PROJECT DELIVERABLE

Participatory Communication of Science

DELIVERABLE 4.1
Report on needs and wishes for participatory science communication (tools)

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Contact (co-ordinator):
Asst. Professor Antti Knutas & Asst. Professor Annika Wolff
LUT University
e-mail: parcos.project@lut.fi

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Authors	Priscilla Van Even, KU Leuven (Belgium) Bieke Zaman, KU Leuven (Belgium)
Reviewers	Antti Knutas, LUT University (Finland) Natasha Tylosky, LUT University (Finland) Catho van den Bosch, VRT (Belgium)
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SUMMARY

This initial report will reflect upon the needs and wishes for participatory science communication (tools) based on insights from ParCos and KUL activities such as workshops, design sessions and meetings that have taken place in 2020. The findings that we identify are widely applicable and account for a diverse set of needs, also for a younger audience. The deliverable will function as a reflexive guide for the creation of science communication tools and future participatory design workshops and will instigate the development of the ParCos Trainer Package, a pedagogical training to educate future content creators and science storytellers on how to use participatory methods and tools to improve their dissemination practices to the public.

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1 INTRODUCTION

The main objective of the ParCos project is to **improve science communication** by taking **a participatory approach** in the development of stories, tools and methods, to support citizens in conducting, communicating and discussing science through **media and technologies**. Supported through the Bristol Approach, this project explores issues such as **inclusion** in science participation and communication as well as the creation of **engaging science stories** that both include and communicate with the public in science outreach. The Bristol approach is based on a framework that supports a people and issue-led process for citizen science and engagement (Hudson, Evans & Banks Gross, 2020).
The communication of science stories through the use of participatory tools and methods alongside scientific evidence, will support the audience in judging the validity of evidence and interpretations and even tell their own science stories with evidence. With **the ParCos tools and methods approach** we want to make **science communication and design approaches** more **accessible, inclusive and engaging in order** to empower the people and to make their **interactions** with technological tools more **meaningful**.

Deliverable 4.1 will function as a **reflexive guide** that highlights **needs and wishes** for the creation of participatory science communication tools and future participatory design workshops. This report is also a first step in the development of the ParCos Trainer, a pedagogical training package to educate future content creators and science storytellers on how to use participatory methods and tools to improve their dissemination practices to the public. In this report we will firstly discuss the needs and wishes for **designing communication tools**. Our findings are based on both ParCos activities and KUL research findings. This section will look at the creation of participatory tools through an expert’s lens. Secondly, we will share findings and insights from the **participatory design workshops** with children during the Kinderuniversiteit (Children’s University) event in Leuven (October 2020). This section will include the perception of child participants on tool designing and science activities. The final step of the report is to discuss future plans and activities to develop the **ParCos Trainer** package.

2 DESIGNING SCIENCE COMMUNICATION TOOLS

2.1 PARCOS ACTIVITIES

Due to covid restrictions, many ParCos activities took place in a digital setting. Consequently, working in a collaborative manner required a different approach and way of working. Miro, an online collaborative whiteboarding platform, was used to brainstorm, and to share, present and visualize ideas or insights in a creative and interactive manner. The Miro boards that have been designed during several ParCos activities provide us with relevant insights and experiences concerning digital tools, science communication and participation through the lens of media experts and academics.

2.1.1 Design workshop (ParCos Consortium meeting, October 2020)

During a virtual consortium meeting on the ParCos platform requirements, needs and wishes regarding digital tools for data processing within the ParCos case-studies were discussed and visualized. The participants were first asked to map their positive and negative experiences with digital tools they were familiar with, which resulted in the following board (see Figure1):

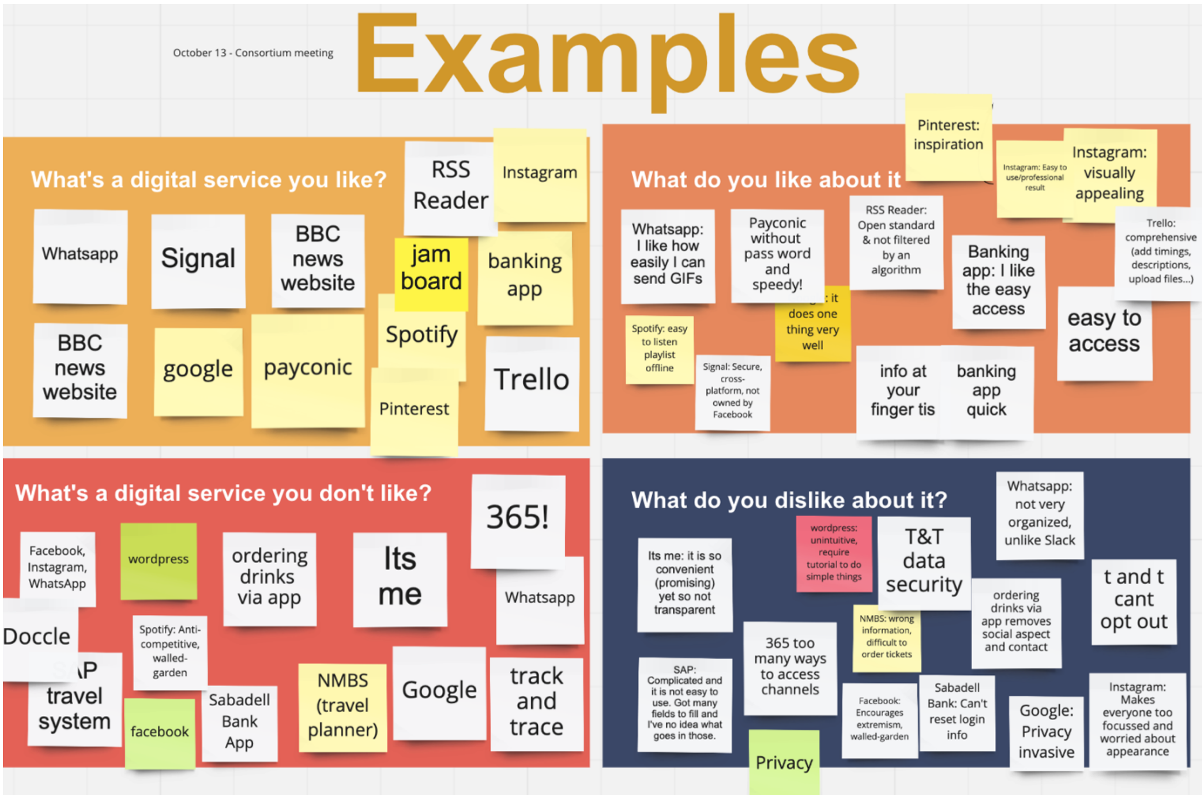

Figure 1: Examples of best and worst functionalities of digital tools

Some functionalities were much appreciated and stimulated the use of and interaction with a tool. From the brainstorming session we can conclude that user-friendly tools score high in **accessibility** (easy or **intuitive** in use, **open** access), **visual appearance, speed,** the ability to **inspire**, **understandability** and **security**. The participants disliked tools that lacked security, **privacy**, **transparency, consistency,** accessibility, or that had negative **psychological side effects**, or are **chaotic** or **unpractical**.

As a follow-up exercise, the participants were asked to imagine their ideal functionalities for ParCos tools and describe their wishes and needs (see Figure 2):

Figure 2: Wishes and needs for ParCos tools

Within this exercise, new and more concrete features came up that are important to take into account when designing tools. Tools should be **interactive**, **educative**, **engaging**, **sustainable** (exceed the project duration), **fun, customizable, open source, (self-)explaining, multilingual** and **visible** (to attract the audience). The design should **not be excessive** in colours and shapes (sober, not distractive) and should reach **a large audience** by focusing on novices with different backgrounds, as opposed to experts. Furthermore, the tools should have a good **lay-out** (also on mobile devices format), a **glossary** (to explain terms), sufficient **storage of data**, a **storytelling** element and a low **language barrier** (for accessibility).

Some ideas for ParCos tools that came up had to do with support in **data visualisation, art guidance,** and the **analysis of data** (also **artistic** data).

2.1.2 Workshop on immersive technologies (November 2020)

ParCos defines science communication in the project glossary as the communication of science through stories in particular media. Within the project there is a special interest in **video broadcast, Virtual-Reality (VR) and Augmented-Reality (AR) technologies** to stimulate **public participation** with science practice, make data evidence more salient and support the publics’ own interpretation of data. In December 2020, a workshop on immersive technologies and storytelling was organized by VRT. **Immersive** technology, such as AR, VR and **Mixed-Reality (MR) technologies**, create and shape **new environments** by blurring the line between the digital and physical realms. We find the integration of virtual and physical objects at different levels as can be seen in Figure 3.

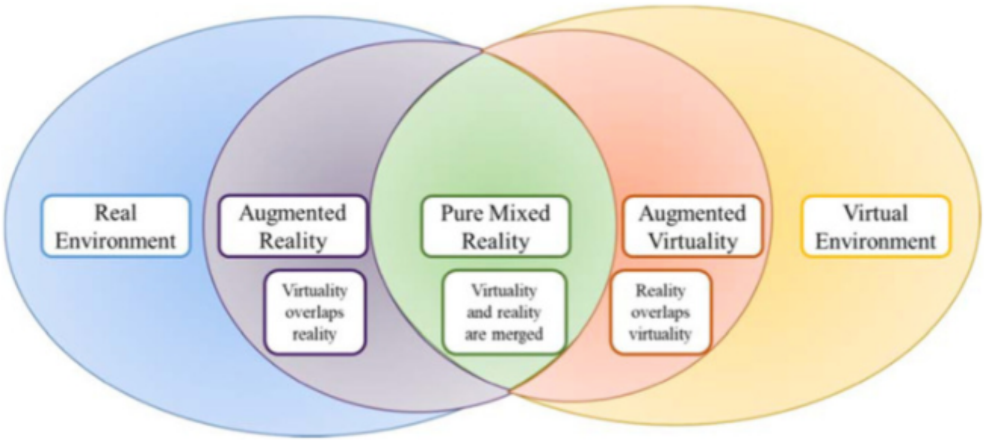

Figure 3: Reality-virtuality continuum (Flavián, Ibáñez-Sánchez &Orús, 2019, p. 549).

Several studies illustrate how the use of immersive technologies and tools can support participatory engagement in scientific activities and decision-making; and **enhance communication** between citizens and researchers, for example Klippel et al. (2020), Schrom-Feiertag et al. (2018), van Leeuwen et al. (2018), Fares, Taha & El Sayad (2017) and Regenbrecht & Abbott (2011). We also find studies that focus particularly on the role of immersive technology as a tool for **children’s participation and inclusion** in science activities**,** such as Sobel (2019) and Bakyr, El Sayad & Shokralla Thomas (2018).

Immersive technologies alter how we interact with science content and turn the observation of content into an immersion into the content when properly applied. Within the ParCos workshop that was organized by VRT it became clear that participants were familiar with the use of immersive technology tools and science storytelling. In a brainstorming exercise, the participants were asked to give examples of best practices and ideas from their personal experience (see Figure 4). These examples could be divided into four categories: information design, theme parks, games and film or documentaries.

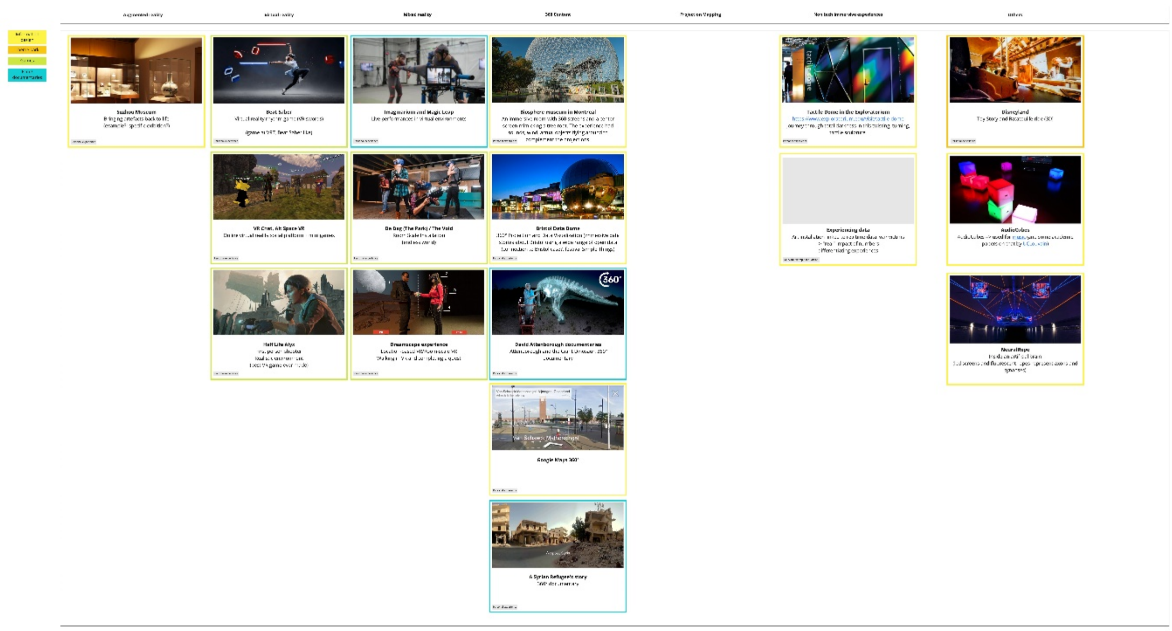

Figure 4: Board with best practice examples of immersive technology tools

Based on this workshop, some general characteristics were generated on how to make storytelling immersive, namely: by **collaborating**/connecting experiences, stimulating **imagination**, **exploring** without limitation, linking **fiction** to reality (gaming), supporting a **narrative** and using different **senses** to tell the science stories (smell, tactile experiences and sound).

In addition, it is interesting to reflect upon some characteristics of different types of immersive **devices** itself to distinguish the more **participatory oriented**. We find in the work of Flavián, et al. (2019) that we can divide these technologies into external (stationary or portable), and internal devices (wearable or implanted) which are situated on a perceptual presence continuum between a sense of being here or a sense of being elsewhere. Some of these internal or external devices lead to a higher form of interactivity than others. Within ParCos, we are interested in those that leave room for **control and manipulation of the participant** (see Figure 5).

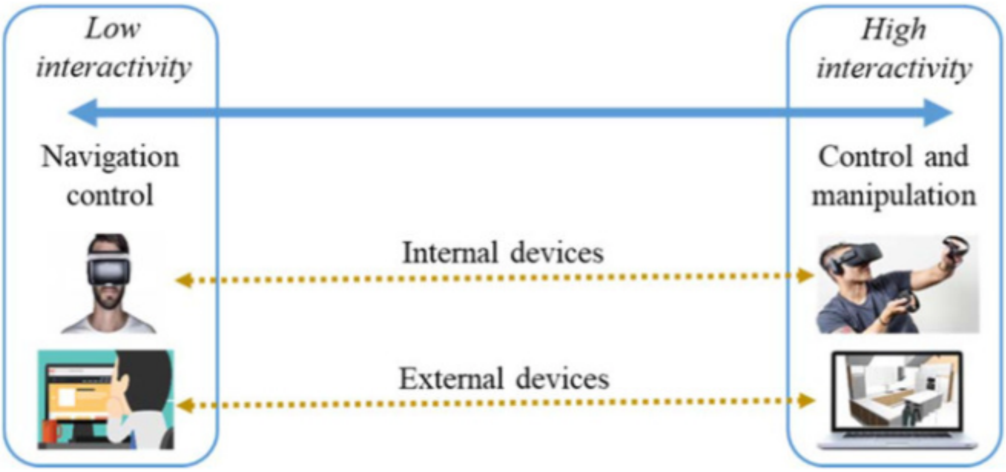

Figure 5: Behavioral interactivity continuum (Flavián, et al., 2019, p. 552)

The authors place a wide variety of existing technologies in what they call an EPI (Extreme levels of perceptual presence) cube in accordance with their positions relative to interactivity.

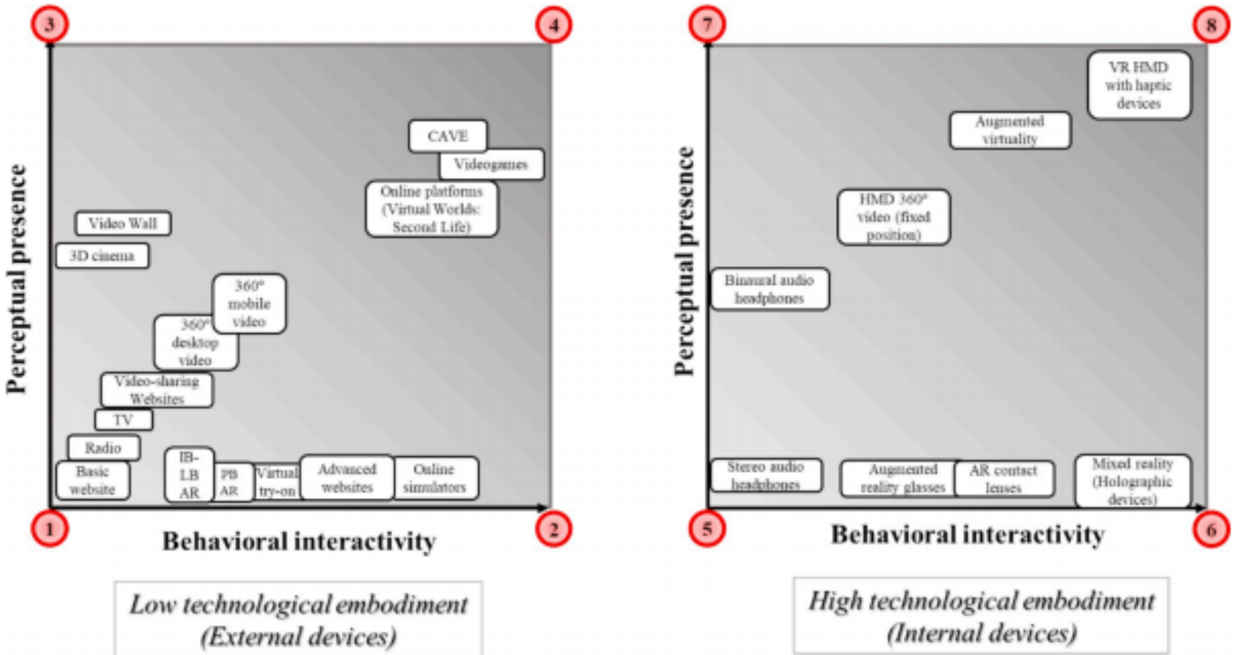

Figure 6: Technologies placed on the faces of the EPI Cube (Flavián, et al., 2019, p. 557)

As shown in Figure 6, devices that score higher on interactivity are: **advanced websites, online simulators, online platforms, videogames, CAVE** (Cave Automatic Virtual Environment), **VR HMD with haptic devices, mixed reality** (holographic devices), **augmented virtuality** and **AR contact lenses**.

2.2 Meaningful Interactions (Lab)

We have discussed desired functionalities for participatory tools and looked at immersive technologies to enhance interactivity in science storytelling. Another crucial step in this report is to reflect upon how we can establish a **meaningful interaction** between the public, science, and tools.

The mission of the Meaningful Interactions Lab (Mintlab) department from the KUL is to design user-friendly tools that create meaningful interactions with technology. This notion of ‘meaning’ is an important **quality** of interaction that is of growing interest in literature (Mekler & Hornbaek, 2019; Lu & Roto, 2015; Grosse-Hering et al., 2013; Hassenzahl, 2013). Also, past Mintlab experiences with children in the RETINA project (RE-thinking Technical Interventions to Advance visual literacy of young people in art museums) have shown that interactions that lack this element of meaningfulness could lead to the development of tools that are **distractive** rather than supportive (Van Even & Vermeersch, 2019).

In the work of Mekler & Hornbaek (2019) we find a framework that outlines five components of meaning that can function as useful guidelines for ParCos tools, namely: **connectedness, purpose, coherence, resonance** and **significance**. Table 1 provides an overview of these components with a brief clarification.

	Connectedness	Purpose	Coherence	Resonance	Significance
Meaning is ...	always connected to the self and the world	sense of core goals, aims, and directions	comprehensibility and making sense of one’s experiences	clicking with something or feeling it is right	enduring value and importance
Absence	Self-alienation	Aimlessness	Absurdity and uncertainty	Feeling of ‘wrongness’ and anxiety	Triviality
Orientation	Self and the world	Motivation	Understanding	Feeling and Intuition	Mattering
Temporality	—	Present to Future	Past to Present	Present	Past, Present and Future
Process	Living	Goal-setting	Sense-making	Intuiting	Evaluating

Table 1: Meaning components (Mekler & Hornbaek, 2019, p. 5)

3 DESIGN METHODOLOGY

Within ParCos, we want to organize workshops with participants with different skills and mindsets. The KUL has taken a specific interest in **children as a focus group,** since they are a population group that is often overlooked and often not included in studies. ParCos wants to stimulate the participation of the public in science communication and make science also accessible to youngsters in our society. Makuch & Aczel (2018) emphasize that appropriately designed citizen science activities are in fact age-inclusive and thus accessible to all children (p.391). Also, by giving voice to a young audience and designing projects appropriate for children we are able to provide insights that are widely applicable and that account for a diverse set of needs.

3.1 CO-DESIGNING WORKSHOPS WITH CHILDREN (KINDERUNIVERSITEIT, OCTOBER 2020)

The KUL participated at the Kinderuniversiteit that took place physically in Leuven, Belgium. Kinderuniversiteit is an event where children get the opportunity to follow science lessons and workshops at the University. In the ‘Kidslab’ workshops we co-designed with children (aged 8 to 13 years-old) a child-friendly city of Leuven in the future. The activity taught them more about citizen science and how researchers work, and they taught us more about their perceptions of science activities and society.

3.1.1 Perceptions of children on science activities and inclusiveness

During the workshops we asked several questions to the children. The first question was to get examples and impressions of what they think scientists do and what science is:

“they are explorers”
“inventing things”
“making machines/new technology”
“they do research”
“they find solutions”
“discovering new things and develop them”
“they read a lot”
“they travel to different countries”
“there are different kind of scientists”
“Einstein is a scientist in books”
“cure diseases”
“research animals”
“they do a lot of calculating”
“Mark Van Ranst is a scientist from television”
“writing things down”
“experimenting”

“they make everything as good as possible”
“they do competition”
“explaining things to people”
“they show things to people”
“they try things and let things fail”
“Professor Gobelijn is a scientist from a comic book)“

The children were also asked whether they think it is important that researchers/scientists **include the voices and opinions of children on society and science** in their **research** and why. Two children thought it was not very important without giving an additional motivation. The other 20 said it was important to them and some of them gave a motivation:

“We think very differently about things from adults”
“Adults think they know how we think but they don’t”
“A child sees things differently”
“There are a lot of problems because of adults”
“Adults don’t listen enough to children”
“We will have to live in this world and grown-ups will not in the future”
“Adults are not enough interested in what we think”
“We also want rights”
“Adults say too much what we have to think”
“We also have good ideas”
“There are also children in the city”
“I can never really say what I think in school”

Most children mentioned that they think very differently from adults. Authors such as Kellett (2005) and Hart (1997) remark that children can contribute greatly to research through their **‘genuine child perspective’** and their ‘**child voice’ to disseminate information**. They assert that children have unique competencies and strengths that are valuable to research. However, when the children had to discuss their ideas during the co-design session for the city of the future, they often did so in terms of punishment/rewards/fines/control and approached problems from a perspective that does not diverge from adults. The youngsters were very much aware of environmental issues and the climate debate and it was striking that they repeat a lot of **what they hear on the media**, solution wise**.** When the children were asked to clarify in what way adults did not understand them or what they see differently, they were not able to respond to the question. They kept repeating the narrative around world problems and the(ir) future. This phenomenon reveals a difficulty concerning science dissemination to children, namely that children could lose their unique perspective by learning and integrating the ‘adult perspective’ too much. One could pose the question whether we can speak of true participation in a design or research process when the participants already have been taught what to expect and how to think. On the one hand the environmental movement has inspired children to voice their concerns, but on the other hand they are taught to think within a system that has been designed by adults and is in need of a paradigm change.

3.1.2 Methodology and results

The co-designing sessions adhere methodologically to the principles of **Participatory Design**, a research approach involving different stakeholders in the design process itself (Robertson & Simonsen, 2013; Stappers et al., 2011; Ehn & Badham, 2002). In our particular case, we designed *with* children *for* children. The visualization of the children’s ideas happened through a creative, **arts-based method approach** (see the ParCos guidebook of Pässilä Wolff & Knutas, 2020). The children were asked to think of something that would make the city of Leuven more child friendly. This idea could be related to something that is currently missing in the city or inaccessible to children. Something they experience as a problem or find disturbing, or perhaps something that already exists but should be improved or is too limited, etc. The workshop started with an individual brainstorming session wherein the children articulated their ideas on separate post-its. They wrote down what they did and did not like about the city in two different post-it colours. On a third color of post-its they noted concrete solutions or tools for the other two categories. In a following phase they tried to categorize and combine these ideas and had to select a final cluster to work with. After this brainstorming, they received a box with different crafting materials to visualize their ideas on a flag and they wrote down a slogan.

Some children found it difficult to visualize their ideas in a creative manner. They were more text-oriented and used the craft materials as **decorations** that did not attribute meaning to the flag, for example Figure 7.

Figure 7: Example of a decorative approach.

Due to the limited time for these workshops (1,5 hours) and instructors (1 for 10 children) it was too difficult to assist children with less **creative skills** or struggles. We would recommend for future practices to work in **small groups** (maximum 3 to 4 children) and account for time to stimulate and support children during the co-design sessions.

In Figure 8 we find an example of a flag where visualization **added meaning** to the proposed solution. This child designer pleads for more playgrounds and shows that children should be spending less time behind computers. Especially during these covid times many things take place in a digital format while children experience a strong need for physically activities. Interestingly, the child was concerned that this idea was perhaps not good enough to develop since most children were focused on environmental and societal issues. Even though they were instructed to think from their own situation and needs, the child was concerned that wanting more playgrounds was too selfish.

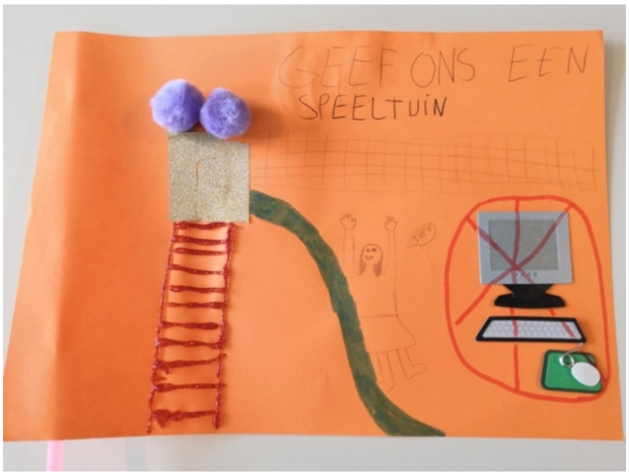

Figure 8: Example of added meaning through design.

Most flags depicted an **invention** design for tools. For example, on Figure 9 we see the design for a bus that drives on solar power and fluorescent poles at a pedestrian crossing. On Figure 10 we see the design for a garbage bin with the appearance of unicorn that rewards good citizens that put their garbage in the bin with candy.

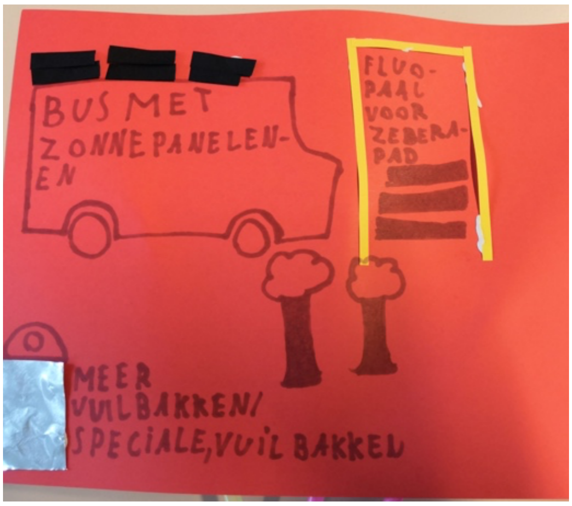

Figure 9: Example of invention design for ecofriendly traffic.

Figure 10: Example of an invention design to fight illegal dumping.

The co-designing workshops revealed to us that children are very aware of societal issues and the role of researchers. They are very much concerned that their interests are not taken into consideration by adults causing environmental problems nor by the politicians and scientists that need to fix these problems.

3.2 Future activities

The original plans for participatory design sessions have been affected by covid restrictions, therefore at this stage ParCos partners draw some information from other sources as well. Prior to LUT engaging with their case study game, the designer of that game (who is from outside ParCos) had been speaking with children. They came up with the idea of doing science communication using a live action game and originated this idea behind the LUT case study activities. LUT and the designer will continue this collaboration in the future. The game participants are and will be supported by LUT workshops to reflect on their design experiences. The **arts-based approaches** brought into the workshops are based on ParCos ideas of Deliverable 3.1 (see Pässilä, Wolff & Knutas, 2020). LUT will also work specifically with **children participants** for their case-study. These workshops will thus provide us with further insights about participatory and arts-based methods with children. During these workshops, similar questions as with the co-design workshop of the Kinderuniversiteit will be asked to the children, namely:

- Do you think it is important that researchers/scientists include the opinions of children in their research? Why? (inclusivity)
- What do scientists do? What is science? (perception of science)
- What scientists do you know? Why do you consider them a scientist? (perception of science)
- Where do you see scientists? Where do you hear about science? (science communication

The designing activities by LUT will be formalized in the form of templates, training materials and other tools to help educators to organize similar events in the future. These activities are related to how children like to engage and participate to science and how arts-based methods are used in this and thus will have a lot of input towards Deliverable 4.2 and 4.3.

Furthermore, during the second phase of Deliverable 4.1, we will investigate the design angle through pilots or shared workshops when WP2 has progressed more. More specifically, we will explore the Bristol approach with insights on inclusion in science from Deliverable 2.1 (by Hudson, Evans & Banks Gross, 2020) and findings from Deliverable 2.3 on the re-use of science data.

4 THE PARCOS TRAINER PACKAGE

This report is a starting point for the ParCos Trainer, a pedagogical training package for educating future content creators and science storytellers on how to use participatory methods and tools. This package will be further advanced and supported by (1) future activities mentioned in section 3.2 of this report; (2) the development of a classification of a wide variety of perspectives and approaches to participatory science communication; and (3) a systematic review on interactive and creative science dissemination that is currently being developed for Deliverable 3.2 (Van Even, Zaman & Hannes, 2020). This D3.2 review will provide an appraisal framework that can guide science storytellers to translate and disseminate their knowledge, research or scientific insights in an interactive and inclusive way.

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