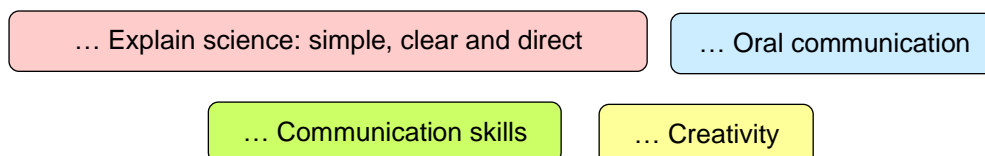


Figure 7 – Selection of keywords that represent the personal objectives³.

Development of creativity and oral communication with different ages

Improve presentation skills

improve my **communication skills** and contribute to a well-formed new generation

Desenvolver a capacidade de comunicar ciência para publico sem conhecimento

To challenge myself in **trying to explain** what are mitochondria and the need to have healthy lifestyles for a longer and better life

Being able to **improve** my **ability to share my knowledge** with different types of public

Desafiar-me a comunicar de forma simples e adequada à faixa etária, melhorando as minhas **capacidades** enquanto **comunicadora**

Espero conseguir **adquirir e treinar** as minhas competências para **explicar conceitos científicos de forma simples e clara**

Em termos pessoais, esta atividade permitir-me-á entrar em contacto com públicos-alvo mais novos e **desafiar-me a explicar dum forma mais simples e direta** termos científicos mais complexos

Aprender a transmitir informações complexas de forma simples para serem **aprendidas por crianças** pequenas. Este tipo de experiência é importante para me tornar uma **melhor comunicadora** (aspeto fundamental na carreira de cientista)

I personally like to do scientific communication. I am very passionate about science and want to talk and share it with the most people, especially pre-university, that I possibly can

Contactar com novos públicos e tentar incutir nos mais jovens a importância dos insetos nas nossas vidas

Figure 8 – Comments from scientists on the personal development objectives (Q1)³.

4.2.6. Key messages

As part of the understanding about, what the scientists thought of the activity in terms of the purpose, the objectives and why they are doing it, they were asked about the key messages of the activity. During I1, they were asked if they could say if there are any key messages, they wanted the children to take by the end of the activity and what they are. During I2 and repeated after reflecting in Q3, with the objective of understanding the scientists' perception of what happen during the activity and if the messages were passed, they were asked, if they thought the key messages were passed and to mentioned what they were.

From the scientists' answers, it is possible to say that, when several answers were collected from one session, the answers were aligned with the same messages they wanted to pass and taken as a group answer.

The answers between the three stages (moments in time), the questions were asked, show coherent answers, the scientists remembered the key messages along the time. After the activity at I2 and Q3, two sessions recognised that not all of the messages, they though, were transmitted to the audience completely. All of the answers for the three moments are shown in Table 10.

Could you say if there are any key messages you want the children to take by the end of the activity? What are they? I1

Do you think the key messages were passed? What were they? I2

Do you think the key messages were passed to the children? Could you explicit what they were? Q3

<p>Os insetos são muito importantes e nós dependemos deles.</p>	<p>Da importância dos insetos, a biodiversidade, e já não me lembro de mais</p>	<p>Sim. Eram os seguintes objetivos: mostrar a importância dos insetos na nossa vida e apresentar a grande biodiversidade destes seres.</p>
<p>Que percebam que necessitamos diferentes nutrientes em nosso organismo e que a sua ingestão tem uma função depois ainda nosso organismo.</p>	<p>As mensagens principais que nós queríamos passar era que diferentes alimentos têm diferentes nutrientes e que diferentes nutrientes também têm funções diferentes no nosso corpo, e daí nós precisamos de uma alimentação variada. O jogo era ... que apesar de ser algo abstrato de eles compreender para perceber de facto aqueles nutrientes estão lá apesar de não os vermos, eles estão lá ...</p>	<p>- I think the main messages were transmitted which included: "different nutrients have different functions in our body"; and "different foods are rich in different nutrients, hence the need for a various nutrition". Some specific nutrients and functions were taught to the kids and if they learnt them and their functions the better, but those were not the main objectives - More a less. The key message was to understand that the food has nutrients and that these nutrients play important roles in our organism. - Sim. A primeira mensagem que queríamos transmitir é que existem vários tipos de nutrientes nos alimentos que consumimos diariamente e que cada um deles tem a sua função. A segunda mensagem é que os açúcares se encontram presentes em bebidas que consumimos diariamente e que devemos ter atenção a isso, embora muitos deles não sejam visíveis a olho nu</p>
<p>A importância da polinização e dos polinizadores, não só para a nossa vida, como ser humano, mas para o mundo em si.</p>	<p>Penso que sim.</p>	<p>Yes. The importance of honeybees and pollinators not only for humans but ultimately for the environment.</p>

<p>Could you say if there are any key messages you want the children to take by the end of the activity? What are they? I1</p>	<p>Do you think the key messages were passed? What were they? I2</p>	<p>Do you think the key messages were passed to the children? Could you explicit what they were? Q3</p>
	<p>Lembrasse de qual era? Exatamente não, ... importância das abelhas e da abelha mamífera, ... A importância e os problemas que elas têm de enfrentar.</p>	
-	<p>Alguma sim, outras se calhar nem por isso. Não ficou assim tao gravado a polinização. Ficou gravado, que são importantes para nós, ... são bichinhos que nós gostamos e ... que nós temos que proteger.</p>	<p>YES: Bees are important organisms. NO: Bees are important for pollination services.</p>
<p>Os fungos não são animais nem plantas, como são os fungos (micélios). Cogumelos são os frutos, São de muitas formas.</p>	<p>Sim, sem dúvida sim. Os fungos são seres vivos especiais, e o corpo deles é ... produzem cogumelos ...</p>	<p>Sim— O corpo dos fungos é formados por fios (as hifas), que formam uma rede emaranhada, o micélio, que é o verdadeiro corpo dos fungos. Os cogumelos são "os frutos" e servem para produzir e dispersar os esporos. Não (mas não era a mensagem principal) — esqueci-me de mencionar que não costumamos ver os micélios porque estão normalmente escondidos no solo</p>
<p>Ter estilos de vida saudáveis permite-nos as nossas, as mitocôndrias, os nossos produtores de energia funcionarem bem e assim nós vivermos melhor e mais tempo.</p>	<p>Acho que a mensagem passou, foi um bocado claro que eles perceberam a questão dos hábitos. Ter mais ou menos energia e como é que nós temos que viver o nosso dia a dia</p>	<p>Mitochondria are our main energy producers, and adopting healthy lifestyles will help in keep our mitochondria and our lives healthier.</p>
<p>Independentemente de todas as situações tem que haver sempre uma célula de um homem e de uma mulher</p>	<p>Sim, embora algum deles não tenham conseguido atingir os nomes científicos, todos perceberam que são duas células ... que tem que se juntar.</p>	<p>yes, in general. the key messages were: 1- there are two cells needed to make a baby; 2- They will fuse in the process of fertilization; 3-development and birth</p>

Could you say if there are any key messages you want the children to take by the end of the activity? What are they? I1

Do you think the key messages were passed? What were they? I2

Do you think the key messages were passed to the children? Could you explicit what they were? Q3

Dar-lhes a **experiência, despertar um sentimento, curiosidade, proteção**

Sim, aqui a mensagem não era toda cientificamente técnica, ... não falei nomes, porque aqui era uma **questão sensorial** ... para já é isso que é importante que eles aprendam, que saibam que no rio há mais que ..., **alargou os horizontes** ... e criar **curiosidade**.

Sim, ficaram a **conhecer** alguns organismos aquáticos e interagiram com eles o que espero tenha **despertado a curiosidade** para descoberta autónoma da próxima vez que visitarem um ribeiro

Table 10 – Summary of the key messages for each session answered at the different moments ³.

4.3. General information about the Sessions: Contextualisation/Situation

The objective in here was to visualise the characteristic of the sessions, in terms of number of scientists involved, situation of the sessions (first time doing it or not) and the used of materials (previous experience doing similar activity). These are the results from the data collected on the first survey Q1 and during observations on the day of the activity.

The total number of sessions researched were 8. The total number of scientists is taken from the observation and corresponds to the scientists involved on the day of the activity, independently of their participation in the surveys or interviews. For 2 of the sessions, there were several scientists that did not participate on the surveys. Out of the 8 sessions, 5 had only 1 scientist involved in the activity, see Figure 9a.

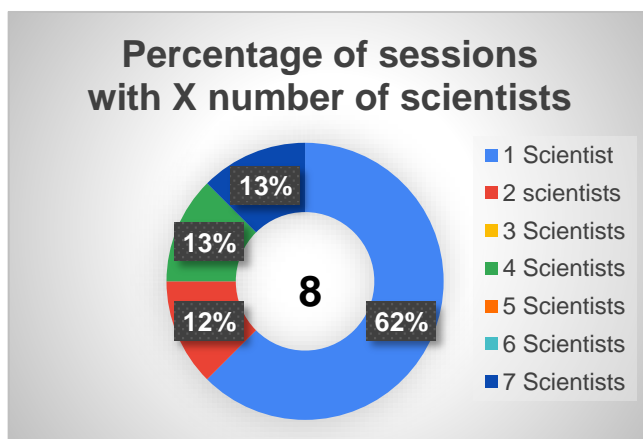


Figure 9 – a) Number of scientists per session (from observation O). b) First time participating in Encontro com Cientista.

Only one of the sessions (S7) was the third time they were doing this activity, as part of the Escola Ciência Viva no UC Exploratório. For the other 7 sessions, they were all doing it for the first time, see Figure 10a.

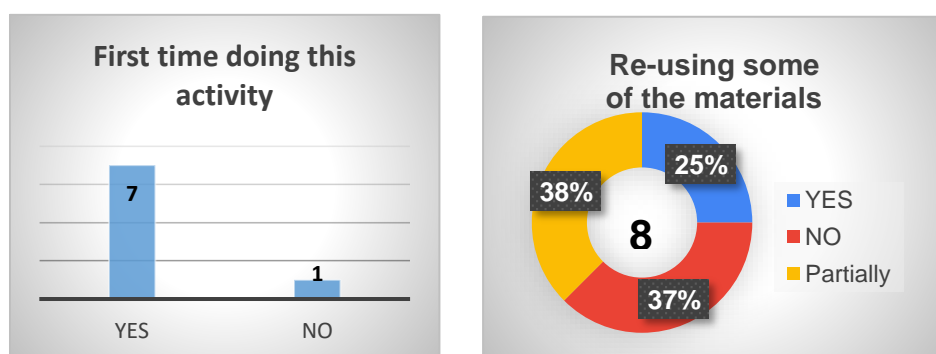


Figure 10 – a) First time participating in Encontro com Cientista. b) Sessions re-using materials.

It is interesting to observe from Figure 10b that:

Only 2 sessions re-used all of the materials, however, the reasons were different. 1 of the sessions (S4) was because the scientist had a lot of previous experience doing SciComm activities and the scientist mentioned:

São tudo atividades que eu já fiz com crianças de esta idade. São atividades que eu vou acumulando ao longo dos anos **São atividades** que eu sei que **funcionam** mais ou menos bem ...

The other session (S7) corresponded to the session that has participated in this activity before and had adapted and changed things on the activity during the previous sessions. When asked if they have changed things during the previous sessions, they left this comment:

Yes, we **always change something**. During our path in science communication, we start from a predefined plan, defined according to the audience, and then learn which are the approaches and narratives that work better. We are always changing/**improving from one activity to the next one**.

Having done similar activities previously, 3 sessions partially re-used some of the materials, but used this opportunity to introduce new things on it.

Three of the sessions were not re-using materials, and the reasons for it were:

- 1 session has not done science communication activities before (S2).
- The other 2 sessions used this opportunity to do something new they have not tried before, either a new topic for the activity or a new format of the activity (S1, S5).

4.4. Preparation of the activity

The objectives of the section were to try to understand how the scientists prepared the activity, how they organised the preparation in terms of allocated time, help and support and who provides it, if any, and how or for what that support/help was needed. As well, to try to find out the situation of the scientists in relation to training in science communication and how that could have or not an influence on the activity.

Other objective was to find out and understand the reasons to, how was the activity organised, in terms of format, style and planning of the interactions and engagement with the audience. This was analysed at the different stages of the study, before the activity,

during and after, to see how prepared they were in advance, how did it happen during the activity and how they thought it was after a couple of days passed from the activity and they had time to reflect on it.

The last objective was to understand the challenges and issues they face, if any, to understand if they had concerns or worries about the activity.

Some of this information is compared between the pre- questionnaire and interview and the information provided in the post-activity questionnaire and interview, in order to see how they see their preparation, activity and challenges from the perspective of already done the activity and before it.

4.4.1. Time

In here the objectives were to find the time dedicated to preparing the activity, and when that time was. This information was collected during survey Q1 and developed during the interview I1.

For two of the sessions, S8 and S4, the time included field work, where the scientists had to go out to search for fresh live animals or fresh fungus, materials needed for the activity and that determined the availability of the scientist to do the activity on that day and its performance, however, they said, they could do the activity without the materials, but it would have been a different experience.

Dedicated time	When it happened
7h	Part of work and personal time
More than 1h	Part of work (em pausas do trabalho) and personal time
1-2 month for the idea / 1 day	Part at work and mostly personal time
More than 1 Day	Part of work
4 h	Part of work and personal time
3 Weeks	Personal time
1 Week	Personal Time

Table 11 – Dedicated time for preparation of the activity.

In Table 11, when the time is more than 1 day, it is because, when the scientists mentioned the time, they counted from the time they first started to exchange ideas and the conceptualization of it. These were sessions that, they had not done this activity previously (S1, S2, S5).

fui-mos madurando algumas ideias, por tanto não foi 1 ou 2 meses continuo. ... Depois de ter as ideias chaves, depois poer tudo junto foi rápido, e elaborar a atividade tal como está agora, mas começamos a pensar em ... por isso coloquei 1 ou 2 meses

In relation to how they organised their time to prepare the activity, it is possible to see in Table 11 that, only one scientist considered that time as part of the work and organised the activity as part of it. However, for most of the sessions, this time was mostly dedicated during personal time. The sessions with more than one scientist, used the time at work for things like conceptualisation of the ideas and catching up with updates in the situation of the preparation, however, the preparation was done mostly in their personal time. Only one session felt the preparation took a bit longer than anticipated.

as reuniões de grupo e como de facto estamos todos juntos, acabávamos então por discutir também alguns destes temas ... acabamos por dizer que foi, tal vez, fora do horário de trabalho, ... se calhar a **conceptualização** foi feita dentro do **horário de trabalho**, mas depois ... foi cada um no seu tempo.

como somos todas colegas de trabalho fomos discutindo brevemente durante o nosso horário de trabalho. Mas a maior parte das coisas foram feitas em horário pós-laboral.

metade e metade, ...simplesmente aconteceu, estava a fazer coisas, tinha outras coisas para fazer e nos tempos que tinha livre ia fazendo ... dediquei um pouco do meu tempo pessoal.

como **não é o nosso trabalho principal**, vamos aproveitando assim os buracinhos que temos, ..., em pausas do trabalho e fora do trabalho.

4.4.2. Guidelines

The data obtained on the survey Q2, answered by 14 of the scientists and based on general science communication guidelines for scientists, reported some results, shown in Figure 11, for what scientists *Consider* or not when preparing the activity.

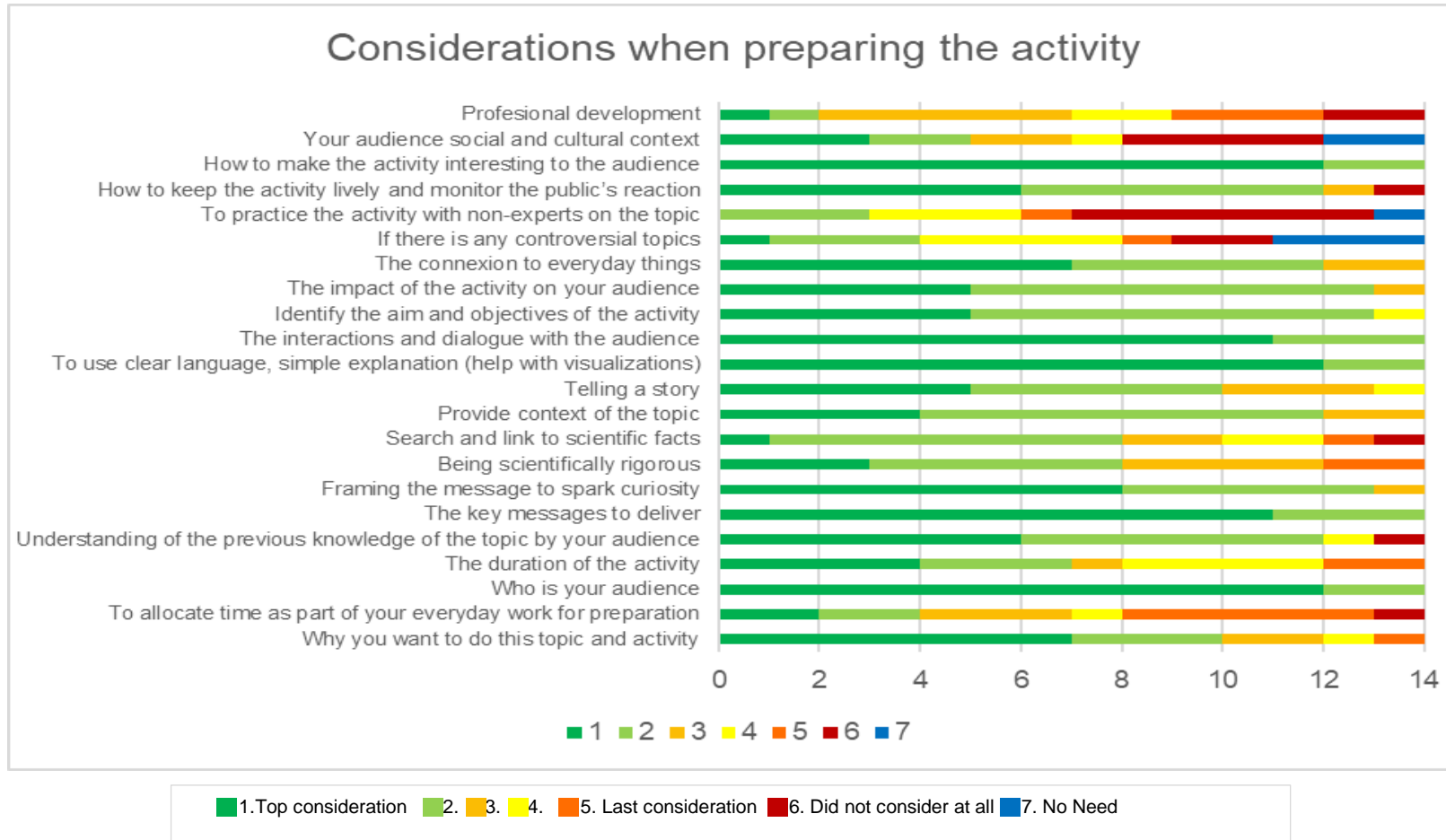


Figure 11 - How much scientists considered some general parameters that could help in the preparation and running of an effective science communication activity.

Mostly all of the scientists agreed to be a *top consideration* (on the graphs lines with mostly shades of green), the followings:

- Who your audience is.
- To use clear language, simple explanation /help with visualizations).
- How to make the activity interesting to the audience.
- The interactions and dialogue with the audience.
- The key messages to deliver.

On the other side, the scientists did not think that is important to consider:

- Professional development
- To allocate time as part of your everyday work for preparation

Some of the scientists did not consider at all or think there is no need for:

- If there is any controversial topics
- To practice the activity with non-experts on the topic
- Your audience social and cultural context

Some of the considerations reported a mix of results in terms of how important it was to consider them, such as:

- The duration of the activity
- Being scientifically rigorous
- Search and link to scientific facts

4.4.3. Support to prepare the activity

All of the sessions had some kind of support when preparing the activity, it is shown in Figure 12 the data collected during survey Q1, when asked “do you have support in preparing the activity and if so from who?” and to select the relevant.

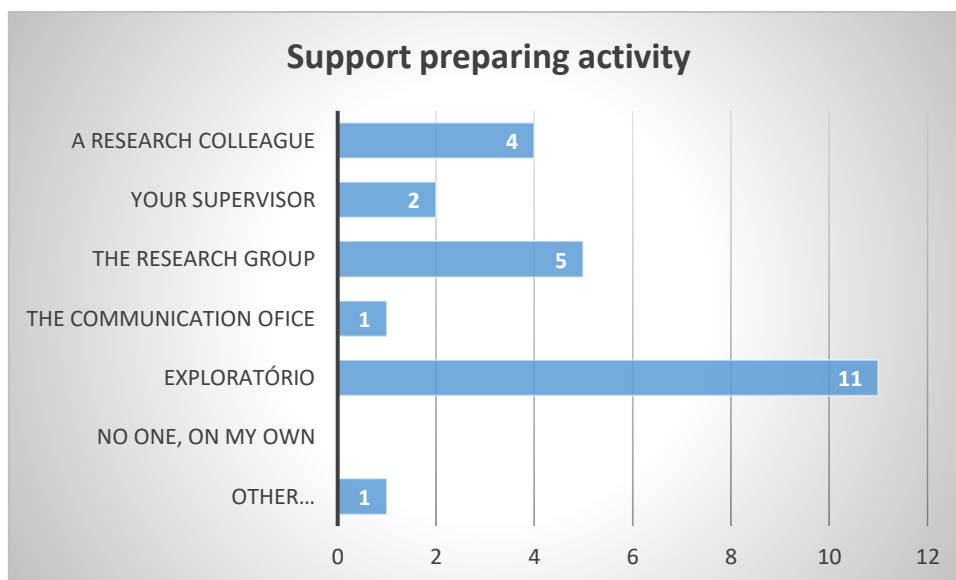


Figure 12 – Who supported the scientists in the preparation of the activity.

Only one session (S1) selected *Other*: “Uma amiga com filhos das idades alvo”.

Most of the sessions except S1, S3 and S6, had support from the Exploratório in preparing the activity. S3 and S6 had support from a colleague (each other), because the two sessions covered the same topic, but had two different scientists presenting in different days and the help and support was only between the two colleagues.

The support or level of involvement from the Exploratório vary, for some was in terms of the design and quality print of the materials (S8, S7, S5, S4, S2) and for some to discuss the ideas for the activity (S7, S5, S2), others borrow some materials (S1, S8, S2). In the case of S2 and S8, these sessions used the laboratory room of the Exploratório and the Exploratório was the one that facilitated/provided the laboratory materials.

S7 was the only sessions that had support from the communication office, this support was in terms of the discussion of ideas and dissemination of the activity to the community.

When asked during interview I1, “if any additional support when preparing the activity could have had an impact on the preparation of the activity”, two sessions S3 and S7 said “Não”, another two sessions S5 and S8 said maybe, one, because depending on the day of the activity, the scientist may need support for the field trip, and the other session, because the scientists did not contact their “gabinete de comunicação”, and they thought “Não sei se ter envolvido o nosso gabinete de comunicação teria dado outro tipo de feedback”, however, they also said that

Da parte do Exploratório, eu acho que tivemos toda a ajuda necessária.... Acho que funcionou bastante bem com o apoio que tivemos do Exploratório.

The sessions that said, they would appreciate some extra support, S1, S2 and S4, for one session, it was about having previous knowledge of the audience.

Conhecimento prévio do tipo das crianças, ... a mim ajudava-me ...

However, for the other two sessions, it was in relation to dealing with such a young audience. For one session, it was about having the right language, for the other, it was about how to communicate and capture the audience attention, this session had no previous experience and they mentioned

sentimos alguma falta de apoio, alguma insegurança da nossa parte, na parte em si da comunicação, ..., não tivemos nenhum tipo de **esclarecimento de como falar para crianças tão jovens, com prender a sua atenção, ...**

These comments are related to what the scientists expressed as the challenges and concerns of the activity and that is developed in section 4.4.8.

4.4.4. Testing the activity

During the interview I1, the scientists were asked about the testing of the activity in advance of the day. The objective of this question was to understand the level of testing/practise they have in advance of the day of the activity, if they have considered it at all and if they had tested or practiced it, how that helped them in adjusting the activity, if they changed something afterwards.

In relation to the question, “have they tested the activity before the day of the event?”, all of the sessions except one, answered “no”. S4 had previously done several times the activity before at other events, for similar audience and said:

Não vou fazer **nada que ainda não tenha feito**, ... são tudo atividades que eu **já fiz com crianças desta idade**. ... Todas elas **são atividades** que eu sei que **funcionam** mais ou menos bem.

S8 performed a similar activity before, but the audience was different

Com **crianças pequenas** não. Isto são coisas que aqui para esta atividade que eu **junto partes que fui fazendo em outras**. ... o que varia é a maneira como vou usar esses materiais.

S6 performed a similar activity for a similar audience before, but today decided to perform the activity differently and did not properly test this format before:

para esta fase de idade, já tinha feito umas duas vezes ...

for the rest of the sessions, the day at the Exploratório was the actual “test session”, for session S3 was only for the new materials the scientist was introducing that had not been tested.

já apresentei outras vezes esta temática, então isso já conta um pouco como **prática**, mas praticar **esta atividade em si, não** fiz

Session S1 used a book for the activity and had a journalist friend that had a quick look at it. The friend already advised to think about some of it for the future, if the activity was happening again and the need to do some adjustments. But there was no time to do the adjustments before the activity. The scientist was also planning to practise and try testing the activity with some children during the weekend, but it was not confirmed to me, if that happened at the end or what effect it had on the activity if any.

For the session S7, who did the activity previously (twice) at the Exploratório, the first time they did it was the “test session”. S7 mentioned that “a primeira vez foi piloto, foi um teste”,

A **primeira vez foi mesmo já com uma escola aqui**. ... Na primeira vez, tentamos introduzir um outro assunto, ..., achamos que não funcionou para esta fase etária, por tanto na atividade a seguir removemos esse jogo. Por exemplo, também na primeira vez, apresentamos o vídeo ali, no chão, e depois na segunda vez tivemos a ideia de fazer aqui tipo cinema, achamos que funcionou muito melhor. Então **vamos assim fazendo essas pequenas adaptações**

It should be noted that, one session (S2) mentioned the reason to not have tested the activity was

A verdade, **não temos assim um público algo semelhante para ir testar isto**, na verdade, é assim, esta atividade no Exploratório vai ser o nosso teste, e para **futuras atividade, depois**, aí vamos ver o que é que vai correr melhor ou menos bem e tentar adaptar, mas vai ser a **nossa primeira**.

This session also mentioned that they will have a rehearsal to see how they will talk to the children, the flow, however, to note is that, there was no audience for it, only the scientists participating on the activity were going to be there.

Hoje vamos realizar uma reunião e acabar o que falta fazer, e vamos aproveitar para fazer o **ensaio** de como iríamos **falar para as crianças**, para perceber se estamos a ser demasiado **informativos** ou muito **complexos**.

For some of the sessions, when they said they have not tested the activity and seemed the activity was mostly new, it was asked about their level of preparation and practise, to see if everything is ready the day of the interview, which was 1 or 2 days before the day of the activity. They all said they were ready and had everything mostly prepared. One session (S5) mentioned:

sim, houve uma das colegas que foi ao Exploratório, diz que estava tudo em terminus de **materiais, está tudo** pratico, preparado, ... **o guião** da atividade está feito, vamos também tentar **improvisar** algumas para não dar aquele ar sério de que está tudo muito estruturado, por tanto adaptarmos ao contexto, ...

4.4.5. Level of preparation for the activity

During the interview I2, the scientists were asked about their level of preparation for the activity, a question that was repeated on the survey Q3 to compare their feelings about it, after some time to reflect in what happened during the activity. The objective of this questions was to understand if anything changed in their opinion about the level of preparation needed to do the activity.

From the interview I2, only one scientist mentioned that was “muito bem” prepared and another “não me preparei muito”. Most of the scientists answered “bom” or “bem”.

The comment left from the “not much prepared” was:

mesmo muito preparado, ... esta **reação dos miúdos** é mesmo muito diferente de grupo a grupo...

Another comment was from S5:

Estávamos preparados, bom. Conseguimos **improvisar e adaptar**... por melhor planeamento que haja, temos que nos adaptar, Acho que conseguimos dar resposta a o que eles estavam recetivos perante nós.

S3 mentioned, “**bem**, podia ser melhor, mas foi bem, foi bem”

One of the sessions, S2, who had no previous experience in SciComm, mentioned that

Nós entramos aqui estávamos completamente assim com medo, ... são muito **espontâneos a falar**, ... não sabemos como é que eles vão reagir, por tanto estávamos assim um bocado a medo, mas acho que esto é algo que podemos treinar para as próximas apresentações para este publico.” “eu estava muito **reticente** qual é que poderia ser a resposta que diriam das crianças e se elas estariam com **vontade ou não de interagir connosco**, ... e portanto acho que até **correu bastante bem**.

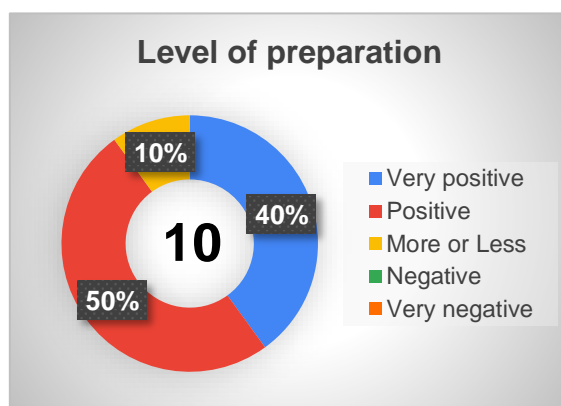


Figure 13 – How the scientists felt their level of preparation was after doing the activity and reflecting on it, data from Q3.

After reflecting on the activity, most scientists mentioned in Q3 that, they felt their level of preparation for the activity was “positive” or “very positive”, except one that said, “more or less”, see Figure 13. They were asked to develop on the reasons for their answers, however, it will be discussed later on in section 4.6.1 to compare with the comments left for, the future of the activity, since some of the answers referred to the resources of the activity.

One comment that summarised the general view was left by S2:

I think that I was **well prepared**, however, since they are so **spontaneous**, we can't prepare for all the **questions** that they may ask.

Another objective related to the preparation for the activity, in order to perceive if there were any surprises during the activity, during the interview I2 they were asked if, there was anything that happened that they have not anticipated for. The answers were four sessions said “YES” and four sessions said “NO”.

correu tudo assim, bem, dentro do esperado

Não, correu tudo mais ou menos, ... foi tranquilo

The comments left by the sessions that said “YES” were in relation to the questions and answers and the behaviour of the audience:

S3: Que eles **acertarem** tantas **perguntas**, que eu perguntei, as perguntas que eu fiz

S1: **chorarem**, também não estava à espera ou batiam acho que houve, ... isso não estava à espera, tão pequeninhos

S2: algumas crianças assim com mais à vontade, e que é bom se nota que tem mais espírito crítico, ..., as vezes fizeram-nos algumas perguntas que nós não estávamos à espera, ... eles começaram logo a **fazer perguntas** muito interessados, ..., nós não estávamos à espera de que perguntassem e tivemos ali responder de formas simples. ... acho que estávamos a contar já um pouco, se calhar não com tanta **espontaneidade** ...

S5: se calhar, só **não interagirem** com o peluche, terem quase receio do peluche. ... ficaram parece-me com medo. Aí estávamos a espera que eles tiveram mais entusiasmo por mexerem, e houve aí uma reação se calhar um pouco oposta

4.4.6. Training in SciComm

The objectives in this section were to understand the situation of the scientists in relation to training in science communication and if they have interest in training, if so, what type of training. The interest in training was also asked after the activity in order to find out if the activity had changed their perspective about the interest in training.

The scientists were asked in Q1 (and if needed during I1), if they had some sort of training in science communication, this could be formal training or informal, such as, where they searched online or in books about the subject. Clarify that, in none of the cases, the training or searches about science communication were specifically done in relation to this particular activity.

From Figure 14, out of the 13 scientists that answered, only 3 scientists had formal training in science communication. One scientist had interest in the topic and took courses when it was possible. Another scientist had a curricular unit in the subject as part of the PhD course.

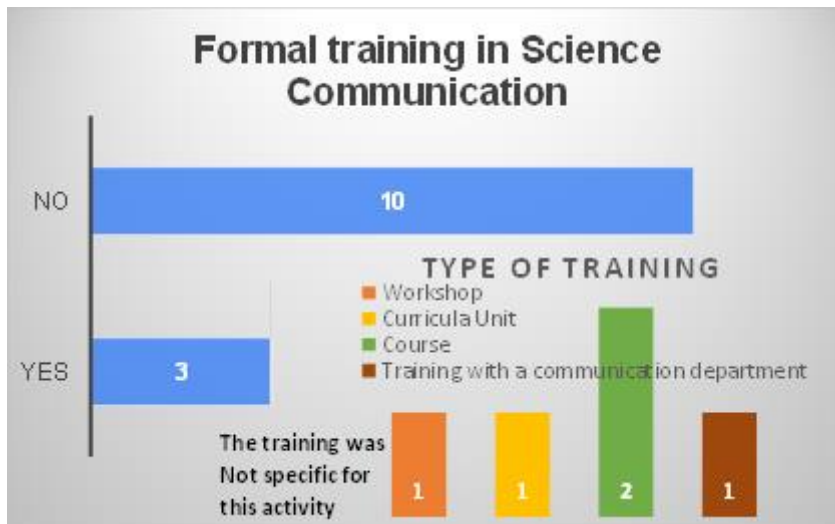


Figure 14 – Did the scientists have any training in science communication?

Individually searched for how to do Science communication were 5 of the scientists. There is no relation between this and the scientists with formal training, as one scientist with formal training also took the initiative to search for more information, the rest (4) did not have any formal training. YouTube was the most researched one, mentioned by 3 scientists. Other searchers were in books, papers, blogs, seminars or some science society online publications. It is worth to mention, one scientist comment, that the searchers are not about “How to do science communication” but about “examples that the scientist thinks are good ideas and could adapt them”. They all agreed (except one that was “not sure”) that, they put in practice during the preparation of the activity, whatever they had learned from the trainings.

From the first questionnaire Q1, except one scientist (a master student), they were all interested in science communication (Figure 15a) and continued to agree on the third questionnaire, that to have training in SciComm is relevant (Figure 15b).

When asked about what type of training the scientists were interested, it should be noted that mostly, they all mentioned that they needed training in:

something that was specific and not just a general course about “How to”. A summary of all the answers is shown in the appendix A2.3.6. However, one thing mentioned by 4 scientists was about “how to efficiently pass the message and adapt the language for the target audience”, more specific for such a young audience of preschool children.

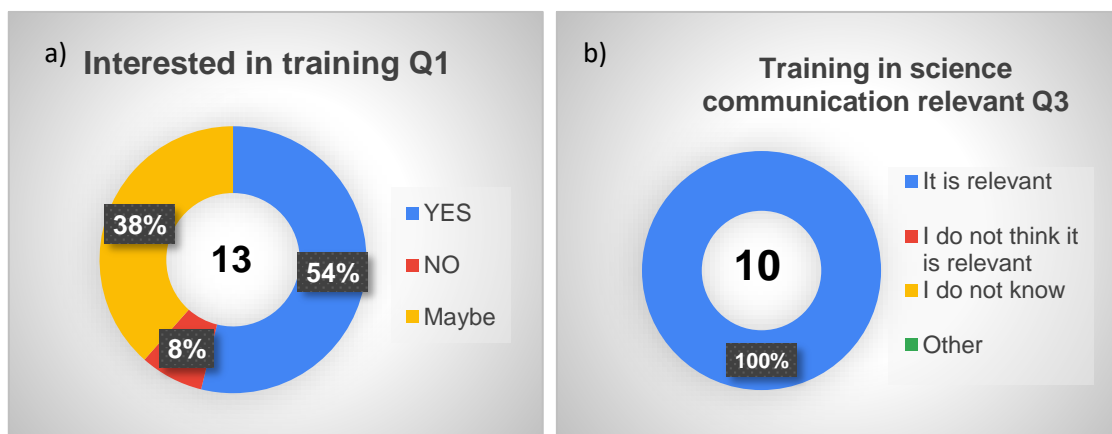


Figure 15 – Are scientists interested in training in SciComm? a) data from Q1, b) is training relevant? data from Q3.

One scientist (S7) that did not have previous training in SciComm mentioned “Maybe” because for the time being:

a **transmissão de mensagens** e da **qualidade** das mensagens que fomos transmitindo, enquanto as nossas **skills** foram **suficientes** para isso, acho que podemos continuar a fazer com esta **experiência que vamos adquirindo**. A partir do momento que se calhar eu sinta que os conhecimentos que eu tenho são obsoletos e que não permitem fazer este tipo de atividades, se calhar então e se tiver disponibilidade, teria que investir ...

4.4.7. Format of the activity and engagement

The objectives in this section were to understand how the scientists planned to organise the activity, in relation to the format and style and to perceive the reasons, if any, behind their choices. For this, in Q1 they were asked “what is the format of the activity?” and “can they list the different parts of the activity?”, with this information to start, to get a deeper understanding and develop in the answers, they were asked during I1 the questions, “How is the activity organised and can you develop in the reasons for each choice?” and “What is the structure/format of the activity, does it have separate moments? What is the style of each moment? What are the resources you will use?”. This information was as well taken note during the observation of the activity.

Another objective of this section was to understand how they planned to interact and engage with the audience and if there is any relation of the style and format with the engagement. This was asked during the interview I1: “How are you planning to interact/engage with the children? How do you see that interaction happening and the reasons for it?”.

A summary of all the information can be seen in Table 12. The data collected in questionnaire Q1 is not presented, because it did not provide any extra information that was not already there in the interview answers, when necessary, a small comment left in () was added with a relevant information from Q1.

Answers from Interview I1, complemented with some information from Q1 in ()

-Format & setting: Optamos por dividir a nossa atividade em **duas sessões** principais, um porque queremos transmitir **dois conceitos** diferentes, mas que se interligam e segundo também, por uma questão logística, porque é do nosso interesse **separar as crianças em dois grupos mais pequenos, porque** sentimos que é **mais fácil prender a sua atenção**. Não existir duas atividades a correr **simultaneamente** ... e depois trocam. Haverá tal vez uma exposição mais **teórica inicialmente**, do que é o **conceito** de ... depois irão então uma segunda atividade, que será em um ambiente mais laboratorial, queremos que eles tivessem uma **experiência mais hands-on**, para também ser mais **divertido** para eles, ... vertente mais **prática**.

(atividade "hands-on" no laboratório: they will **learn about how** different ...)

-Interaction: a traves do hands-on e de perguntas e questões.

-Format & resources: É o livro e instrumentos. Quando chegasse a ... simularem o som, ... quando chegássemos as ... darem a ver o ...

-Interaction: eu acho que eles gostam de interagir, estou a contar com isso, porque quando faço visitas os pequeninos eles **fazem muitas perguntas**. De preferência eu gosto sempre que haja **interação e diálogo**, e eles vão sempre a dizer disparates e coisas muito acertadas também. (L: então não vai ser que vai ficar você a ler o livro e quando terminar é que vão falar) Espero que não, espero que eles não estejam todos caladinhos, sem dizer nada, eu ficar a ler e eles vão adormecer, pronto adormecem.

-Format & Interaction: A atividade **segue uma linha de pensamento** em que pronto, no geral começa com uma **apresentação**, depois, ... havia momentos de **interação**, ou seja, há um momento em que eu vou fazer **perguntas**, e depois dessas perguntas, seguem-se uns pequenos comentários só para ficarem uma ideias chave, ok, e depois voltamos, e sempre **entre momentos de interação e ideias chave**, para tentar em nesses momentos de interação que as crianças se mantinham **cativadas** ...se eles estiveram entretidas a fazer atividades, é muito mais fácil, que depois digamos uma palavras e elas conseguem captar essas ideias. **Tem uma logica**, que vai desde a apresentação e introdução das ... até outros problemas que elas estão a enfrentar e depois a ideia chave de porque é importante ... que essa é a ideia que eu quero que eles levem para casa.

The scientists wrote a document about the activity and organisation, with each moment to keep for themselves.

(**Interaction with the audience** (questions, riddles, ...) with some informative **notes/curiosities**.)

-Resources: Há diferentes materiais, os materiais são simplesmente **folhas**, escolhi por caso da **prática** é fácil de transportar, também **materiais** que elas vai poder **tocar e interagir** e escolhi porque acho que as crianças **gostam** mesmo de isso, (tocar, sentir cheio, sabores ...) escolhi por caso que era uma coisa que **cativa** as pessoas, as pessoas não gostam só ouvir falar, gostam de interagir co os materiais e poder sentir ... levei coisas também **estimular o**

...

-Format & interaction: Hoje é que pense que vou fazer um bocadinho diferente, chego lá e **vou falando**, falo, **oiço**, e **vamos ao "flow" do que é dito**, ou seja, **não havia grande estrutura**, simplesmente **temas core para falar**, depois a partir de aí é **o que surgiram**.

-Format: tem 4 partes a atividade: apresentação, observação e manuseamento, conversa, projeção de imagens e leaflet with games to take.

-Resources: aquários (box), organismos (animais), lab equipment (pinças, pipetas, caixa Petri) e imagens. A projeção acompanha a atividade.

-Setting: crianças divididas em grupos

-Reasons for the leaflet: é uma maneira de mais tarde pensarem no assunto. É uma estratégia se calhar mais para ajudar a **sementar**.

-Interaction: Muito **participativo**, tornar a atividade mais **dinâmica**. para -> **Criar espanto, surpresa, despertar emoções**.

Porque é mais fácil **transmitir informação se associarmos a uma emoção**,

Vários grupos de organismos que cada um criar um momento de **surpresa**

-Format & Interaction: O primeiro momento é **apresentar o conceito** (... vamos tentar simplificar ao máximo, porque são contextos complexos para esta fase etária) ... apresentar o conceito sem ser demasiado exclusive, tentar envolver as crianças e dar o **exemplo pratico** do ... e fazer **paralelismo** com (... é feita com base mas do **inquérito**, perguntar as crianças ..., não queremos ser nós o centro das atividades, ou **centro das atenções** mas terem os meninos) depois a segunda atividade é completamente dependente de eles, por tanto, como as **crianças gostam** muito de **brincar** e gostam muito de fazer **jogos** e de competir no bom sentido, portanto é de **aquelo que transmitimos anteriormente**, torna-los mais **prático**. O terceiro, como vamos ter tempo, eles vão ter que estar a espera um dos outros, é uma maneira no fundo de eles **ocuparem o resto do tempo** que é fazer uma coisa que eles **gostam** que é **pintar** ... o aspeto central da nossa atividade.

Reasons for the three parts: maneira mais logica para nós ... **não** queríamos uma coisa totalmente **expositiva**

-Format: Uma atividade, passa um pouquinho por **conversar** com eles, em que vamos **perceber o que é que eles sabem**, ... da cordo com isso vamos estabelecendo a nossa conversa. Depois mostramos um **vídeo**, para eles terem mais noção visual Depois temos o **hands-on**, são duas atividades ...

(**Short talk** (to **understand** their **knowledge** and, accordingly, explain/clarify **3 concepts** only)

-Resources: Tem um **impacto**, a utilização de **imagens** e das imagens mais adequadas, por tanto isso também exige alguma investigação.

-Interaction & setting: (Interagir) como este publico em particular, é relativamente fácil porque eles são muito transparentes. Nós temos de criar sempre uma **proximidade** também **afetiva com eles**, ... estabelecer essa **ligação** com eles, essa **conexão** e a **simpatia** com eles, para que eles possam estar a **vontade** se calhar para nos **fazer perguntas**, ... **tentarmos pôr** um pouco **ao nível deles**, não criar barreiras. Eles podem falar connosco, tentarmos poer como **pares**. Gostamos sempre de nos **sentar ali com eles**, porque achamos que ficamos ao **mesmo nível** deles ... tentar que eles **gostem** de aquilo que nós estamos a fazer com eles.

-Format: Três atividades cada uma com, em sequência, com os seus objetivos.

-Interagir: Começar com mostrar um objeto e **perguntar-lhes**, sabem o que isto é ... possivelmente alguns vão dizer ... pronto vou perguntando e os ... são Uma pequena **conversa que desbloqueia**, para dar início, mas que não se prolongue muito, porque a minha ideia é então **vamos brincar e vamos descobrir** como é que é, como é a vida de eles. Porque a primeira atividade é para **simular** o ciclo de vida do ...

Table 12 – Style of the activities, resources, setting and engagement.

In relation to the format of the activity, half of the sessions had clearly defined parts and the other half, the activity did not have separated moments. For the sessions with defined parts, on average, 3 defined activities (clear separated parts of the main activity as a whole) was the predominant format. For the other sessions, one had the style of free conversation but with a guide to reach the intended information, another was a story telling with several moments of breaks for very short activities in between the reading, another one was the same activity but with different moments defined by the different objects of observation, and one, seemed to have different parts/activities, however, the scientists did not differentiate them justifying a circular flow of them with similar style (see the details on Table 12).

All of the sessions had in common the first part, an introduction to the main concept, however, the approach was different for each session. This approach was related to the way they interacted with the audience and the purpose of it, in order to introduce the topic, some tried to have a conversation to find out the audience previous knowledge, others approached with questions to the audience, another it was a contextualisation. All of the sessions, except in two, the audience sat on the floor and the scientists too, one session explain this choice as a way to be at the same level as the audience, not creating a barrier, so the audience felt freedom to speak to the scientists. Another tactic was to create affective proximity with the children, to create a connection.

Only two sessions talked, during the interview I1, about the scientific concepts they wanted to cover, one session had 2 concepts and another one said 3 concepts.

For the resources, two sessions had activities in the form/style of a laboratory experiment, these sessions required laboratory equipment, which was particular and suitable for children to do experiments. Several sessions used images, one session explained the importance of the style and quality of the image, because it has an impact on the target audience and how the message is conveyed. One session chose the materials because, they were convenient from a practical point. Some materials were chosen because they captivate the audience or create stimulus. Other reasons given to choose the activity was because, they believed that the children like to do it, such as painting or playing.

The style of the activity, when the scientist justified it, was mostly because the scientists believed that the audience (children) liked it or the audience behave in a certain way.

Three sessions provided something for the audience to take with them at the end of the activity (leaflet with games, colouring design of the main concept of the activity and an

object). One session said it was a souvenir, however, in another session, the scientist explained the motivation behind providing something for the audience to take with them, as a way for the audience to think about the topic later on and as well, an strategy to help seed the information.

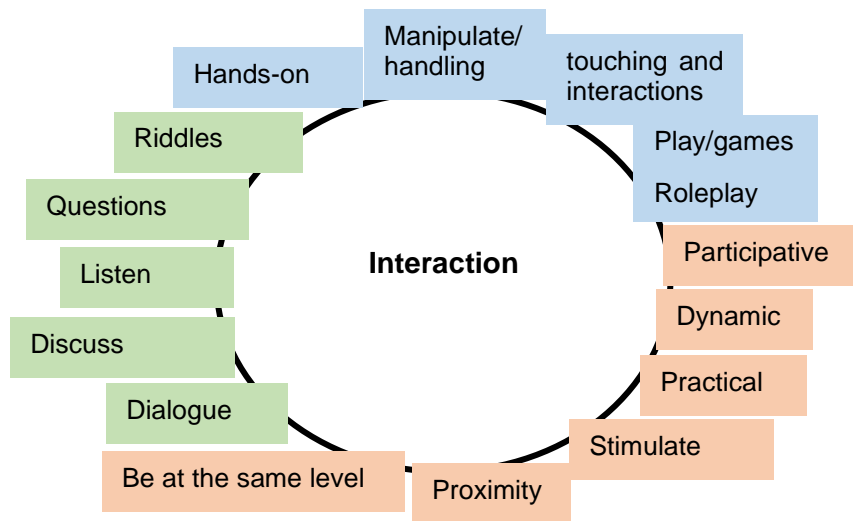


Figure 16 – Keywords related to interaction and group according to: hands-on and experiences, Dialogue and Descriptive words.

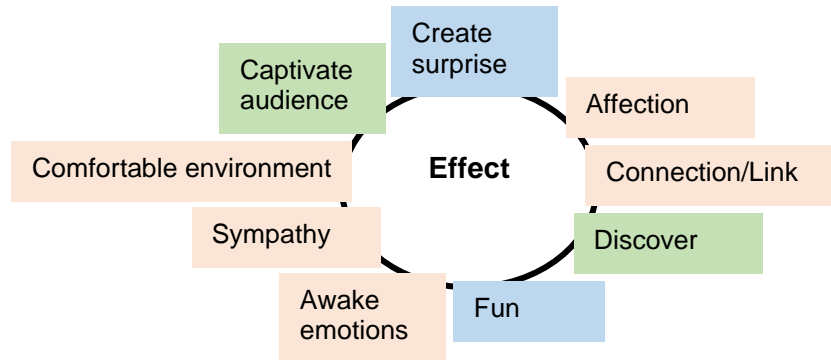


Figure 17 – Keywords related to the effects and grouped according to: Affective, Exploration and Enjoyment.

A summary of grouped keywords representing the interactions and the effects can be seen in Figure 16 and Figure 17. A summary of key comments in relation to the interaction and transmission of information is shown below:

“vamos brincar e vamos descobrir”

“é mais fácil transmitir informação se associarmos a uma emoção”

“momentos de interação e ideias chave, para tentar nesses momentos de interação que as crianças se mantinham **cativadas** ...se eles estiveram **entretidas** a fazer atividades, é muito **mais fácil**, que depois digamos uma palavras e elas conseguem **captar essas ideias”**

“Nos temos de criar sempre uma **proximidade** também **afetiva com eles**, ... estabelecer essa **ligação** com eles, essa **conexão** e a **simpatia** com eles, para que eles possam estar a **vontade** se calhar para nos **fazer perguntas**, ... **tentarmos pôr** um pouquinho **ao nível deles**, não criar barreiras. Eles podem **falar** connosco, tentarmos pôr como **pares”**

A summary of the style and characteristics of the activities, from the observations notes is shown in Table 13. The notes were according to my interpretation of the activity (observation of images in some cases could be considered a game, but because I thought the game involved looking at images, I decided to characterise it as an observation). Columns are in the same order as the summary in Table 14 and correspond to the same session.

From the observations, the duration of the whole activity was around 1 h long. The number of parts refers to the different activities or clearly defined moments of the whole activity. The session where it says 1 (3) is because the format of the activity was always the same, was all one activity, however, the activity was marked by several moments defined by the objects to look at and therefore, it could be said that there were 3 parts. Because this is data from the observation, it is seen from the researcher's point of view and interpretation. Combined the information from the observation and interview data, it is possible to say that: two sessions followed similar style of the activity, there was only one message for the audience, but two/three scientific concepts (vocabulary) for them to learn, and although the activity had several parts, all of the parts were different formats to convey the same message and concepts. Other sessions had different messages for each part of the activity. Something the researcher noticed, related to the way to transmit scientific concepts for this particular audience, was the need to repeat the words (concepts) several times along the activity and get the audience to repeat them aloud, this was a technique shared between most of the sessions, and at the end of each part, recap the key information, and start the next part again with a summary of the previous message and a link to the new information.

Total Duration of the activity

45 min (A)	48 min (A)	50 min (A)	55 min (A)	1 h (M)	1 h (M)	1h 10 min (M)	1h 15 min (M)
Number of parts							
3	1	8	3 + 1	1 (3)	4	4	5
Description of the parts and they occurred							
1 st Introduction big group Sat on the floor big circle 12 min	One big group Sat on the floor big circle Story book with interactive objects	1 st Introduction big group Sat on the floor big circle 12 min	1 st Introduction big group Sat on the floor big circle 26 min	1 st Introduction Small groups Sat around 4 tables 4 min	1 st Introduction Big group Sat on the floor big circle 16 min	1 st Introduction Big group Sat on the floor big circle 11 min	1 st Introduction & game (roleplay) Big group Sat on the floor in rows and standing in certain positions Outside 26 min
2 nd & 3 rd two groups doing two activities (game & laboratory) in parallel and then they swapped Standing around two tables 18 min		2 nd Talking, objects Big group 18 min	2 nd Talking, objects Big group 17 min *object souvenir to take with them	2 nd Different object to observe and interact Small groups Sat around 4 tables Use of lab equipment	2 nd Exercise Big group moving around 3 min	2 nd Cinema Big group sat on chairs to look projector (watched twice the video) 1 min	2 nd Story & demonstration Big group Sat on the floor big circle 8 min
		3 rd Game 6 min moving around to find group	3 rd Game 12 min moving around to find group	3 rd Different object to observe and interact Small groups Sat around 4 tables	3 rd Game Big group standing around a table 23 min	3 rd & 4 th two groups doing two activities (game/paining & story) in parallel and then they swapped	3 rd Observation Big group Standing around a big table 8 min
		4 th Talking Big group 2 min	4 th See closer an object Only a small group went while getting ready to leave and others were running around	Use of lab equipment *took leaflet With activities games/ colouring /labyrinth	4 th Art Painting Sat around different tables *took paintings with them 20 min	and then they swapped Sat around two tables 3 rd 18 min 4 th 17 min	4 th Game Four small groups sat on the floor small circles (all of the groups had the same game) 6 min
		5 th Talking Big group 7 min					5 th Art Plasticine (created exhibition) Individually 15 min
		6 th 7 th & 8 th Three small groups in parallel doing different activities Sat on the floor					

Table 13 - Data collected during the observation of the activity. Each column is a session. Duration of the different parts of the activity and description of the setting. M: morning, A: afternoon.

Style of the activity								
Laboratory	✓				✓			
Observation		✓	✓		✓			✓
Game	✓	✓	✓	✓		✓	✓	✓
Story book		✓						
Art						✓	✓	✓
Demonstration								✓
Video							✓	

Table 14 – Summary of the characteristics of each activity, a session per column.

Some sessions gave something for the audience to take with them, for two sessions that was a drawing and a leaflet, for another session it was an object.

In relation to the setting of the activity, only one session had the opportunity to do the activity partially outside and then move in-doors, for the rest of the sessions, the activity occurred all in one space. Although the activity occurred in one room, most of the sessions had defined locations in the room for the different parts to happen, according to the needs of the activity, the audience moved around. This moving around or changing spaces were considered by the scientists like brake moments, to get the audience back to concentrate in the activity. In a few sessions, where different activities happen simultaneous, sometimes the activities did not have the same duration and some groups had to wait, which in some cases created a distraction for the group, trying to get them calm and back to the next activity.

Most of the sessions did the first part introduction with everyone sat on the floor and the style was a conversation, with the audience free to speak, interrupt and ask whenever they felt, it was like the audience guided the conversation, with their comments and questions and the scientists had to keep it on track with the subject and so to convey the message.

4.4.8. Challenges and Issues

The objectives for this topic were to understand the concerns the scientists had about the activity, and to understand how they planned to resolve them when possible. This was about the activity in general, about the topic of the activity for this particular audience or about the interaction and engagement with the audience. In relation to engagement and interaction with the audience, they were asked, if they predict any challenges in relation to the level of interest or engagement in the activity from the young audience.

During the first questionnaire Q1 and interview I1, the scientists were asked about what the concerns or worries were, if any, that they had about the activity in general, for them to interpret about it. More specific during I1, they were asked to develop, about the scientific topic and engagement of the audience. If they had any issues or barriers in relation to the topics they were covering during the activity, and as well as, about talking about the topics to such a young audience. When we prepared these questions, we had in mind for them to interpret it so to think about everything they were planning to talk about, any small topic / subtopic that could come up during the activity, including from questions, and for them to reflect, consider and be aware, if it could be a sensitive topic or controversial in some respect and how they planned to deal with it. However, for most of the scientists, we did not feel they interpreted it in this way and did not get much information from the answers in that respect, however, from my observations during the activity and from my point of view, I realised that sometimes, these sensitive topics occurred during the activity, the difference being, they were not the main general topic of the activity.

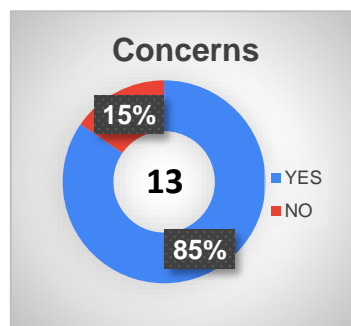


Figure 18 – Do the scientists had concerns or worries about the activity? (data from Q1).

We can see from Figure 18, that except 2 scientists (who belonged to the same session S7), they all had some concerns. I understand the reasons for the session with no concerns is due to, being the only session (S7) that had participated and done the activity previously for this event *Encontro com Cientista*.

From Q1, there were two common topics between all of the answers, they were in relation to the message and the interest of the audience. They were worried about the message being transmitted, being clear and correct. They were also worried about keeping the audience interested and attentive. All of the answers can be seen in appendix A2.3.7. And the answers were developed during the interview I1 and summarised as follows.

One thing I would like to mention here, considering for example that several activities involved something related to animals, was a comment left during the interview I1 by one scientist, however, it was not in relation to the question about challenges, it was left as part of another question, but from my interpretation of the information, this could fit into the question about the challenges of communicating the topics, “para adultos por exemplo tenho frasquinhos com os animais conservados em álcool, para as crianças vou usar animais vivos”, the scientist had previously explained in another question the reasons for it:

evito ao máximo sacrificar animais... . Com crianças pequenas eu evito ao máximo usar animais conservados em álcool, porque os **animais são mortos**, depois cria aquelas questões dos animais estão vivos ou mortos? depois um tem de dizer estão mortos, depois as crianças vão perguntar, mas estão mortos porquê, matou os animais, depois entramos na quela e **desviamos nos completamente para as questões éticas, e perdemos** ... depois é muito difícil explicar as crianças o motivo pelo qual os animais estão mortos ...

In this case, the scientist made a conscious decision about dealing with dead animals and the consequences that it could have, when running the activity for this particular audience, and found a way to resolve it. In another sessions, there was a small chance of taking a box of dead animals, when I asked the scientist about how the scientist will deal if asked about them, the scientist answer was “é uma **coisa natural**, é o ciclo da vida”. Previously in the conversation and respect to another part of the interview, the scientist mentioned that children “**deslumbrassem** com os animais, depois fazem confusão por estarem mortos, alguns choram e ficam tristes, mas quando não pensam muito em isso, adoram estar na presença de animais de outros cantos do munto e que desconhecem, ...”

In another session, due to the topic being reproduction, the scientists had already experience in talking to different audiences about it and were aware of the situations and questions that could emerge and had found a way to deal with it.

Ainda é um o assunto um bocadinho tabu, “com certeza vai levantar questões quando eles chegam a casa. ... se calhar o obstáculo sempre é, se eles tocarem na abordagem mais física, ... é tentar transmitir isso de uma forma simples, de forma que também **não leve muitas perguntas em casa**. ... tentando **não ir muito contra aquilo que os pais querem**, ... os pais ... não querem que sejamos muito explícitos.

In other session due to the topic, they made a conscious choice to not talk about illness, however, the reasons were more related to the image of the scientist.

optamos por não dirigir a nossa atividade exclusivamente para esse fator, porque lida com doenças, ... tínhamos medo que isso pudesse passar a **imagem errada**, também de nos e de aquilo que nos fazemos, e da nossa medição, não queríamos estar a condicionar ninguém por o certo ou errado estas crianças tao novas, e por tanto tivemos essa preocupação de se calhar **tentar ir para temas** não diretamente relacionados com doenças, porque estávamos com medo que isso pudesse, criar uma certa **imagem nossa**, estar assim a **associarmos a conceitos maus**, por exemplo.

In a similar direction of giving a good image of the animals, another session related to animals, mentioned:

os pesticidas, tipo algo os completadores que se alimentam de animais mortos e também de humanos, não sei se vou focar nos humanos e só falar dos animais, ... não sei se é muito **sensível para eles**, parece assim muito, do resto acho que não há assim nada muito sensível. Na referi muitos insetos que sejam assim ... esquecime de falar de esses, **são mais maus e eu queria dá a imagem do bom**, embora também ... podem ser uma praga, ... acho que não tenho assim muitos problemas por falar, o meu **maior problema é a linguagem**, tal vez algum que não saiba explicar bem para eles mais pequeninos.

For other session, "*O tópico em si não*".

o **vocabulário ... a partem mais científica**, ... tenho de explicar de uma forma que eles consigam, e isso pode ser difícil, porque podem ainda não estar **familiarizados com alguma palavra**, vou tentar simplificar essa palavra, ... tenho **verbos** que sejam mais próximos de eles, ... tentar degradar essa palavra de forma a que eles entendam ...

which is similar to the answers given in the questionnaire Q1.

It should be noted that, several sessions mentioned that, in relation to the *scientific content and scientific vocabulary*, they did not expect any issues, they had

conceitos relativamente simples, ..., podemos usar alguns términos científicos e eles vão compreender-lhos. ... **perceber os conceitos eles até são capazes** conseguir perceber com alguma facilidade, ... não é importante que eles saibam

qual é a palavra, o **importante é passar a mensagem**. ... crianças tão pequenas soubessem que é (palavras científicas), **não é esse o objetivo**

com os anos, ... comecei a usar as **palavras (cientificamente corretas)**, ... **três vocábulos** que eles não conhecem, mas que se foram introduzidos no âmbito do jogo, e repetidos alto, eles (crianças) **acho que até apanham**

In relation to the challenges related to the level of *interest and engagement* of the children and if any, how they planned to solve them, three sessions did not have any worries, S7 mentioned:

não, acho que todos eles **se interessam, fazem perguntas**, ... querem **todos falar**, ..., tentamos fazer assim um paralelo com a situação deles, ... então depois é mais fácil nós pegaremos nesses pormenores e tentar explorar

S1 mentioned that “vou tentar dizer piadas, ..., não tenho muita dificuldade em captar a atenção do público mas pequenino espero eu” and S5 said:

nós estamos em crer que eles vão gostar e que **vão interagir**, pronto como nós introduzimos **jogos**, e vamos tentar eles serem o **centro das atenções**, eu acho que eles **vão aderir**

For session S4, the scientists recognised that

há sempre crianças que não têm interesse. ... Não prevejo que haja assim grandes problemas

For other sessions however, they think it could be complicated because:

elas (as crianças) **distraem-se muito facilmente**, ..., vale só uma criança a perder o interesse, ... depois temos dificuldade em voltarem a concentrar o grupo todo. Aqui vão haver vários grupos, vamos ver se isso também não é depois uma complicação, porque eu sou **só uma** e se há **vários grupos**, tem que ver como é que vai ser a **dinâmica de circular entre os grupos**

In developing the answer from Q1, session S3 mentioned

o meu objetivo é, entre falar e o levá-las a interagir espero que elas ao sentirem que **estão a contribuir**, fiquem mais **interessadas do que estar só a escutar**

In another sessions S2, their main problem was about:

fixar a **atenção** deles, porque se calhar temos pouco tempo para dizer aquela informação em que eles estejam no seu estado máximo de **concentração**, e se não usarmos a **expressão corporal** correta ou o **tom de voz** correto, eles se calhar vão **desinteressar** muito rapidamente, ... nossa maior preocupação e mesmo **cativar a atenção** deles.

4.5. Overall perception by the scientists

The objectives in this section were to understand how the scientists perceived what happened during the activity, from their own perspective, about the activity and the audience, about satisfaction, enjoyment, about the interaction with the audience and what they perceived the feeling of the audience was. This was asked during the interview I2 and some of the questions again during Q3 to compare, after they reflected on the activity.

They were asked during the interview I2, to mention what was their favourite moment of the activity and what they (from their perspective) thought was the favourite moment of the audience, in order to understand if there is any relation between them, the reasons for their choice and if there is a connexion to the feeling of satisfaction and the general view of what happened during the activity. As well, from what was mentioned about the preparation of the activity, if these moments were part of the planning in the preparation of the activity with a specific reason for them.

4.5.1. In relation to the activity

In order to understand how the scientists perceived what happened during the activity, the general feeling of the activity, they were asked during interview I2, how they feel overall about how the activity happened, as well as during Q3, if overall they were satisfied with how the activity ran.

Some of the comments from I2 about, how they felt overall about how the activity happened, were:

Fiquei contente.

Fico sempre feliz porque acho que eles **aprenderam** alguma coisa.

Correu bem, ... no geral foram bastante **recetivos**.

... Dou para eles também **oportunidade** de falarem, saíram de aqui **felizes**, por isso, isso é o que interessa na minha opinião

... Conseguimos manter a atividade **sem interrupções** durante o período todo, foi 1 hora, penso que correu bem.

Correu mais ou menos, ... acho que foi **demasiada interação**, haha, não consegui **controlar muito o grupo**, ...cada grupo é um grupo.

In two sessions, they said that “correu muito bem”, in other three “correu bem” and in one “correu mais ou menos”.

The two sessions that said “muito bem”, mentioned a similar sentence

Correu muito bem, houve **muito/bom feedback** dos miúdos/crianças.

After reflecting on the activity Q3, (see Figure 19), most of the scientists confirmed the level of satisfaction as being *Yes* or *Mostly Yes* satisfied, and one *More or Less*, being these responses in the same positive way as the ones before reflecting on the activity.

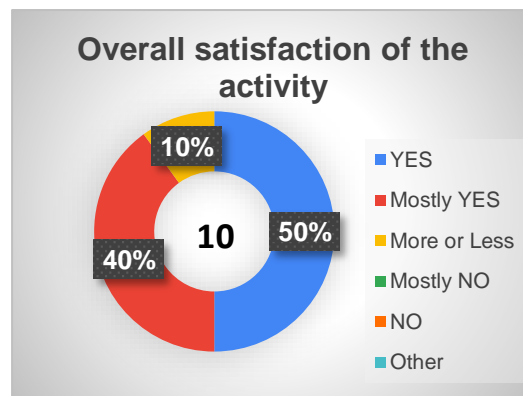


Figure 19 – Level of satisfaction about how the activity was. Data from Q3.

To understand the level of enjoyment of the scientists, they were asked during I2, “did you have a good time?”. All of them said they enjoyed it, five sessions said “sim” and three said “sim muito”. Most of them did not mention any comments about it, however some that did, said:

Sim, **foi fixe**, uma **experiência diferente** para todos nós ... foi um **desafio** para nós, mas acho que levamos todos daqui mais uma **aprendizagem** e divertimo-nos muito também.

Sim **diverti-me**, claro, algumas coisas fiquei assim um pouco em pânico, **não estão a ouvir** nada, mas depois acho que alguns, pelo menos ouviram alguma coisa.

Sim muito, as crianças são muito **genuínas**. Foi muito divertido.

Gostei. ... acho sempre que **é muito gratificante** esta noção de saber que estou a trazer-lhes um mundo que eles desconhecem.

4.5.2. In relation to the audience

This section is to understand, from the point of view of the scientists, the perception they have about the audience, the children, in relation to the interest in the topic, the enjoyment and the engagement of the audience on the activity (during I2), and during Q3 they were asked again about the level of engagement.

One of the questions was, "how do they feel about the children's interest in the topic?"

Varia muito. Há meninos que têm mais interesse e a outros que nem parece. ... Mas acho que tem que ver com a **maturidade deles**.

Um **50-50**, 50 interessadas, outras 20 % interessadas em dormir, outras 20 interessadas em estar a falar entres eles durante, é normal, mas no geral, tinham interesse, e sobretudo **muitas questões**, a verdade é essa, por isso **foi bom**.

Em geral estavam **interessadas e participativas**. Tirando o normal em um grupo grande, ... pareceu-me no geral que **estavam divertidas, que é o principal objetivo**.

Eles até estavam **interessados, uns mais que outros**, claro, mas até me surpreendeu eles gostarem de insetos e quem disse inicialmente que não gostava, depois no fim já estava a gostar.

Eu acho que elas estavam **muito interessadas, muito efusivas**, e esse é um dos aspetos que **torna a atividade difícil de gerir**, porque as crianças querem todas ao mesmo tempo, ... eu acho que da parte deles havia este interesse, esta descoberta, este contacto com o desconhecido ... eu acho que eles **receberam muito bem**, acho que **gostaram bastante** da atividade.

Eu acho que eles acabaram por **gostar** muito da questão dos hábitos saudáveis ... essa parte da **mensagem** foi bem passada e eles até acharam **interessante**.

Penso que eles, que têm interesse porque também mexe com o doce, com animais engraçados, portanto acho que eles tiveram **interesse**.

Eu acho que na parte laboratorial ... eles estavam muito **entusiasmados**, ... nós estávamos com as **batas** e eles acharam logo **piada**, e depois ... estavam a lidar com **material do laboratório e a mexer** ... e porque estavam a olhar para bebidas, no nosso caso, que conhecem do dia a dia e a ver o que está lá dentro.

Eles tiveram bastante **entusiasmo** na parte dos jogos, ... mas acho que no fundo se **divertiram**.

Four sessions recognised that the interest of the audience on the topic cannot be expected to be the same for all the audience, given the diversity in number and age of the audience. Other sessions mentioned the excitement and enjoyment as a demonstration of interest on the topic. One session mentioned the number of questions received from the audience and another the participation as a measure of interest.

The question during I2, to understand the level of enjoyment of the audience, was, if they thought the children had a good time. For all of the sessions the answer was “Sim”, and some of the comments were:

Espero que **sim**, ... dentro de uma atividade deste género, em que também temos que **transmitir conceitos mais sérios**, acho que tentamos aqui **conjugar o divertimento**, acho que sim.

Acho que sim, uns mais que outros, mas sim

Sim, divertiram-se, e os adultos também, por isso. ... saíram daqui felizes

To understand the level of engagement of the audience, the scientists were asked during I2, “how do you feel the level of interaction and engagement was?” and “was it as anticipated?”. From Q3 the question was about, “how do you rate the level of interaction and engagement?” and to develop on the reasons for their answer.

A summary of some of the answers can be seen in Table 15. All of the sessions answered in Q3, the level of interaction as either *positive* or *very positive*. And during I2, four sessions said that the level of engagement was even more than what they anticipated. Sometimes, they said that this was a bit too much and created dispersion or not being able to listen, others mentioned in relation to the questions, the audience asked a lot or they were able to answer more than the scientists anticipated. A completed summary of all the answers is shown in the appendix A2.4.3.

How do you feel the level of interaction and engagement was? Was it as anticipated? I2	How do you rate the level of interaction/engagement? Q3
sim, aliás, as vezes até de mais , ... porque depois respondem todos ao mesmo tempo e às vezes é difícil até perceber o que cada um diz concentrados na atividade	- I think that they look very interested in what we were saying - The children seem receptive, interested and willing to learn , but the complexity of the games with the difficulty of the words ... made it hard for them to enjoy it to the fullest
eu acho que sim. Até superou . Porque são muito pequenos e interagem desta forma, no sentido que nós queríamos, foi muito bom acho que sim	I thought that talking about ... and ... could be too complex , especially for the 3-year-old children. But, in the end, I believe that we managed to simplify our messages and, since we used the familiar parallelism with ... and we directed the activities for the children , I think this helped a lot in their interest/engagement .
até melhor , mais do que estava à espera. Ou seja, muito mais questões	The kids asked questions , stayed quiet most of the time and wanted to watch the ... and touch ...
foi, foi um bocadinho melhor até, eu não estava à espera que acertassem tantas perguntas	They were really paying attention and participating throughout the whole activity with minor periods of disturbance
sim, eu já estava a prever que iria a haver muitas perguntas, muita interação , claro que alguma foi excessiva , porque houve muita dispersão , mas pronto é conforme ao grupo	Houve, definitivamente muita interação .
sim, eles interagem muito	We have created proximity and empathy with the children and they felt comfortable with us
sim, foi, eles interagiram bem para o que seria de esperar , se calhar um bocadinho distraídos em alguns momentos, estavam ocupadas com outros aspetos, mas sim há muita distração, com crianças desta idade crianças nestas fases estão na fase da descoberta ... e focam o seu interesse ao mesmo tempo que distrai do que nós queríamos. ... eles envolveram-se bem e acho que estavam muito com uma apetência muito muito forte , para o que vinha a seguir ...	As crianças estavam muito participativas e curiosas e responderam de modo muito positivo à introdução dos vários ... usados na atividade
sim, eu já não trabalhava com crianças de esta idade há muito tempo, e não, nunca sei muito bem, sem olhar para eles, e sem chegar ao pé de eles, nunca sei muito bem como é que vou interagir	Em geral, as crianças envolveram-se nas atividades de forma empenhada

Table 15 – Interaction and engagement of the audience during the activity from the point of view of the scientists.

4.5.2. Favourite moment

The scientists were asked I2, “what was their favourite moment?”, as well as, “what they thought the favourite moment for the children was”. A summary of the comments is shown in Table 16.

Favourite moment for the scientists	Favourite moment of the children
Oportunidade de mexer nos animais Momento UAUUU Ter esta noção de que estou a quebrar pré-conceitos e que estou a alargar os horizontes	O último, andar a mexer , ter o animal na mão e ve-lo mexer e sentir... Vários, porque andar a apanhar os animaizinhos com pinça , porque ao início não viam nada ... depois quando as crianças perceberam que era o animal, acho que valeu um momento de efusão em que toda a gente queria pescar ...
O da atividade ao ar livre , a primeira	Ou o jogo aca fora ou fazer as plasticinas
Quando eles efetivamente pegaram nas imagens e olhavam ... e víamos que a nossa mensagem tinha sido passada com sucesso	Pintar
Quando as crianças dizem algo que é extremamente absurdo , ... fora da caixa, mas que na verdade é muito interessante , que tem muita coisa por detrás ... e de repente há ali toda uma conversa que se começa à volta daquilo. E quando as interações deles, fazem com que a malta mais velha que esta cá, simplesmente fique a rir porque aquilo é realmente absurdo, mas ao mesmo tempo interessante.	O jogo ... mas na verdade, acho que não, ... gostam de mexer em coisas ... foi giro mas foi um bocado caótico. Por exemplo se todos tivessem sentados agora aqui no fim, aquele grupinho que se juntou por exemplo agora à minha volta a olhar para os insetos , acho que isso foi o momento favorito deles, e acho que isso é o que acaba por ficar na memória .
Achei bastante piada a certas respostas que eles davam, as respostas assim ... achei muito engraçado essas respostas de eles, interessante . E mesmo a espontaneidade e a inocência com que eles respondem a algumas das perguntas que acaba por nos mostrar a visão que eles têm do problema que nós estamos a expor.	A atividade laboratorial, porque era hands-on e eles estavam a mexer nas coisas do laboratório, então fizeram mesmo muitas questões , até questões que nós não estávamos à espera, eu acho que então foi divertido para eles
Foi a identificação das abelhas, acho que é muito engraçado , porque as crianças, umas sabem outras não sabem, está sempre aquela dúvida sabe ou não , é um momento muito engraçado	Provar o mel
Do olho da mosca, que todos queriam ver e viram como a mosca vê, é muito engraçado	Aqui que também foi do olho da mosca, que também gostaram todos, e viram todos quatro caras ...
A corrida ... é sempre engraçado	A corrida. Também gostam do filme

Table 16 – Favourite moments of the activity, from the perspective of the scientists per session.

In three of the sessions, the scientists chose the same moment of the activity to be the favourite for the scientists and for the audience.

It should be noted that the used of the word “engraçado” for several sessions, seems to be what determined their favourite moment. For some, this moment “engraçado” was in relation to the verbal interaction of the audience.

Several scientists mentioned that what they thought the favourite part of the activity for the children was the part where they had to “mexer”, hands-on.

Developing more on one comment from one session,

Acho que todos eles ao nível dos organismos foram **bem escolhidos** porque proporcionaram sempre **momentos que criaram algum interesse** O ponto alto talvez terá sido ter a títula na mão e perceber que é uma sensação agradável.

It is possible to see that in this session, creating these special moments and “UAUUUS” along the activity was part of the design of it and part of the objectives the scientist had when preparing the activity.

4.6. For the Future

In this section, the objective was to realise if there was anything that scientists identified a need to change/modify in the activity, if there was something that could make the activity more effective, something that did not work as anticipated or something missing. This was asked during interview I2 and during Q3 to compare.

Another objective was to perceive the interest of the scientists to participate again in the future and to understand what were the reasons behind that, as well as to realise if these could have any connexions to how the activity occurred and other previous answers given in general. This could have a link to what were the motivations of the scientists to participate in the first place.

This research focuses on effective and quality communication from scientists to a young audience and as such, it is important to understand from the point of view of the scientists that have gone through the experience of participating in this particular event of *Encontro com Cientista* and from their previous experiences, what they considered to be important, useful things and tips, and advice they thought could be useful for anyone (scientists mainly) that could be interested in taking part in this particular event, to understand if there was anything the scientists took on board from this experience first hands.

4.6.1. The future of the activity

Changes to the activity and level of preparation

Because of the comments about the level of preparation (during Q3 after reflection) were related to the running of the activity, it seemed relevant to show them at the same time as the comments left about, what changes they will do of the activity. The data shown in here (Table 17) corresponds to the question in Q3, “could you develop in the reasons for your answer (in relation to rating the feeling about the level of preparation for the activity)?”, during I2, the question was, “anything you could think straight away that maybe you would do different if you do the activity again?”, and to compare the answers after reflection with the question during Q3, “if you have the opportunity to repeat this activity again, for the same audience and initiative, is there anything you would change? If so, could you explain the reasons?”.

There were some common comments between scientists from different sessions. For two sessions that had only one scientist, they commented that the activity could run better if there were several scientists, at least one per group of the activity in order to support each group at the same time.

Some sessions talked about the resources they used, either the need for more, modified them, or in relation to how and when they will use them.

Some sessions mentioned changes in the content, one said to simplify the concepts, while another said to change some of the content to clarify the concepts.

For one session was the third time doing the activity and therefore, all the changes they considered that could be necessary, were already done before this time. It could be said that it took two runs of the activity to get it to where it was this time and not require more changes.

Develop the reasons for the answer “level of preparation” Q3	Changes to the activity, straight away after activity I2	Changes to the activity, after reflecting from Q3
I have performed the activity before	Como já fizemos vários ajustes , acho que desta vez não identifiquei assim nada que necessitasse de melhorar .	No, we already made those improvements before
I had some games for the kids and some small gifts for them to touch and smell.	... ter mais coisas para eles mexerem . Trazer várias amostras para eles ficarem com eles mesmo, ... acho que qualquer pessoa gosta de levar uma recordação. ...Acho que era uma boa coisa ter algo para eles levarem uma recordação que lhes faz lembrar o que é isto das abelhas... Ter frascos com abelhas lá dentro para eles verem ao pormenor . Trazer mais quadras com cera para mexerem . Eles gostam de tocar, gostam de sentir e é interessante para perceberem este tipo de coisas.	Yes, I would try to make it more interactive for the kids. And take real bees on an observation hive for them to see.
Both the materials and the story line that I prepared were applied without significant problems.	Trazer um colaborador , para gerir a parte final, porque estava só eu, e tive que recorrer a ajuda de pessoas, mas que depois não conseguem dar informação ao mesmo tempo que estavam a fazer a atividade final.	Bring a colleague to coordinate better the practical activities.
Já tinha realizado as atividades anteriormente, mas há muito tempo, como resultado alguns pormenores já não estavam devidamente afinados.	A pequena preparação que fiz antes, quando cheguei cá,... só preparei aquela coisa, ... as plasticinas não estavam cortadas o que causou um bocadinho de entropia, ... um bocadinho de confusão . Rever mentalmente tudo o que vamos fazer e ter a certeza que todos os pequenos por menores estão calculados para que depois seja tudo mais rápido , ... esqueci-me do glitter ...	Teria preparado algumas coisas com antecedência. Uma coisa que não pude controlar , mas que acho que teria feito com que as atividades em sala, decorressem com mais facilidade, seria ter tido as crianças sentadas em mesas adequadas à sua estatura em grupos pré-definidos e bem separados . Também queria saber de antemão quantas crianças estariam na atividade e quais as idades.
As crianças não conseguiam ver as imagens do livro, poderia ter projetado as imagens, enquanto lia a história para eles.	Dar os estímulos , das fotografias ou dos objetos, para eles brincarem, mas ser eu a dar um de cada vez e retirar para eles ficarem mais focados na história e não dispersarem tanto com todos os objetos à sua disposição, e estabelecer os	Sim, mudava então como mostrava a história . Não daria logo os materiais didáticos e tentar ter materiais didáticos semelhantes para todas as crianças.

Develop the reasons for the answer “level of preparation” Q3	Changes to the activity, straight away after activity I2	Changes to the activity, after reflecting from Q3
<p>Achei algo difícil gerir os vários grupos, tendo acabado por se gerar algum tempo de espera. Teria sido melhor concentrar a atenção de toda a turma na projeção antes de introduzir um novo animal</p>	<p>limites de para eles ficarem mais atentos, ... ir lá para fora acho que seria mais interessante, para ver as coisas da natureza.</p> <p>A dificuldade acho que foi ... ter vários grupos e ser só uma pessoa o monitor. Isto funcionaria melhor se cada mesa tivesse um cientista, ..., não havia os momentos de espera... estas idades são muito irrequietas, não têm um tempo de atenção muito longo, não conseguem estar quietinhos à espera até que as coisas aconteçam, as coisas têm que estar sempre a acontecer... quanto um grupo está a espera crio algum rebuliço alguma agitação, ...</p> <p>Alternativa seria manter o grupo como todo, mas também seria complicado, porque depois andar de criança em criança e o tempo de espera para cada uma de eles aumentava ainda mais. ...</p> <p>Solução, para grupo grandes é realmente subdividir,...tem que arranjar voluntários para vir com migo.</p>	<p>Sim, como turma foi dividida em grupos, numa próxima oportunidade será preferível (i) concentrar a atenção de toda a turma na projeção antes de introduzir um novo animal, (ii) ter animais para todos os grupos, (iii) agilizar a troca dos animais.</p>
<p>We managed to simplify the messages, use familiar examples and develop simple, funny and engaging activities that exemplify the function of mitochondria and the importance of healthy lifestyles.</p> <p>- Everything was done with a lot of taught behind, so that kids could learn as much as possible, hence we tried to do everything very didactic, and such was done with time to spare</p> <p>-I think that I was well prepared, however, since they are so spontaneous, we can't prepare for all the questions that they may ask.</p>	<p>Se calhar poderíamos falar de mais hábitos, bons e não focar tanto só a atividade física, ... deu para perceber que quando houve aquela imagem da leitura gerou confusão, porque não promovia movimento ...</p> <p>-Recortar algumas imagens e não trazer uma que nunca foi mencionada.</p> <p>-O nome de alguns ... foi difícil para eles reter a ideia e portanto eliminá-los de uma próxima vez.</p> <p>-A atividade como está é apta para crianças tal vez do primeiro ciclo. Para o prescolar, simplificar um pouco mais ainda os conceitos e tirar alguma informação.</p>	<p>Maybe I would find another toy that represents the mitochondria. Children were cautious/scared in handling it.</p> <p>-Yes, for the reasons I stated before, I would simplify some of the activities so they can have more fun and learn more.</p> <p>-Uma das alterações que faria seria dividir as atividades em diferentes salas de forma a que o barulho não interferisse tanto com a experiência. como referi manter os conceitos mais simples tendo em conta que são um público-alvo jovem.</p>

Table 17 – Preparation of the activity and changes for the future of the activity.

4.6.2. Interest in future participation in the activity

During Q3 they were asked, if they would like to be part of this event at *Encontro com Cientista* again and if they could explain in a couple of words the reasons for the answer.

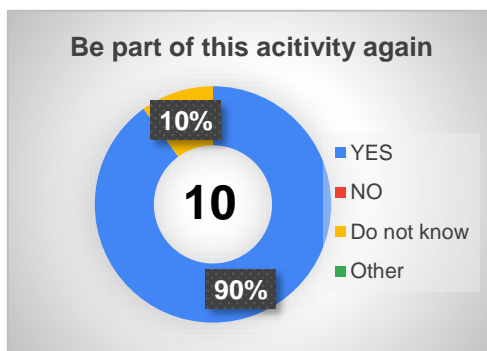


Figure 20 – Do scientists want to be part of this event again? Data from Q3.

From Figure 20, only one scientist answer was *do not know*, the reason was:

- Depende do contexto, do momento

The rest of the scientists answered *YES*, with the comments being related to enjoyment, the importance of creating interest in science and critical thinking, see Table 18.

- I **enjoyed** it
- I **like** the initiative
- I really **enjoy** to do this kind of activities and I believe that they are **important** to **increase the literacy** of the youngest
- It's importance in **increasing science awareness** since very early ages.
- Considero que estas iniciativas são cada vez mais **importantes** em todas as idades, mas sobretudo nas crianças e jovens, pois assim é possível **incutir o sentido e espírito crítico** cada vez mais cedo bem como o **gosto pela ciência**
- **Oportunidade de interagir** com crianças e **despertar-lhes o interesse** para explorarem um ambiente desconhecido
- Because I believe in the **importance of the communication** between scientists and the society in general. We can find the solutions for the problems of the world, but it will not have a global impact if we're not **supported by the general public**.
- Porque **gosto de desafios** e penso que a atividade está **engraçada** só necessita de ser limada para funcionar em pleno.

Table 18 – Reasons for wanting to be part of this event again.

As it is possible to see from the comments, some of them are similar to the comments left for the motivation in section 4.2.3, such as, increasing science awareness, interaction with society, bring critical thinking and some others are related to the objectives of the activity, such as enjoyment and doing something challenging.

4.6.3. Advice for future scientists

The question in Q3 was about leaving some recommendations, advice or tips for scientists, that in the future want to get involved in an activity for pre-school children. The comments were diverse and are shown below Table 19: they are mainly related to the interaction with the children, the message and style of the activity. Putting the comments all together give a good sense of some of the things that could make a science communication activity effective, with quality and successful. A summary in Table 20.

<ul style="list-style-type: none"> - Sejam empáticos com as crianças. Use linguagem clara— não precisam de abdicar da qualidade nem da correção científica dos termos/factos, apenas da quantidade! Menos é mais. E, sobretudo, divirtam-se! - A pilot activity is highly recommended in order to understand if the activity is suited for the audience - Use activities to interact directly with them - Mensagem simples e direta, reforçar a ideia/mensagem que queremos transmitir várias vezes ao longo da atividade, uma mensagem que eles consigam aplicar diariamente na sua rotina - Something I have noticed is that usually in these sessions, because of the limited time mostly, the more introverted kids are usually forgotten and left behind, but if you ask questions to those specifically, they end up talking and joining the activity. Every kid should learn and have fun and not only the more extroverted and it is the job of who's teaching them to pull them into the activities. - Know in advance what they enjoy, get advice from the team at Exploratório, spend most of the time discussing the ideas before performing them - A gestão de vários grupos de crianças pequenas é complicada e deve ser tida em conta na preparação da atividade - Escolham atividades simples - Give kids space and time to say what is on their minds even if it is not in the scope of the activity. - Have fun
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Table 19 – Advice for anyone interested in taking part in a similar event with a similar audience (preschool).

Preparation	Format	Communication
Discuss the ideas	Scientific correctness	Be empathetic
Know your audience	Small number of scientific concepts	Ask questions
Manage group size	Simple activity	Direct Interaction
Pilot the activity	Simple message	Get the audience involved
	Clear language	Repeat message/concept several times
	Repeat the message	

Table 20 – Summary of the keywords from all of the comments for advice, grouped by topics.

Conclusions

The conclusions are presented in a way that shows that, several of the topics of interest⁵ in this research were related to each other, and therefore, it is not divided by the topics but presented as a whole to show those relations.

For this research, it does not seem to be a particular **type of scientists** that dominates the participation in this activity, with similar participation across the different career levels. For all the sessions except one, this was their first-time taking part in Encontro com Cientista. In relation to previous **experience** in science communication, over half of the scientists had previous experiences, however, only three scientists (not counting with the two that already participated) had previous experiences with this audience of preschool children (3 to 6 years old). Some of the **motivations** for the scientists to participate in science communication activities were the “interest”, to have “an experience” and “having a good time”. Which seems to be related to the answers given when the scientists were asked, if they would like to **be part of this activity again**, they all said “yes” with reasons such as “enjoyed it”, as well as the “importance of communication to bring interest and joy in science”, “an opportunity to interact with children” or “do something challenging”. This is related to the **level of satisfaction** about the activity, half of them answering that they were “satisfied” and the others except one, were “mostly satisfied”, with comments such as, “they learn”, “they left happy” or “it was very rewarding”, and in common they all had a “good time”. This could be related to what the literature mentioned (see introduction) about science communication being “something that requires an extra effort but that brings great satisfaction”.

Although in the question for **motivation**, some options were provided, which could limit the respondent interpretation and thoughts on the matter, still allowed us to get a view of the situation. From the data, “mostly not consider” or “not important” were the “institutional requirements” or “project funding”, the comments left in “others” were “important mission to increase the scientific literacy” and “share science for children to contact sooner”. All this aligns with previous studies that said the motivations are usually “individual motivations rather than an institutional” and the sense of responsibility to engage is also mentioned in the bibliography.

In relation to the barriers or **deterrents** for scientists to take part in a science communication activity, several scientists mentioned during the interview that “time” was one of the main factors, confirming previous literature that mentioned “demanding time

⁵ Highlighted text represents the research topics.

for preparation". In relation to the other comments mentioned in the literature (Wilkinson et al., 2023), only one scientist talked about, the "lack of recognition" and "difficult to get others involved", but overall, except for this scientist, most of them said, they felt they were **valued, by** their research group and institution when engaging in this type of activity. Over half of the sessions were performed by one **scientist** only, however, it is not possible to conclude any reasons for such, since only in one case, some reasons were mentioned, such as, "difficulty to find scientists interested in participating" and "lack of incentives, in such as valorisation in the curriculum", which agree with previous literature as deterrents. These deterrents form part of what literature called the personal benefits.

Not trying to limit the thoughts of the scientists, no definition was given for "aim" or "objectives" of the activity, and therefore, the answers in relation to the aims/objectives were analysed as one. When preparing the activity, the **objectives** of the activity were mostly related to, inform or educate about a topic. This could make sense from the point of view of the context of the activity (part of an educational program) and confirms similar results from previous literature mentioned in the introduction. After the activity, there was another objective added that predominated, which was related to entertainment, "enjoyment". Some other objectives were related to excitement or emotions, which were expected to have a future effect or responses on/from the audience, continuing to be in alignment with the literature. Two sessions objectives were related to providing an experience for the audience.

The **key messages** of the activity were related and aligned to the objectives of the activity, and the scientists kept them in mind along the time. Most of the scientists believed the key message was passed and only in two sessions they were not sure that all of the messages were completely transmitted, this is similar to the results obtained in relation to achieving the objectives of the activity.

There are several **stakeholders** involved in the activity and as such, everyone has their own objectives and expectations from the activity. From the point of view of the scientists, they were asked in the form of their own **personal development objectives**. The conclusion is that the answers are related to improving communication skills, such as how to present, speak or transmit the message.

In relation to how the scientists **prepared the activity**, they were provided with a list of general suggestions to rate (how important they had considered them or not when preparing an activity) which was based in some of the guidelines found in the literature. There were some suggestions in common that were rated as very important/important to

consider between the scientists' answers, such as "the audience", "clear language", "to make the activity interesting to the audience", "interaction and dialogue with the audience" and "the key message", that they seem to be things related to the style and format of the activity and the audience. However, the things they considered less important were "professional development" and "to allocate time as part of their work for preparation of the activity", which as mentioned previously, are both related to the deterrents for scientists' participation in science communication. For most of the sessions scientists **dedicated** personal **time** to prepare the activity, and that the time was not allocated for during working hours when necessary, it was mostly when there were spare moments, a relevant comment was "it is not part of our main job". The things the scientists did not consider at all or thought there was no need for, were "controversial topics", "the audience social and cultural context" and "to practice the activity with non-experts on the topic", the first two are related to the audience, however, it seems to contradict what they rated as important, which is knowing your audience. The **testing of the activity** has not been considered important, which is related to the results that showed that none of the activities (except one) were previously tested or practised (the day of the activity was the first time they performed it as a whole). The relevance of this could be confirmed by the only session that performed the activity for the third time, and each time they have changed and adapted something. For this last time, they felt there was no need for any more changes if they have to do it again, however, it did take three times to optimise it, in the scientists' point of view. Although, it could also be justified, since some sessions had performed a similar activity and used similar materials previously, but for some, all of it was new. One session justified not testing the activity because they did not have similar audience to do it. Another confirmation on the matter, was the fact that, after the activity, they all mentioned some things they would **change**, if they had the opportunity to do it again. Some comments about the changes to the activity were related to the practical part of the activity, such as the need to have more scientists during the activity, others were about the resources, format and style of the activity. However all of the scientists mentioned that their **level of preparation** was positive. Although, several scientists mentioned that, due to the spontaneity of the audience, it was impossible to be fully prepared for what they could say or ask. At the same time, when the scientists were asked if anything happened during the activity that they did not **anticipate**, the answers were positive affirming that there were no big surprises.

With respect to the **support** the scientists had to prepare the activity, it is possible to see that out of the eight sessions, five had support from the Exploratório team, being this

support mostly related to the discussion of ideas, images design or materials. Two sessions with the same topic but different scientist presenting only had the support between each other, they did not have any contact with the Exploratório before the moment of the activity and another session asked a friend for feedback. There was a mixed of awareness between the scientists, about the existence of a **communication office** in their respective institutions, when they said there was one, mostly mentioned the only support it could provide was institutional, only one session said they could have asked for support and maybe had an influence on the activity. When asked about the impact that **additional support** could have on the activity, only three sessions said that it could have an impact, mostly related to the audience, either having more particular information about them or knowing how to deal with them (vocabulary, asking questions, getting their attention, ...), however, the other sessions could not think so. This extra support is related to the general issues the scientists had about the activity and the **hardest part of preparing** the activity. A common comment was again related to the audience, their interest during the activity, the transmission of the information or the interaction. However, the hardest part of the preparations were the materials/resources for the two sessions that were prepared only by themselves and having ideas for another session.

With respect to the **interest** of the audience, some sessions did not have any worries, other suggested that in a group there is always some children that will not be interested, but that should not be a problem, some sessions will use games and the interaction to keep them concentrated. Not many **concerns** were related to the content or covered topics of the activity. The concerns were about the transmission of the information and a clear, simple message, using the right vocabulary.

Another topic of this research was **training** in science communication and to know what the experience of the scientists was and their perspective about it, meaning their possible interest and what contents should cover. The majority of the scientists did not have any formal training, and for the ones that did, it was not specific for this activity. Some of the scientists had personal initiative to search for relevant information about science communication but in an informal way. All of the scientists thought training in science communication was relevant, however, not all were interested in taking part: over half said yes and the rest said maybe. The training was not about “how to” do science communication in general, but about specific subjects, such as getting examples of ideas to adapt, create teaching resources, for specific target audiences, strategies to transmit the message effectively, communication skills and attitude changes, some of them again

related to what the scientist mentioned as the challenges of the preparation. Even though scientists valued and showed interest in training in science communication, one comment mentioned that learning on the go with practise should be enough as long as the scientists had enough skills to transmit quality messages.

In relation to the topic about the **style and format** of the activity, it should be pointed out the several variables involved in the event in general, such as, the different scientists, scientific topics, audience or support for each session, could be one of the reasons, that there was not found any characteristic in common between the session, with respect to the format, style or resources of the activity. Even the two sessions that were about the same scientific topic, were different in the way they were performed by the different scientists. The only thing in common between all of the sessions was the introductory part. The introductory part was always performed as a big group, in the style of a conversation, where the audience was able to be part of the conversation and speak as they pleased. For most of the sessions, this was done with everyone sitting on the floor in a circle, where the scientists tried to create empathy with the audience, be at their level and use this moment to introduce themselves, the topic and to learn about the audience and any previous knowledge they could have about the topic. The justification to sit on the floor with the audience was to be at the same level as them, to create proximity, make them feel comfortable and with the conversation to create a connection and make them part of the activity. This is related to what was mentioned in literature about dialogue (two-ways) and affective as ways of communication and know your audience (although this happened as the activity occurred and not previously during the preparation stage).

Two of the sessions had, as part of the activity, the style of a laboratory activity and hands-on, however, the objectives of the scientists for the audience were different, one was focused in transmitting scientific concepts and enjoyment, while the other was about creating an experience and wonder. In literature, hands-on approached activities are often mentioned often as one of the methods to perform the activity, the fact of using laboratory equipment, also allows the audience to try something different to what they can do in their standard environments (school or house), making it one of the reasons for the audience to attend an activity (being something special), creating that experience is mentioned in literature as another method to perform the activity. Several sessions (three) had some sort of observation activity, which in literature mentioned as an important characteristic of doing science (scientific process), however, none of the sessions considered that as an objective of the activity, and the reasoning behind their choices was more aligned in terms of being a game. For this particular audience,

literature mentioned playing as considered the main method used in education, a natural way of behaviour of the audience, which aligns with some of the comments left by the scientists, justifying the choice of a game as part of the activity as the audience likes it. Most of the sessions (six) had some sort of game involved as part of the activity. Arts was also part of some of the sessions because the audience like it.

The **scientific content** was not something mentioned by the scientists in relation to the parts of the activity. Only in two sessions was mentioned having a number of concepts to focus the activity around and those concepts were repeated in all of the parts of the activity, always going back to them. This meant that the several different parts of the activity were about the same concepts but transmitted in different styles of activity parts. Several sessions mentioned purposely repeating the concepts along the activity, and getting the audience to repeat the words, and when starting and ending one part of the activity, going back to the concept, making sure the audience understood them and remembered them.

After the activity, and from the perspective of the scientists in respect to the audience, most of the scientist's **perception of the audience** interest in the topic was positive, they felt most of the audience was interested. The scientists thought the audience had a good time and enjoyed the activity. The scientists had a positive view about the level of interaction and engagement with the audience and in some cases, they mentioned it was more than anticipated, justifying this with the number of questions received or how children responded to their questions. Some scientists mentioned again the reason for this interaction happening was that the audience felt comfortable and easy with the scientists, because they created empathy with them.

The scientists recognised that due to the age of the audience, it is expected that some of them get distracted at some point.

The scientists' favourite moments were related to what they have considered to be the funny parts of the activity. However, from the scientists' point of view, the favourite moment of the audience was related to the hands-on part of the activity. This could be related to what was mentioned previously in relation to the chosen style of the activity.

The suggestions left by the scientists, for **future scientists** that want to participate in a similar event to Encontro com Cientista with a preschool audience, are related to similar points mentioned in literature in relation to the activity preparation (Pasotti et al., n.d.), such as, to know your audience, pilot the activity and have fun. However, there are some that are more specific for this audience, such as being emphatic with them, and try to do

direct interactions with the audience, using a clear and easy message and a few scientific concepts that should be repeated along the activity, always going back to them so the audience remembers them.

To summarised, we believe this research have answered the research questions.

Concerning the research question related to the contextualisation of the scientists RQ1, it is possible to see that there is a wide range of participants and with different level of experiences and training related to science communication. They all have in common an interest and enjoyment as their motivation to participate in such an activity. In terms of their personal development, to achieve from this activity, it is related to improve some communication skills. The scientists have not allocated time for preparation of the activity and in most cases some of the time was out of working hours, in their personal time. It seems to be different levels related to the amount and type of support the scientists received for preparation. There is a common interest in training in science communication, but with different interests as to what should be covered in them, however, a common theme is that the training should be specific to an audience. Most of the scientists would like to be part of the activity again, with common reasons being enjoyment and the idea that the impact of this science communication activities is important in society.

Considering the research question related to the characteristics of the activity RQ2, it is possible to say that the activity was not pilot in most of the cases. Most of the activities had a clear message the scientists intended to transmit. In relation to the aims and objectives of the activity, it is not clear to conclude how the scientists thought and organised them when preparing the activity. However, a common objective, appeared after the activity, which was for everyone to enjoy their participation. There is no conclusion about the number of scientific concepts to transmit. A common style used for some of the activities were games and hands-on. The scientists thought about how the interaction and engagement with the audience could occur during the activity, and after the activity they were all satisfied with the audience participation, being in some cases better than anticipated. Several scientists mentioned that a characteristic of the audience was being spontaneous. As well, due to the characteristics of the audience (large number and preschool age), the scientists mentioned that it was not expected for all of the audience to have the same level of interest in the topic of the activity. The limited number

of sessions did not show a common format of the activity between them. The only common part of the format was the introduction, sitting on the floor and being the moment to get familiarise and connect with the audience. Some of the scientists thought about the image of a scientists they wanted to transmit in advance.

To summarise some general ideas that came out from this research, from the perspective/interpretation of the researcher, in relation to guidelines for scientists that could participate in the future, in the event *Encontro com Cientista*, related to RQ3, are as follow:

- Think about the purpose of the activity, the objectives and key messages of the activity.
- Try to find other scientists to join you in the activity/preparation.
- Search for appropriate support (communication office, other colleagues ...).
- Discuss the ideas with different people and take your time to decide what the objectives are and how to reach them.
- Clarify the number of scientific concepts, scientific vocabulary and always be scientifically correct.
- Consider less information but that repeats in different activities.
- Organise time to prepare the activity and try to make it part of your work.
- Talk to the Exploratório education team to see what kind of support they could provide.
- Search for quality materials and resources suitable for your audience.
- Choose activities that are related to the interests of the audience and suitable for them, in order to meet the objectives.
- Pilot and test the activity with different external audience than your research group, as many times as possible.
- Pay attention to the vocabulary, how you will speak to the audience and the type of questions to the audience.
- Think about all of the topics that you will talk about, if there is anything that could be “controversial” or “sensitive” to your audience and how you plan to deal with questions or comments from the audience about it.
- Think in advance of possible questions the audience could make and how you will answer them.

- Think about how to engage and interact with the audience.
- Be emphatic with the audience.
- Think about the image of a scientists you want to transmit.
- Consider the setting of the activity, the number of groups and how to manage large number of children in advance.
- Understand the role of each person that would be present in the room in advance. -Try to enjoy and have fun.
- After the activity, take time to reflect on it, think about what happened, think about your objectives, and think what could be different, if there was a next time.
- Consider asking for feedback from someone present during the activity.

Limitations of this research and perspective for the future

A limitation in this research was that it was not possible to compare between the sessions in the specifics of the activity. This was due to each sessions having different scientists presenting, different disciplines and topics, and different audiences.

The effectiveness and impact of the activity was not possible to evaluate from the perspective of the audience, due specially to the limited duration of the research.

In this research, it needs to be considered that there is a personal/internal bias from the researcher. This means, that the interviews were personalised for each session according to the previous responses to the survey, and that some questions were leading/guiding, in the sense that sometimes, in order to get the intended topic covered for a question, the researcher gave some orientations. Some of the questions had the intention of making the scientists think about something before the activity, which were more in relation to the topic, about how the activity was prepared, and things that should be considered then.

Due to time limitations, it was not possible to pilot the questionnaire or the interviews. In the future, this research could serve as a pilot for any research with similar interest in an event, where scientists participate in science communication, or for future reference to research *Encontro com Cientista*.

The researcher would have liked more time so, the research could be complemented with an analysis that could have included other people's perspective in the discussion of the results.

In the future, in order to measure the impact and effectiveness of these activities, part of the *Encontro com Cientista*, a longitudinal research could be done on the audience. As well, it would be interesting to get an understanding of the perspectives of others involved, such as the facilitators, organiser and stakeholders.

In the future, it could be interesting to compare these results with other *Encontro com Cientista* at other Escolas Ciência Viva of other Ciência Viva centres.

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Appendix 1 – Introductory email

Introductory email sent to the scientists for the first time.

Meeting a scientist: the experience and challenges of communicating science to preschool audiences

Dear Scientist,

I believe you are presenting at the Exploratório on Date

I would appreciate, if you could confirm your consent to participate or not in the research project described below.

My name is Lara, I am a physicist currently doing a master’s degree in science education and communication at the Faculdade de Ciências da Universidade do Porto (FCUP). I would like to invite you, as a scientist, to take part in the research project for my dissertation, which I explain below.

I am doing my dissertation based on the project of “Encontro com Cientistas” at Escola Ciência Viva (Exploratório Centro Ciência Viva Coimbra), as an external observant.

The research project consists of understanding how scientists communicate to an audience of preschool children and the challenges they face.

Your participation in the research project is completely voluntary and anonymous. It would imply, for you, to take part in a series of **questionnaires and interviews** at different stages, during the days before and after the day of your activity at Exploratório, see the **timeline** below. The research also involves me, Lara, observing (non-participant, outside observer) during the day of the activity.

The information collected will only be used for the purpose of this research project. The people with access to the data will be me (Lara) and my supervisors.

In order to keep your anonymity, it will be **assigned to you a number and a letter** (you need to keep it) which you would have to write on the questionnaires. This would be sent to you **once you give your consent to participate**. For the interview and observation, verbal consent of participation would apply before recordings.

The results from the research will be published as part of my dissertation, and it could be possible to have some publications on journals and conferences. At the end, if you are interested in the results, do not hesitate to contact me (Lara) via email.

You can withdraw your participation in this research project at any stage without the need for justification until the 1st of April 2023 (start of the analyses of the final data).

If you have any doubts, questions, concerns or want any further information about the research project, do not hesitate to contact me (Lara) at up202008688@edu.fc.up.pt

Thank you in advance for your time and contribution to the research project, it is really appreciated.

Kind regards

Lara San Emeterio Alvarez



Appendix 2 – Other results and discussion

A2.1. Contextualisation of the scientists

The type of audiences the scientists had previous experience doing science communication, data from Q1, is shown in Figure 21. In this data, it is taken into account, the recent experience of two the scientists with preschool audiences, because they had performed this activity before for this event.

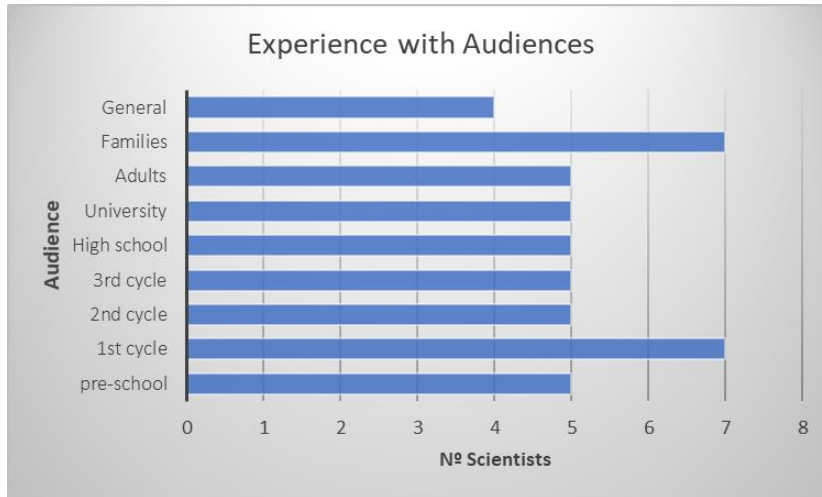


Figure 21 – Previous audience SciComm experience.

A2.2. Contextualisation of the sessions

A2.2.1. Session topics

Topics covered in the sessions in no particular order (Table 21).

Activity Topics
Mycology
Insects and their biodiversity
Bees
Ecology of the rivers
Biology of reproduction
Cell biology (Mitochondria)
Obesity and diabetes (O que acontece ao que comemos)

Table 21 – Topics of the activities.

A2.2.2. Perception of the value of scientists' participation in SciComm activities

The objective of this question in Q1 and developed for one session during I1 (due to the negative feeling of the response in Q1), was to understand, how scientists felt they were valued and perceived by their colleagues (research group) and the institution or

university where they work, when they participate in science communication activities. From the results, it is possible to see that no one thinks there is a negative perception about taking part in SciComm activities, however, one scientist (who did the activity alone) was clear that, the scientist felt there was no interest by either of them, explaining that:

Não (há interesse), porque em outras atividades eu anuncio e pergunto se alguém quer participar, e acaba sempre a fazer tudo sozinha, por isso acho que não há (interesse)... Do ponto de vista da **valorização curricular**, não pesa, ... isto acaba por nos desviar do nosso objetivo principal (como investigadores) ... Eu faço porque gosto realmente de esto, é mia profissão alternativa. O eu faço ciência ou eu comunico ciência. E cada vez mais tenho percebido que fazer ciência sem a comunicar não funciona... o conhecimento só é útil se for a transmitido...

Eu própria tento implementar uma atividade de comunicação de ciência, só que isso, realmente, **desvia atenção, consome tempo** ...

Não somos **incentivados** a fazer comunicação de ciência....

However, the other scientists, the majority felt they were positively perceived and viewed by their colleagues and institution when they participate in the activities, see Figure 22.

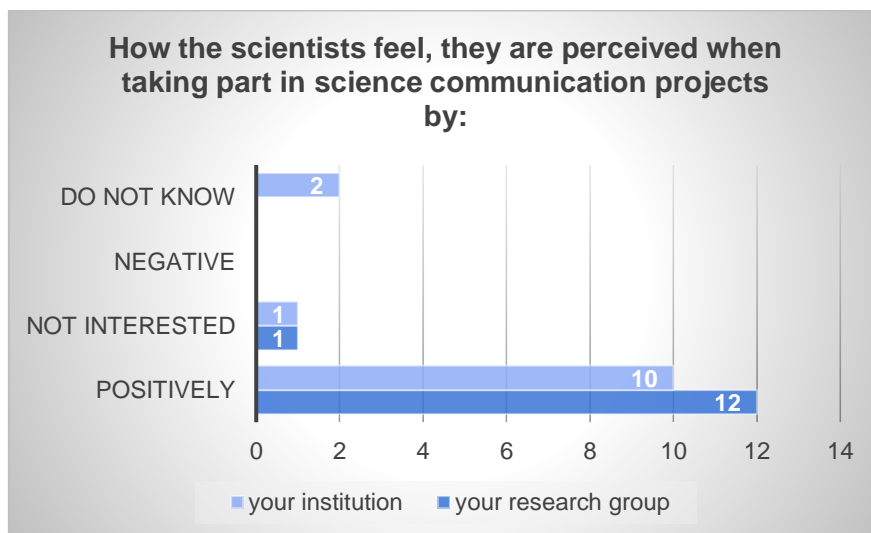


Figure 22 – Perception of the scientists.

A2.3. Preparation of the activity

A2.3.1. Communication office

During Q1, the scientists were asked, if they had a communication office where the scientists could request some sort of support to prepare the activity.

A summary of answers is shown in Figure 23. Some scientists that came from the same institute, however, some said *YES* and some said *NO*. The reason was: *YES*, they have a communication office but, the role is more institutional communication rather than support in the actual activities.

Some scientists from the same group gave different answers, either “NO” or “Do not know”.



Figure 23 – Do you have a Communication office?

A2.3.2. Time dedicated to preparing the activity

More answers developed during interview I1 about the organisation of the time (follow up from section 4.4.1):

Eu não fiz unicamente isso, como eu tive uma **saída de campo** ontem, para fazer outras coisas, eu **acoplei as atividades** que tive que desenvolver na preparação de esta iniciativa. ... Não foi ao rio de propósito para apanhar os animais, **tente conjugar** e isso realmente é que aceite o convite para fazer a atividade esta semana, porque foi perfeito que eu tinha a saída de campo agendada.... Se eu não tivesse a saída de campo, se calhar, tinha que fazer de propósito e se calhar já não teria aceitado o convite....

Nós preparamos **tudo de cero**, ..., **é nossa primeira atividade** de comunicação de ciência, ... tivemos que construir toda a **conceptualização** da atividade, e também todos os **médios físicos**. ... (3 semanas) Não sempre a preparar a atividade em sim ou os materiais que vamos precisar, mas também muita na conceptualização.

Levo **materiais didáticos para interagir** com o público. Então foi o que **demorou** mais, porque se não, se calhar não tinha demorado tanto tempo. Demorou um pouco mais (que o tempo que tinha planeado) porque eu levo artes plásticas, mas do resto, o discurso e o tema, já estava mais ou menos dominado.

When the session S7 prepared the activity for the first time, they said it took some time:

Demorou algum tempo porque tivemos que fazer alguma **investigação**, mesmo no sentido de transmitir, no só transmitir os **conceitos** corretos, mas também da melhor forma dos **transmitir**. ... fazer pesquisa em términos de imagens o que é que funcionaria melhor para eles. ...

A2.3.3. Addition support to prepare the activity

During the interview I1, in order to understand, what the level of support they had, the scientists were asked, “is there any additional support that would have made an impact in the preparation of the activity?”. The answers are presented in Figure 24

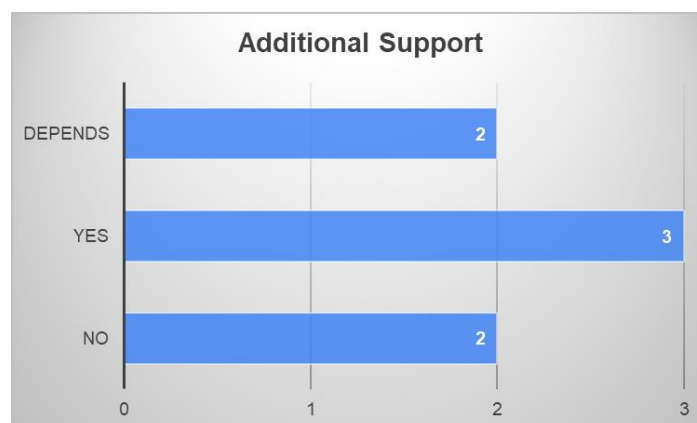


Figure 24 – Need for additional support (I1).

A2.3.4. Image of a scientists

This was not a topic that we had in mind to ask about in the beginning of this research project, however, due to several comments made during the first two sessions of interviews by the scientists, who pointed out that, they thought about their appearance and the positioning on the room, because it was important in order to transmit the message. We thought, it was actually an interesting topic to talk about and consider, with the objective of a more global view of the activity, considering that meeting a scientist was the “objective” of that particular event *Encontro com Cientista* of the Escola de Ciência Viva. Therefore, it was added a question in relation to it, during the interviews I1 for the following sessions, when they were talking about the preparation for the activity. The question posed during I1 was: “Did you think about the image, as a scientist, that you want to give (transmit) to the audience?” “Did you think about how you will dress, about the setting of the room and where you will position yourself?”

The comments left by the first two sessions that led to the question being added were:

(comment left at the end of I2 without being asked about) Permitir as crianças este contacto com o cientista, eu **vesti a bata** para envergar este estereótipo, não era necessário andar de bata, podia andar normal, mas depois era uma pessoa como outra qualquer, e eles vieram aqui para ter contacto com cientista, de aí eu ter feito aquela introdução inicial, porque também era importante que eles saberem que **para ir ao rio** apanhar os animais eu não vou asi, como ando no dia a dia, **uso uma botas compridas e uso um equipamento especial ...** mas depois **no laboratório, os cientistas andam de bata**, e eles vieram a conhecer um cientista, então apareceu a bata, acho que **é importante porque lhes dá tal vez o modelo...**

The other comment from the other session was left at the end of I1, and they mentioned that they “forgot to say”, they chose what to wear to give an **image “descontraída” and colourful** for this particular audience, and that they planned to **sit on the floor** with them, to be at the same height. With all this, the scientists tried to create a relax and familiar environment so the audience could feel comfortable, they thought it was important to create this familiarity especially in such a young audience so they could easily engage with them, as well, because scientists do not wear formal cloth either when they go to work and that is **how they dress on a day to day**.

It should be mentioned that, for the majority of the sessions, the answers for “did you think about the image of the scientist you wanted to pass?” were *No*, they have not thought about it, however, after thinking they did mention something.

aquele que eu pensei, em termos de **vestuário** é ir o **mais simples e pratica**, para se **nada do muito formal**. ... se houvera condiciones para nos **sentarmos no chão**, ou pada sentarmos nas cadeiras **ao lado das crianças**... por tanto interagir com as crianças e não estarmos ali a dar uma aula... . A tentar no máximo porque tal vez seja **a forma mais simples e mais eficaz de passar a mensagem**.

Não pensei. ... **não** quero de tudo passar a imagem da **bata branca**, quero passar a imagem de que é **uma pessoa normal** que estuda coisas estranhas. Eles podem fazer perguntas, e estar a vontade, mas não pensei muito em isso, para ser sincera.

Não pensei. Se calhar vou de **bata?**, não será melhor ir de bata para pensarem que sou cientista?, não pensei em isso. Posso ir **vestida de saída de campo**, que é mais a minha onda, de **exploradora** da natureza, com chapéu, botas de campo... . É outro, eu ainda não tinha pensado, é outra abordagem de cientista que normalmente tem sempre **a ideia dos cientistas de bata**, algo assim, e então mostrar. From the observation, I can say that at the end the scientist dressed as an explorer.

(roupa) vai ser **mais formal**, ... levar uma **t-shirt da nossa equipa** que desenvolvemos para este tipo de atividades, ...depois vou levar uma roupa formal.... Não (pensou) porque eu **não conheço a sala**, ... eu espero estar por exemplo no centro e ter como semicírculo a vota, ... e que **não haja um distanciamento** muito grande entre mim.

Por acaso ainda não pensamos em isso.

A2.3.5. Training in science communication

The type of training in science communication, that the scientists are interested, are shown in the comments of Table 22.

What type of training? Answers from Q1, I1 and Q3

Formação com enfoque na comunicação para crianças/adolescentes (psicologia do desenvolvimento) para aumentar a eficácia na transmissão da informação de modo a que seja mais facilmente retida/lembrada por mais tempo. (Tipo de estratégias, como se fala com as crianças para que elas aprendam o mesmo mensagem que eu quero transmitir aos adultos.)
Métodos para passar a mensagem de modo eficaz para a faixa etária 3 - 6 anos
O tipo de linguagem a utilizar em cada faixa etária para explicar um mesmo conceito
Training that helps us simplifying/adapting our message to the target audience.
People in science need to learn how to make it simple and how to deliver key messages despite all the research done on the background.
Formação em materiais didáticos e que tipo de linguagem se deve usar para cada faixa etária.
Public speech training to have more fluidity throughout the presentation.
I recognize little are the courses and/or workshops that fully prepare us for scientific communication. In specific I think there should be different courses depending on the age of the audience.
Maybe some classes where first we learn tips to get better and after that there's presentations with different scenarios.
A training with both theoretical and practical component
Practical course on how to deal with people's expectations (... a ciência o menos que podemos dar são certeza, ..., a ciência esta sempre a mudar, ..., as pessoas acham que os cientistas estão sempre a mudar de opinião, e por tanto ... não são pessoas creíbles , ... como lidar com isso é a parte mais difícil).
Participate in more science communication events
Muito específica. (comunicação para a conservação, ..., mudança de atitudes...)

Table 22 – Type of training scientists are interested in. (in brackets are comments from I1).

The type of trainings were grouped according to: Yellow- Transmission of message for specific audiences. Blue- Resources. Grey- Soft skills, oral communication. Green- General SciComm. White- Learning with experience. Violet- SciComm to change behaviour/attitude. All of the comments are related to training for specific audiences.

In Figure 25 is shown the individual ways of searching for information.

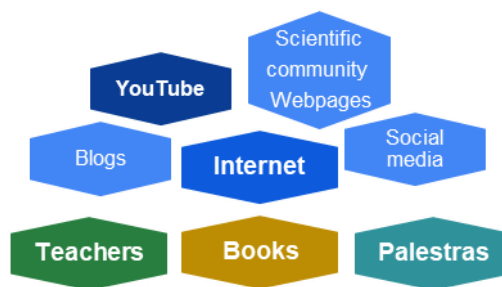


Figure 25 – Individual ways of searching for information about science communication.

A2.3.6. Hardest part in the preparation of the activity

From interview I1, there was a variety of responses in relation to what was the hardest part in the preparation of the activity depending on the session, however, there was a common topic shared for three sessions in relation to the target audience:

Eu acho que quando nos fazemos as coisas porque gostamos muito, acho que não é muito difícil a preparação. O principal desafio ... qual era a **reação deles**, o que eles iriam dizer, o que eles já sabiam, como eu iria lidar se fizessem uma pergunta... esse tipo de preparação, muitas vezes estava a pensar, e **se eles perguntaram isto** como é que eu repondo... optamos por **responder sempre cientificamente correto**.

Decidir a maneira que nós manteremos as crianças, ao mesmo tempo **interessadas** mas também que o **mensagem** passasse **claramente** e não fosse demasiado complicado para eles, ... sem ter que simplificar demasiado....

Ter ideias, que ter que funcionar com crianças tão pequenas, por tanto **ter ideias simples**, transmitir isto de forma muito simples. Nos somos cientistas, somos investigadores e temos sempre **adaptar a atividade** e adaptar a nossa **linguagem** para crianças é um desafio enorme, é o nosso maior receio.

From these comments, it is possible to see that, there is a relation to, what most of them mentioned were, their concerns and challenges of the activity and that is developed in the following part A2.3.7.

For other two sessions that prepared all the materials by themselves, that was the most difficult part. For the two sessions that needed to go on a field walk, that was actually the hardest part, since:

Os organismos para estas atividades têm que cumprir alguns critérios.

One comment was in relation to finding time to prepare the activity.

Arranjar tempo ... para concentrar um pouquinho e estruturar a atividade de uma forma coerente.

A2.3.7.Challenges and concerns when preparing the activity

A summary of all the comments left during Q1 and for some developed during I1 are shown below in Table 23. In Q1 the question was, “do you have any concerns or worries about the activity you are preparing for Escola de Ciência Viva?”, while during I1, the question was, “do you have any barriers or issues in communicating the topic?”, “what are the challenges so far, if any, of communicating such a topic, in particular to this young audience?”. Even if the questions are not the same during Q1 and I1, some of the responses they gave during I1 are related and therefore, it is interesting to show them together independently of being from the interview or questionnaire, as well, some scientists were asked to develop during I1 on the answer given at Q1.

<p>- Sim, que a mensagem que queremos transmitir não seja transmitida ou passada de forma correta e que o público-alvo não se sinta cativado ou não interaja conosco.</p> <p>- A atividade será feita para crianças muito pequenas, com as quais não costumo lidar, o que me deixa um pouco apreensiva sobre se serei capaz de transmitir as ideias da atividade de forma clara e simples para mantê-los entusiasmados e interessados no tema.</p> <p>Que a linguagem abordada não seja a adequada para as idades</p> <p>- That I cannot pass the message correctly (or too complicated for these ages)</p> <p style="padding-left: 40px;">Como conseguirmos adaptar o nosso discurso, ... simplificar o discurso. Para nós não é importante que eles saibam qual é a palavra, qual é ..., o importante. Não seria realista da nossa parte esperar que crianças tao pequenas soubessem que é a .. e que são ..., não é esse o objetivo.</p> <p>- Sim, tenho receio que a mensagem não seja clara para o público-alvo.</p> <p>- yes, I would say I am afraid that the kids won't be interested, and that this might not be the right approach</p> <p>- Maintaining the audience interested and focused</p> <p>- To lose the attention of the kids</p> <p>- Sim, não conseguir cativar a atenção das crianças</p> <p>- Preocupa-me sobretudo a variedade das idades das crianças.</p> <p style="padding-left: 40px;">Criança de 3 anos, ... eu dizer para estar quieta em um sítio não sei si vai estar. É não perceber se é possível fazer uma parte da atividade, ... é muito caótica passar a outra parte.... Um jogo em que andam em pé, pois haver um momento que tem que se sentar e estar a olhar só para mim, ... as vezes até ajuda a baixar um pouco o nível de energia e estar aí um pouco sossegados, não sei, vamos ver.</p> <p>- A gestão de grupos grandes de crianças pequenas é difícil (distraem-se com facilidade o que causa destabilização), mas penso que as crianças serão distribuídas por pequenos grupos e haverá adultos responsáveis a ajudar.</p>
--

Table 23 – Concerns about the activity.

Several scientists during the interview I1, mentioned that they felt it was easier to communicate the topic to this young audience than to the adults, for several reasons, one because, if the adults are involved, there is a bit of an obstacle about what could be explained, said and how, because is such a “tabu” topic (for one of the topics covered in one session).

As well,

As **crianças** têm uma **curiosidade inata**, ... uma criança **para e observa e pergunta** o que quer, ... comunicar para estas idades até pode ser mais fácil tirando a partida de essa curiosidade inata que elas têm e uma certa tabua rasa, não têm as coisas encaixadas e não têm aquela ideia de que isto é bom isto é malo estão muito mais abertas.

another scientist mentioned

Com crianças até é mais fácil, porque as **crianças** têm mais facilidade em **dizer** que **não percebem** quando se diz alguma coisa assim, ... um palavrão ... e isso da te uma **oportunidade de explicar**. Muitos dos palavrões que eu usava antes deixe de usar porque foram as crianças que me disseram, que é isso? E eu percebi que tinha que explicar, que não podia usar aquele termino, tinha que usar outro.

A2.4. Overall perception of the activity

A2.4.1. Aims and objectives and key messages

Summary of the data from Q3, to the question if they have met their objectives and if they could comment in which ones *Yes* or *No* and *Why* if possible. And a summary of the data from Q3 about, if they thought the key messages were passed to the audience. Results shown in Figure 26.

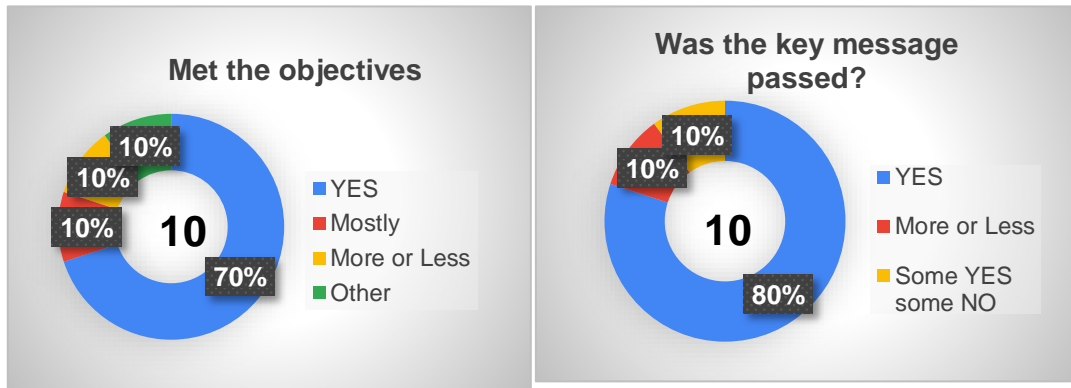


Figure 26 – Data from Q3 that represent the answers about meeting the objectives and passing the key messages during the activity.

A2.4.2. Level of engagement and interaction during the activity

During the reflection questionnaire Q3, they were asked to rate the level of interaction/engagement during the activity. All of the scientists rated the level of engagement as positive or very positive, as shown in Figure 27.

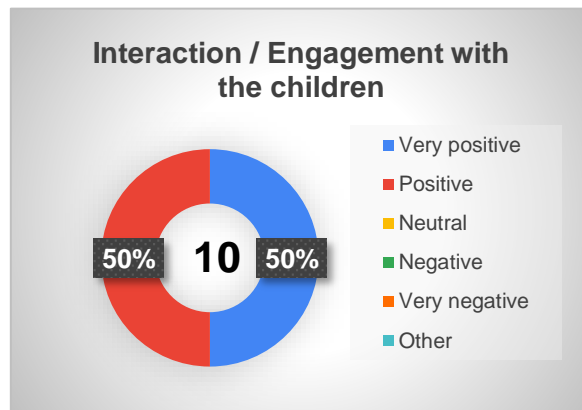


Figure 27 – Level of engagement with the audience during the activity.

A2.4.3. Perception of the activity in relation to the audience

Level of engagement and interaction, full summary of the answers from I2 is shown in Table 24.

How do you feel the level of interaction and engagement was? Was it as anticipated?
I2
sim, alias, as vezes até de mais, ... porque depois respondem todos ao mesmo tempo e as vezes é difícil até perceber o que cada um diz e compartimentar essas respostas.
Eles até, o seja, apesar de ser um número grande, eles até estavam todos cada um ao seu nível tão concentrados na atividade, e faziam até mesma questão, nós percebemos que eles estavam a perceber aquilo que estavam a fazer e que efetivamente estavam a gostar, porque nós chamavam individualmente para virmos se ... por tanto acho que eles também, eles próprios também gostaram, inclusive a mais.
eu acho que sim. Até superou. Porque são muito pequenos e interagem de esta forma, no sentido que nós queríamos, foi muito bom acho que sim
até melhor, mais do que estava a espera. Ou seja, hubo mais questiones, dedo no aire, tipo os miúdos a tentarem dizer coisas as vezes um pouco parvas, mas faz parte, não é, isso é si, foi melhor, a interação foi melhor do que eu estava a espera.
foi, foi um pouquinho melhor até, eu não estava a espera que acertassem tantas perguntas
sim, eu já estava a prever que iva a haver muitas perguntas, muita interação, claro que alguma foi excessiva, porque houve muita dispersão, mas pronto é com forme ao grupo
sim, eles interagem muito
sim, foi, eles interagiram bem para o que seria de esperar, se calhar um pouquinho distraídos em alguns momentos, estavam ocupadas com outros aspetos, ... mas pronto, eu repetia depois novamente a mensagem, se achava que era alguma coisa que devia dizer, repetia novamente, quando voltasse a passar na mesa voltava a repetir,... mas sim há muita distração, com crianças de esta idade, com muitas coisas encima da mesa, o próprio material é um fator de distração, porque são materiais com que as crianças não tem no dia a dia contato, então tive oportunidade de pega uma pinça, ... e som coisas que para nós acabam por ser, usamos todos os dias, ... não lhes atribuímos uma grande importância, mas para uma criança em estas fases estão na fase da descoberta ... e foca o seu interesse ao mesmo tempo que distrai do que nós queríamos, onde nós queríamos que o interesse estivesse, ... as vezes é um bocadinho difícil gerir esse aspeto. Mas acho que sim, acho que eles engajaram bem e acho que estavam muito com uma apetência muito muito forte, para o que vira a seguir para ver os animais, para mexer nos animais acho que sim.
sim, eu já não trabalhava com crianças de esta idade há muito tempo, e não, nunca sei muito bem, sem olhar para eles, e sem chegar ao pé de eles nunca sei muito bem como é que vou interagir, porque já não me lembro. Mas assim que os vejo, que tenho logo a noção da faixa etária, depois é muito fácil, no caso ali foi apresente-me, eles começaram a dizer o nome, prono começamos a estabelecer o diálogo assim.

Table 24 – Level of engagement with the audience during the activity.

Appendix 3 – Questionnaire Q1

1- Escola Ciência Viva no Exploratório - Encontro com Cientistas - Pré-questionário

Dear Scientist,

Thank you for taking part in this research project.

My name is Lara and I am doing a master's degree in Science Education and Communication at Faculdade de Ciências da Universidade do Porto.

The research project is based on the activity "Encontro com Cientistas" at Escola Ciência Viva do Exploratório CCV Coimbra. The aim is to study the characteristics of the communication from the scientists to pre-school children.

I would appreciate if you could answer this first questionnaire. It should not take more than 15 minutes to fill.

Your participation in this research project is completely voluntary. This is an anonymous questionnaire and the information will only be used for the purpose of this research project.

If you have any questions or need further information about the project you can contact Lara: up202008688@edu.fc.up.pt

*** Deadline to respond: no later than the day before the interview.**

****Por favor, responda em português**

** Indicates required question*

1. Number *

(the number assigned for this research)

2. Research Topic *

3. What is the stage in your career as a researcher? *

Mark only one oval.

- Master student
- PhD student
- Postdoctoral researcher
- Principal investigator
- Group leader
- Other: _____

Experience in science communication

4. Is your research topic the same topic you will present in the activity? *

Mark only one oval.

- YES
- NO

5. If the previous answer was NO, what is the topic of the activity? and WHY?

6. Have you taken part in previous science communication activities? *

Mark only one oval.

- YES
 - NO
-

7. If so, who were your audiences?

Tick all that apply.

- Pre-school children
- 1st cycle students
- 2nd cycle students
- 3rd cycle students
- High school students
- University students
- Adults
- Families
- General
- Un-known
- Other: _____

8. Are you re-using some of the materials previously used in other events?

Mark only one oval.

- YES
- NO
- Partially
- Other: _____

9. Is this the first-time taking part in this activity ("Encontro com Cientistas", Escola
Ciência Viva no Exploratório Coimbra)? *

Mark only one oval.

- YES
- NO

10. If the previous answer was NO, have you changed anything in the activity from the previous times? If so, what and why?

Objectives, motivations and expectations

11. Could you rate by order of importance, some of the reasons/ motivations for you to be involved in this initiative: *

Mark only one oval per row.

	Very Important	Important	+/-	Not important	Did not consider
Project / funding requirement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Institutional requirement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interest	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An experience to do something different	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A favour because someone else asked you to (colleagues / institution)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have a good time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. If in the previous answer you've considered OTHERS for your motivations, could you specify?

13. Could you mention the aim and objectives of the activity? *

14. Could you mention your objectives in terms of your own personal development? *

Preparation of the activity

15. How long are you planning to take to prepare the activity? (allocated time if any) *

16. Do have support in preparing the activity, and if so from who? *

Tick all that apply.

- A research colleague
- Your supervisor
- The research group
- The communication office
- Exploratório
- No one, on my own
- Other: _____

17. What kind of support? *
(*design, build, discuss, practise, ...*)

18. Do you have a communication office where scientists could request some sort of support to prepare for this kind of activities?

Mark only one oval.

- YES
- NO
- You do not know
- Other: _____

19. What is the format of the activity? Can you list the different parts of the activity? *

Training

20. Did you receive any formal science communication training? *

Mark only one oval.

- YES Skip to question 21
- NO Skip to question 24

Training

21. What type of training in Sci Comm? *

Tick all that apply.

- Workshop
- Curricular unit
- Course
- Training with a communication department
- Other: _____

22. Did you put it in practise? *

Mark only one oval.

- Yes
- No
- Not sure
- Other: _____

23. Was it specific for this activity?

Training

24. Have you searched, as an individual, for how to do science communication? *
(YouTube, books, webpages,...)

Mark only one oval.

- YES
- NO

25. If previous answer was YES, where did you search for advice, tips, recommendations?

26. Did you put it in practise?

Mark only one oval.

- Yes
- No
- Not sure
- Other: _____

Training

27. Would you be interested in having a training program in science communication? *

Mark only one oval.

- Yes
- No
- Maybe

28. What type of training do you think could be useful and why?

Challenges and Issues

29. Do you have any concerns or worries about the activity you are preparing for Escola *
Ciência Viva?

Perception about the participation in science communication projects

30. How do you think you taking part in the activity is seen/valued ?

Mark only one oval per row.

	Positively	Not interested	Negatively	Do not know
By your colleagues (research group)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The institution/university where you do your research?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments

31. Any comments/questions you would like to share that are relevant to the research topic (communication of science research for pre-school children):

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Confirmation message after submitting:

Thank you for your time and contribution to this research project. We will meet in a couple of days at the interview and later, on the day of the activity.

Kind regards

Lara

Appendix 4 – Questionnaire Q2

2- Escola Ciência Viva no Exploratório - Encontro com Cientistas - Preparation

Dear Scientist,

Thank you for taking part in this research project, which aims to study the characteristics of the communication from the scientists to pre-school children.

I would appreciate if you could answer it now, after we finish the interview.

It should not take more than 5 minutes to fill.

Your participation in this research project is completely voluntary. This is an anonymous questionnaire and the information will only be used for the purpose of the research project. If you have any questions or need further information about the project you can contact Lara: up202008688@edu.fc.up.pt

This questionnaire is based in some general guidelines for scientists that want to take part in science communication events. You can find some of the references at the end if you are interested on it.

* Please deadline to respond: the day before the activity.

** Por favor, responda em português

~~* Indicates required question~~

1. Number *

(the number assigned for this research)

How to keep
the activity
lively and
monitor the
public's
reaction

How to make
the activity
interesting to
the audience

Your audience
social and
cultural
context

Professional
development

3. Any comments/questions you would like to make that are relevant to the research topic (communication of science research for pre-school children):

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Confirmation message after submitting:

Thank you for your time and contribution to this research project. We will meet in a couple of days, on the day of the activity.

If you are interested in some general guidelines for scientists that want to take part in science communication activities, you can find the link to some of the references below.
<https://questproject.eu/download/leaflet-checklist-for-scientists-communicating-science-to-the-public/?wpdmdl=15894&refresh=62ecf8018146a1659697153>

<http://www.cerclefsr.org/en/sciomm4all-presentation/>

<https://culturacientifica.usal.es/guia-evidencia-marz/>

Kind regards Lara

References:

López Navarro, I., & González Rodríguez, V. *La divulgación basada en la evidencia científica*. Unidad de cultura científica y de la innovación de la Universidad de Salamanca. <https://culturacientifica.usal.es/guia-evidencia-marz/>

Pasotti, J., Mannino, I. & Fornetti, A. *Quality and effective science communication for public audiences*. Venice International University H2020 QUEST project. <https://questproject.eu/download/leaflet-checklist-for-scientists-communicating-science-to-the-public/?wpdmdl=15894&refresh=62ecf8018146a1659697153>
<https://questproject.eu/how-to-improve-science-communication-consider-these-12-guiding-principles/>

SciComm4all. (n.d.). *Videos* [YouTube channel]. YouTube. Retrieved September 06, 2023, from <https://www.youtube.com/playlist?list=PLrXqsfMU5hN6WVREeFkMCPHh9hwMGWs8v>

Appendix 5 – Questionnaire Q3

3- Escola Ciência Viva no Exploratório - Encontro com Cientista- Reflection Period

Dear Scientist,

Thank you again for taking part in this research project, which aims to study the characteristics of the communication from the scientists to pre-school children.

Now that a couple of days has passed, and you have some time to reflect from what happened during the day of the activity, I would appreciate if, for the last time, you could answer this questionnaire.

Filling the questionnaire should not take more than 15 minutes.

Your participation in this research project is completely voluntary. This is an anonymous questionnaire and the information will only be used for the purpose of the research project.

If you have any questions or need further information about the project you can contact

Lara: up202008688@edu.fc.up.pt

*** Please deadline to respond: before a week passed from the day of the activity.**

**** Por favor, responda em português**

~~* Indicates required question~~

1. Number *

(the number assigned for this research)

Satisfaction

2. Are you overall satisfied with how the activity ran? *

Mark only one oval.

- YES
- Mostly YES
- More or Less
- Mostly NO
- NO
- Other: _____

Objectives

3. Have you met your objectives? If you could comment on which ones Yes or No and why if possible? *

4. How do you rate the level of interaction/engagement with the children? *

Mark only one oval.

- 1- Very positive
- 2- Positive
- 3- Neutral
- 4- Negative
- 5- Very negative
- Other: _____

5. Could you develop in the reasons for your answer?

6. Do you think the key messages were passed to the children? Could you explicit what *
were those messages?

Preparation

7. How do you feel about your level of preparation for the activity? *

Mark only one oval.

- 1- Very positive
- 2- Positive
- 3- More or less
- 4- Negative
- 5- Very negative
- Other: _____

8. Could you develop in the reasons for your answer?

Training

9. How do you feel now about training in science communication? *

Mark only one oval.

- It is relevant
- I do not think it is relevant
- I do not know
- Other: _____

10. If you think it is relevant, what type of training do you think could be useful and why?

Future

11. If you have the opportunity to repeat this activity again, for the same audience and initiative, is there anything you would change? If so, could you explain the reasons for it? *

12. Would you like to be part of this activity at Escola Ciência Viva again?

Mark only one oval.

- YES
- NO
- Do not know
- Other: _____

13. Could you explain in a couple of words the reasons for your answer?

Advice

14. Could you leave some recommendations, advice or tips for scientists, in the future, *
that want to get involved in an activity for pre-school children?

Comments

15. Would you like to leave some feedback, comments, suggestions, recommendations or
advice for the Exploratório in the future, in relation to planning and preparing for the
activity with pre-school children?

16. Any comments/questions you would like to make that are relevant to the research
topic (communication of science research for pre-school children):

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Confirmation message after submitting:

For the last time, thank you again for your time and contribution to this research project, it is really appreciated. It will help to shape the way science communication is done when such a young audience is involved. Do not hesitate to contact me if you need anything at up202008688@edu.fc.up.pt Kind Regards Lara

Appendix 6 – Interview I1

Questions that start with Opt.: means they are optional and it depends on the answer from the previous questionnaire Q1.

1- Introduction

Objectives
- Explain who I am, explain the research and the objectives of the research. - Explain the legitimate participation in the research and consent for recording.
Hello number ...

2- Scientist context

Objectives
- Deeper Contextualise the scientists.

a) Objectives, motivations and expectations

Objectives	Questions	Expected answers
- Deeper understanding of why they are taking part in this project - Develop, if they have thought about what the aim of the activity is, why they are doing the activity, compared to que questionnaire.	- Hello number ... já sei que falo de alguns coisas no Q1 mas é para aprofundar	
	a. Could you explain the aim and objectives of the activity you are preparing? <u>poderia explicar o propósito e os objetivos da atividade que você está preparando?</u>	a. Aim: Awareness of the topic, educate on the topic, inform, showcase my research/work, awareness of science,... Objectives: children learn, C have a good time, I improve some skills, I improve my communication, I learn from trying to explain something...
	b. Could you say if there are any key messages you want the children to take by the end of the activity? What are they? <u>poderia dizer se há alguma mensagem-chave que você deseja que as crianças levem no final da atividade? O que eles são?</u>	

3- Preparation of the activity

a) Preparation

Objectives	Questions	Expected answers
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<p>- Compare if the expected time to prepare the activity corresponded with the reality.</p> <p>- Understand when they prepare the activity. Understand if they would have organised their time differently.</p> <p>- Understand how they are preparing the activity, if they have support, from who and for what.</p>	<p>a. How long did it take (at the end) to prepare the activity? Is it all ready by now? <u>Quanto tempo levou no geral para preparar a atividade, diz que só demorou ... na preparação? Já tem tudo pronto hoje?</u></p> <p>b. Opt.(Was it similar to the predicted time? Or Did you need more or less time?) <u>foi como previsto e planejado? Ou demorou muito mais?</u></p> <p>c. Was this time during your everyday work or was it time allocated outside your working period? (would you have preferred to be some other time?). <u>Foi este tempo organizado durante o seu trabalho diário ou fora?</u></p> <p>d. Opt.(Have you prepared the activity on your own?) <u>Vi no questionnaire que você teve algum apoio ...</u></p> <p>e. Opt. (Could you develop, if any, the type and level of help/ support you have received and from who, no names (the same as in the questionnaire)? (design, build, test, discuss, decide, practise...))</p> <p>f. Is there any additional support that would have made an impact in the preparation of the activity, (more ... support, training, practise...)? <u>Mas acha que algum apoio adicional poderia ter tido impacto na preparação da atividade?</u></p> <p>g. Opt. (If so, how would have that helped you) <u>como isso teria ajudado a você?</u></p> <p>h. What was the hardest part of the preparation for the activity? <u>Qual foi a parte mais difícil da preparação para a atividade?</u></p> <p>i. Opt. you mentioned that you are reusing some of the materials, the new materials in the activity have you tested them?</p>	<p>c. No</p> <p>d. - Communication office: design and build, create the story, discuss ideas - Group colleagues: discuss ideas, reused some materials they already had from previous activities, practise the activity - Exploratório: discuss ideas, format and style from their experience, suggestions, discuss topic, create video, design</p> <p>e. - Support: colleagues discussions, building or finding materials (more fancy activity, demo, hands-on...), creating media things, design (right style for the audience, nicer colours and characters for images...) - Training: Advice in how to speak to such an audience. (understand how to keep them engage, interested, what could be the best format and style...) - Practise: It would have made the day of the activity more relax, knowing that I had the right vocabulary, that it was a good flow, time</p>
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	<p><u>Você diz que vai a introduzir algum novo material na atividade já testou de alguma maneira?</u></p> <p>j. Did you think about the image, as a scientist, that you want to give to the audience? Did you think about how you will dress, about the setting of the room and where you will position yourself?</p> <p><u>Você pensou na imagem de cientista que quer passar para o público? Já pensou em como vai se vestir, no setting do espaço e onde vai se posicionar?</u></p>	
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b) Training

<ul style="list-style-type: none"> - Understand if they value training in science communication. - Understand if they have science communication training or interest on it. <p>(Adjust according to the answer in the questionnaire, confirm/develop from it)</p>	<p>Opt. Would you be interested in having a training program in science communication?</p> <p>Opt. (What type of program do you think could be useful and why?)</p> <p><u>Você mencionou que, gostaria ...Como vê que poderia ajudar?</u></p>	
--	--	--

c) Style, format and engagement

<ul style="list-style-type: none"> - Understand how they plan to run the activity, format and the reasons for each part. - Understand how they plan to interact and engage with the audience. 	<p>k. Opt. How is the activity organised? Can you develop in the reasons for each choice?</p> <p>What is the restructure/format of the activity, separate moments?</p> <ul style="list-style-type: none"> i. Different parts/moments ii. What is the format and style (presentation, videos, hands-on, demonstration, storytelling, games...) iii. What are the resources you will use? (lab objects, games, projector, books, painting, music, art...) <p><u>Qual é a estrutura/formato da atividade? tem momentos claramente separados?</u></p> <p><u>Qual são as razões para o formato? Que materiais vai utilizar?</u></p> <p>l. How are you planning to interact/engage with the children? How do you see that</p>	<p>k. 5 parts, 1st intro us, what we do, 2nd intro topic, easy words, using a video/presentation/images /models</p> <p>3rd game, grab their attention to participate and get some concepts, Story telling, read a book for them to relax and connect to the activity. Engage by discussing the story, the characters role...</p> <p>5th hands-on, an experiment to play, visualise the science, guau factor...</p> <p>Painting, colouring some cartoons that represent the characters of the topic</p> <p>l. the interaction is by asking them questions along the way, letting them ask at any</p>
---	--	---

	<p>interaction happening? (reasons for it)</p> <p><u>you could explain a little more, How do you plan to interact/engage with the children? How do you see this interaction happening? (motives for it).</u></p>	<p>time... (keep concentration, focus...)</p> <p>engage with the game, hands-on (they participate and are active in the activity, they have fun, ...)</p>
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d) Testing

- Understand the level of testing/ practise of the activity in advance	<p>m. Have you pre-tested the activity before, with who? (In previous events/ with colleagues/ with similar audience... in a group or a individual)</p> <p><u>Did you test the whole of this activity with the new parts, with whom?</u></p> <p>n. If so, did it help you in adjusting the activity? How? What did you change?</p> <p><u>If so, did it help you in adjusting the activity? How? What did you change?</u></p>	<p>YES, previous events, with colleagues, ...</p> <p>The audience was different, I have not practise it for such a young audience... I already did this activity here at Exploratório.</p> <p>n. Yes it helped, I changed the story, made it shorter, the vocabulary was a bit complicated, found some analogies more relevant for the audience,..</p>
	<p>o. How would you described your level of practise in advance? How long and WHY?</p> <p><u>How do you describe your level of practice with antecedence? How long and WHY?</u></p>	<p>o. hope so, I practised twice, one to check how long it would take, another to see the flow...</p>

e) challenges and issues

- Understand if they have any worries regarding the activity.	<p>p. Do you have any barriers or issues in communicating the topic?</p> <p><u>Do you have any barriers or issues in communicating the topic?</u></p> <p>q. What are the challenges so far, if any, of communicating such a topic, in particular to this young audience?</p> <p><u>What are the challenges so far, if any, of communicating such a topic, in particular to this young audience?</u></p> <p>r. Do you predict any challenges related to the level of interest or engagement in the activity from the children?</p>	<p>p. Yes, it is very difficult to get the science vocabulary right for this audience, The topic could be driven into a negative interpretation, so it needs to be very carefully though about how it is presented. The topic is not very visible into everyday life, so I is difficult to make it exciting...</p> <p>q. It is difficult to decide how much science to explain, find the right vocabulary or expressions attractive to the audience</p> <p>r. the hands-on demo is...I am not sure the game will ...it was solved by using</p>
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	<p><u>Você mencionou que prevê algum desafio relacionado com o nível de interesse ou envolvimento na atividade das crianças?</u> s. Opt. (If so, how are you planning to solve that and get them engage with it?) <u>como você planeja resolver isso e fazer com que eles se interessem com isso</u></p>	<p>different characters in a cartoony style...</p>
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4- Comments

Objectives	Questions	Expected answers
	<p>a. If in the questionnaire they left any comments or questions, talk about them.</p>	

Thank you for your participation, it is very valuable for the research project.

If it is ok with you, could you fill now this quick questionnaire (Q2) online by clicking the **link in the chat**..... It is part of the general guidelines and suggestions for “how to” do science communication for scientists.

I will see you on When you do the activity, I will be there observing as an external person to the project.

Thank you for your time.

Appendix 7 – Interview I2

1. Introduction

Objectives
<ul style="list-style-type: none"> - Reminder of recording - General information about the legitimate participation in the research and consent for the recording

Hello number...

Thank you for taking part in this research project.

Just to remind you that I am an external viewer in the project, and I am here to do my research only.

A reminder that, if during the interview you use your names, they will not be used during the transcription. I will transcribe with numbers and letters.

This interview is being recorded, if you could please verbally confirm your consent now, we can start.

2. Perception of the Activity

a) **Scientists**

Objectives	Questions
- Understand how the scientist perceived what happened in the day of the activity	a. How do you feel overall about how the activity happened? <u>Como vocês sente em geral que a atividade aconteceu?</u>
- Perceive the level of satisfaction and enjoyment on the day	b. Did you have a good time? <u>vocês se divertiram?</u>
- Understand what the key moment was for them	c. What was your favourite moment? <u>Qual foi o seu momento favorito?</u>

b) **Children**

- Understand their perception about the level of interest	d. How do you feel about the children's interest in the topic? <u>Como você sente o interesse das crianças pelo tema?</u>
- Understand how they felt about the level of engagement of the children in the activity	e. How do you feel the level of interaction and engagement was? was it as anticipated? <u>Como você acha que foi o nível de interação e engajamento?</u> <u>foi como previsto?</u>
- Perceive the level of enjoyment they think the children had	f. Do you think the children had a good time? <u>Você acha que as crianças se divertiram?</u>
- Perceive if there was a particular moment for the children	g. What do you think the favourite moment for the children was? <u>Qual você acha que foi o momento preferido das crianças?</u>

3. Objectives

- Perceive if the activity run as planned, if they actually met the objectives they had	a. As a quick reflection of how the activity was, do you think you fulfilled your objectives? <u>Fazendo uma rápida reflexão de como foi a atividade, você acha que cumpriu seus objetivos?</u>
- Understand what their perception was, of the messages the children took with at the end, if it was as planned	b. Do you think the key messages were passed? What were they? <u>Você acha que as mensagens-chave foram passadas? Pode dizer quais eram eles?</u>

4. Preparation

a) Changes

- Understand if they already noticed something that would need to be modify	a. Anything you could think straight away that maybe you would do different if you do the activity again? <u>Alguma coisa que você possa pensar imediatamente que talvez faria diferente se fizesse a atividade novamente?</u>
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b) Preparation

- Understand if anything changed in their opinion about the level of preparation needed to do the activity	b. How do you feel about your level of preparation for the activity? <u>Como você se sente em relação ao seu nível de preparação para a atividade?</u>
- Perceive if there were any surprises	c. Was there anything that happened that you have not anticipated for? <u>Houve alguma coisa que aconteceu que você não esperava?</u>

5. Closing Interview

a) Comments

	a. Anything you would like to comment about? <u>Alguma coisa que você gostaria de comentar?</u>
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b) Acknowledgements








Thank you for your time and participation in this research project.

I will send you in a couple of days, so you have time to reflect on how the day of the activity was, a short questionnaire to double check a couple of things, hope that is ok with you. Thank you gain for taking part in this research.

Appendix 8 – Observation matrix

Code of things to measure:

- 1- Draw setting of the room for each part of the activity. (general description notes)
- 2- Time keeping of the activity parts: different periods of the activity (how long was the intro, storytelling, presentation, hands-on, questions time, ...)
- 3- **NP**- number of parts of the activity
- 4- **NS**- Number of Scientists
- 5- **N**- Number of children participating in the activity
- 6- **NT**- Number of teachers
- 7- **NF**- Number of facilitators
- 8- **QS** - Keep track of when and the number of questions from the scientist.
- 9- **QSA**- Keep track of when and the number of questions from the scientist are answered by the children.
- 10- **QC**- Keep track of when and the number of questions from the audience.
- 11- **I**- Keep track of when and what type of interaction the audience has
 - a. As an individual, as a group, as pares, big group, small groups...
- 12- **ICT**- Keep track of the children verbal interaction with the teacher.
 - a. Reasons for it, ask questions they did not understand, distractions, help...
- 13- **ITC**- Keep track of the teacher interaction with the children.
 - a. Reasons for it, ask questions they did not understand, behaviour, support...
- 14- **D**: If there is a demonstration, does anyone from the audience take part on it? How many?
- 15- **HO**: If there is hands-on, how is it done?: do they all get to do it, as a group, individually, in pairs?.
- 16- **E**: Over all the group. Observe the children expressions/ emotions: when they have to do something, when they are listening,.... How they do things.
- 17- **F**: Interventions of the facilitator. Facilitator’s role during activity

N= number of children	C= Children 	T= Teachers 1+2 
S= Scientists  	F= Facilitators (2) 	A= Answers
Q= Questions	P= Presentation	D= Demonstration
HO= Hands-on	D= Drawing	G= game
V= Video	NP= number of parts	Table  Chair 

- **Field notes:** details while observing. Each part of the activity has its own form.

Week:		NP:		Description of the part of the activity, Topic:		Support material:	
N:	NT:	NS:	NF:	Intro research topic	Intro Conversation	PowerPoint presentation	
Start time:		Finish time:		Intro life and work of a scientist		Video	Images Poster Photos
				Demonstration Hands-on Game		Text	Infographic Music Book Art
				Questions Time Story telling Role-play		Models	Objects
Topic/ Title				Description of Who is involved & How:		S talks C go out on stage (how many)	
Do they have a script to follow?				Vocabulary used / Verbal Expressions / Analogies			
				E: emotions/ feelings/ expression of C		When/Why reasons for it	
				Happy, animated Participative Bored Engaged Quiet/Calm Surprised			
				Interested Not-interested Concentrated Lost concentration			
Verbal Interactions ⁶		QS S → C	QC C → S	QSA S ↔ C	ICT C → T	ITC T → C	
Time	Type	Comments Reasons Type of Q= Where/How/Why/When					
		{C=confirmation of understanding Q (YES/NO) answers CC=confirmation of understanding with comments E= ask children to confirm/repeat some explanation. G= general Comments Q to: all in general/ 1 to1 around/1 replies back from comment / several reply to same Q/ Several comment about same topic }					

⁶ At the end, this section was not used, no notes were taken.

Reflection NOTES: When the observation finishes

Write down things that the researcher observed that thought could be useful information.

- Did I think there was a story/logic behind the activity? (in order to meet the objectives)
- Did the audience follow the activity? Did it feel the audience understood the topic?
- Did they keep to the topic?
- From my perspective: Structure of the activity
- Key message I understood:
- Scientific concepts, explanations, vocabulary:
Scientifically correctness:
- Did the scientists use a presentation: if so, with text, images, infographics, videos ...
- What type of support for the activity the scientist used? (audio-visuals, video, poster, images, real objects, non-real objects, simulator, games, art, music, books ...)
- Style of video: Characters, animation, real people, design, colours... (duration)
- Hands-on activity: how was it, was the audience capable of doing it independently, did they need help, did they do it as a small group, individually, pairs, big group...
- If help was needed, Who provided the help, the teacher, the facilitator, the scientists.
Reasons for it, was it too hard for them, difficult vocabulary...
- Overall, did it feel the children were having a good time, did they want to engage? Were they curious, initiated interaction, participated?
- Issues / Expressions out of the scientific context, scientific accuracy...
- General Notes
- Comparison between two days of the same activity topic (if applicable)

