PARCOS
Participatory Communication of Science

DELIVERABLE 4.2
Report on Science Communication Guidelines for the Design and Curation of Participatory Science Stories

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SUMMARY

The goal of Work Package 4 of the ParCos project is to support science storytellers in their creation of participatory science stories via methods, tools, and principles. In this report we offer science communication guidelines in the form of an evaluation framework to support the design of participatory and creative science stories and curation tools. These guidelines are based on the results of a systematic review analysis. The protocol of this review can be found in a previous ParCos Deliverable (D3.2).

Keywords: science communication, science stories, curation, participatory design, systematic review, evaluation framework

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1 CONTEXTUALIZATION

This report offers science communication guidelines for the design of participatory and creative science stories[1] and curation tools[2]. These guidelines are presented in the form of an evaluation framework based on the results of a systematic review of evaluation criteria for creative, interactive science dissemination practices. The protocol of this systematic review can be consulted in D3.2 (Van Even et al., 2020) and contains, among other things, the inclusion and exclusion criteria of the selected works and the methodology to search, screen and analyze the articles.

This framework can be used to support the design of science stories and their curation tools, but it can also be used retrospectively to evaluate existing stories and tools. The guidelines can be used by different kinds of science storytellers in different settings. Before going deeper into the framework model and its use, we would first like to discuss two important limitations of this framework. (1) This model, a result from our systematic review, is in development. It still needs to be finetuned, extended and adjusted through pilot testing. This model should thus still be seen as a starting point and not a final version of the framework. For example, in the current framework we mainly use an academic jargon because the articles that were generated in the review had an academic orientation. This limitation is surmountable. (2) The second one is philosophical and existential by nature and thus harder to cope with, namely: modelling and structuring reality. There are different ways of structuring and modelling information into what we come to see as 'reality'. One could argue that it is not essentially problematic that we structure our knowledge: we do it continuously and spontaneously to order and understand the phenomena around us and to be able to 'speak' about them. It is, however, problematic if we forget that the model and structures we use (resulting in 'knowledge' and 'language') do not necessarily correspond with the phenomenon and reality outside of our minds. We are reminded of Korzybski's (1933) famous observation:

> "A map is not the territory it represents, but, if correct, it has a similar structure to the territory, which accounts for its usefulness." (p.58)

[1] What is a science story and why did we choose this term? A story, or narrative, tells a series of events. The communication of this story can take many forms (written, spoken, performance, visualization, and so on). Since it is a 'science' story, it is not a fictional story, but a story that is based on scientific evidence and thus has scientific grounding. Characteristic to a 'story' is that there is a 'storyteller', which means that the meaning of the story depends on a storyteller and the format even though the story has scientific roots. Communicating science as a story, is a way to bridge the gap between the academic and public realm.

[2] What is a curation tool and why did we choose this term? The science story will be communicated in a certain format. The decision on 'which' format will depend on the maker, the goal, the story, and the people we want to engage. A 'curation tool' is used for the content 'curation' of the science story. A tool to support curation can take various forms such as a digital immersive app, but it might as well take form in an artistic exhibition, for example.

The usefulness of our mapping of certain aspects of reality is not self-evident. Moreover, there is the obvious pitfall that we mistake our models and structures with reality itself. We need them because they provide us with a way to order and understand things, but our dependency on them can make it difficult to assess their usefulness in the long run. Language and knowledge are thus *fragile* and *creative* ways to ‘grasp’ phenomena since reality itself is very complex and perhaps impossible to fully express through knowledge.

What does this implicate in relation to our framework? A systematic review is considered to be the highest level of scientific evidence (Glover et al., 2006). However, making sense of the generated information (in our case criteria) and ordering this information into a model (evaluation framework) requires translation and creativity. This means that the framework could differ drastically between researchers even though they started from the same findings. This element of subjectivity and creativity is present in all the phases of the review.

- Designing the code to generate articles in databases can differ from researcher to researcher even though they have the same research question in mind. Developing a code requires a multitude of various things: a background in the field, knowledge of common terminology and labels, analytical skills as well as a level of creativity of the researcher (team). This code will determine the selection of articles: *the base of our findings*.
- The analysis of the articles that made it through the different screening phases require a level of creativity and translation as well. Different authors (with very different fields of expertise) use different terms and concepts to sometimes indicate the same thing or to highlight a difference in nuance. The interpreting review researcher will decide whether it indicates the same or something different which in its turn will determine categories and subcategories: *the base of our framework model.*
- When the review analysis is completed and the framework constructed, decisions will be made to puzzle the information together and to order it into something sensical and understandable. It will determine the visual and linguistical outcome of the framework: *the base of our knowledge and language.*

This framework should thus be seen as one way of representing, structuring, and modelling the found criteria and as one way to design and evaluate participatory science stories and curation tools. The framework is the result of an iteration process wherein different decisions were made to structure information. Awareness of this limitation is important since we want to leave an openness in the framework so that knowledge can remain something dynamic and fluid that keeps meandering along future lines. The science storyteller that uses this framework (or any other) should avoid turning the knowledge translation from the framework into something fixed or static, which is very challenging

and difficult to do. Since ‘grasping’ information in the form of a published framework model inevitably takes the form of something static (the visual, presented work always has a physical beginning and an ending), it is the task of the reader to bring it alive and protect its fluidity and potentiality.

2 THE EVALUATION FRAMEWORK

After screening 8696 abstracts in three screening rounds, 87 articles were selected for the analysis of our review. After fully reading these 87 articles, only 18 articles matched the in- and exclusion criteria of the protocol and made the final cut. Based on these 18 selected works criteria were generated and brought together into a framework to evaluate and design science stories and curation tools. Figure 1 gives an overview of the authors of the included works. The full reference of these works can be found in the bibliography. Each author was given a number to indicate within the framework which criteria were generated from which work(s).

Legend	Authors
1	Nsangi et al. (2020)
2	Perry (2020)
3	Semakula et al. (2019)
4	Green et al. (2019)
5	Giang et al. (2019)
6	Kukkonen & Cooper (2017)
7	Tahir & Wang (2017)
8	Newell et al. (2016)
9	Sylaiou et al. (2016)
10	Polman & Gebre (2015)
11	Vervoort et al. (2014)
12	Wirth et al. (2014)
13	Lafrenière (2012)
14	Wernbacher et al. (2011)
15	Hainey et al. (2011)
16	Giannakos (2010)
17	Piercy & Benson (2005)
18	Trigano & Pacurar-Giacomini (2004)

Figure 1. Legend with author reference

The different guidelines for quality science communication have been divided into three main categories, namely: normative, substantive criteria, and performative criteria. The full framework can be consulted in a more readable size in the Appendix section of this report p.16. A more detailed explanation of the criteria will be available in a forthcoming publication of the systematic review in 2022.

2.1 NORMATIVE CRITERIA

The framework is intended as a guide for the curation of ‘science’ stories. This means that the science behind the science story is a crucial part in the design process. The normative criteria are a good guide to assess scientific soundness, data representation and safeguarding ethical dimensions concerning research integrity (See Figure 2).

Methodological (13)/ Research methods (4)	Relevance (5) (10), purpose and message (10)	Rationale (10)
		Meaning (10) and value (17)
		Appropriatness (10) (13)/ feasibility
	Scientific soundness of data (re) presentation (10) (12) / curation	Context (10) (14) (17)
		Scale/magnitude (3) (10)
		Rigour (1) (3) (10) (12) (13) (17)
		Completeness and suffiency (10) (17)
		Clarity (8) (10) (11) (13)
		Accuracy (10)
		Scientific control (4)
		Transparency (3) (4) (5) (11) (13) (17)
		Background researcher / positionality (4) (17)
		Scientificness data (12)
		Primary sources (12)
		Lived experience (4) (12)
		Trustworthiness (17), reliablity (13) and robustness (1) (12)
Ethical dimension (13)	anonymity (13)	
	assessment (13)	
	integrity (13) (17)	
	authorship and contributon (13)	
	harms and benefits (13)	
	voices of represented (4)	
	sensitivity (17)	
	accountability (17)	
	respectful (17)	

Figure 2. Normative criteria

Not all science story intermediaries have a background in science. In practice, the design of a science story is often made by different people with different expertise and data analysts. Researchers usually combine their forces with curators, developers, and artists. It is therefore possible that in the design process of a participatory science story, different experts will use different parts of this evaluation framework. It is not necessarily a problem if an expert only uses the part in which he or she has expertise of. However, it is important that the other parts of the framework are also represented and used to design and curate a proper science story. This wholeness of the framework should thus be safeguarded in the overall design process.

2.2 SUBSTANTIVE CRITERIA

The substantive criteria support the design of both the science story and the tools for curation (See Figure 3). Some criteria were generated from articles oriented towards the Arts-Based Research (ABR) tradition and others from the Human Computer Interaction (HCI) field. While most articles contained criteria with a strong pedagogical and educational focus, others were more focused on criteria concerning engagement and interactivity, impact, or artistic translation. This umbrella of diverse topics, orientations and expertise has led to the identification of a variety of criteria which we structure under the following categories: cultural selection, designed outcome(s) of the science story and the interaction with science stories via curation tools.

Curational Selection	Reach / resonance (4)	
	Display order and organization (10)	Organization of information (10) (11) (18)
		Critical (4)
		Intentional (10)
	Evidence (4)	Ethical selection (4)
		Scientific dimensions (4)
		Display Process (4)
	Modes of meaning (2)	Visual (2) (18)
		Textual / linguistic (2) (10) (18)
		Gestural / kinetic / embodied / haptic (2)
		Sound/audio (2) (18)
		Technical/digital (2)
		Interdependency (18)
	Theoretical engagement (4)	

Designed outcome(s) of the Science Story (4)	Appropriate form (4) (12)	
	Cohesiveness (4) / allignment (10)	
	Space (4) (10)	accessibility (4)
		virtual spatiality (9)
		effectiveness (10)
	Iterative revisions (4) and reflection	outcomes (4)
		original concept (4)
		internal reflection (4)
	Retrievability (4) (8)	
	Aesthetic merit (8) (17)	attractiveness (8)
		aesthetic standards (17)
		data and art spectrum (8)
	Vividness (8)	
	Message translation (10)	
	Complexity translation (8) (11)	Feedback loop (11)
		uncertainty (11)
		nonlinearity (11)
		path-dependency (11)
		openness / multiple perspectives (11) (17)
		scale dynamics (8) (11)
	Facilitating understanding (10)	Good examples (12)
		Avoidance of distractions (8)
		Clarity and Readability (8) (10) (11) (12)
		understandability (1) (3) (8) (10)
		Effectiveness communication (8) (12) and display (10)

Interaction with Science Stories via Tools	Personalisation (18)	local knowledge (12)
		local identity (12)
		elicit emotions (12)
		existing norms and values (12)
		everyday life (12)
		audience preferences (10) (12) (15)
		audience perspectives (10)
	Story support	design mechanisms (7)
		narration (9) (18)
		Visualizations (10) (12)
	level of automation (5)	
	Imageability (9)	perceptual quality (9) (10)
	attractiveness (12), motivation (7) (12) (14) (15)	desirability (1) (3)
		aesthetics (5)
		enjoyment (5) (7)
	Interactivity (5) (8) (9)	audience engagement (7) (9) (11) / involvement (17)
		communication and collaboration (5) (8) (9)
	playability (7) (14)	immersion (7)
		fun of play (14)
	technical quallity / realisation	sound (14)
		graphics (14)
		controls (14)
		feasiibility (3)
		self-reliant (3)
		navigability / structural elements (9) (18)
	Usefulness of tool (1) (3)	practical value (1)
		effectiveness and efficiency (16)
	identificiation with tool (1) (3)	familiarity (1) (3)
		appropriatness (3)
	user-friendly tool (1) (3) (7) and usability (14) (15) (16) (18)	easy and satisfying (1) (16)
		consistency interface (16) (18)
		guidance, efficient support and manuals (7) (16) (18)
		user manipulation (18) / proactvity (16)
		Adaptability / flexibility (3) (5) (18)
		clear error messages (16)
		exit (16)
		avoid unnecessary elements (11) (16)
		comfort of physical setup (5)
		shortcuts (16)
		minimalize cognitive workload (5) (16) (18)
		level of difficulty / situation (5) (14) (15) (18)
		comprehensive language (3) (16)
		intuitive design (11)

Figure 3. Substantive criteria

2.3 PERFORMATIVE CRITERIA

The performative criteria look at the impact of the science story. These can be divided into effect and affect indicators (See Figure 4). These criteria require a follow-up during the presentation of the design to measure the impact and the result of the curation.

Performative criteria (13) Impact of the Science Story	Affect indicators	attitudes towards design / tools (15)	
		attitudes towards taught subject (15)	reflection (3) (5) (17)
		emotions (13) / feeling (1) (18)	reassuring - disconcerting (18)
			innovating - traditional (18)
			playful - serious (18)
			active - passive (18)
			simple - complex (18)
	Effect (12) indicators	reach (6)	
		partnership and collaboration (6) (15)	
		Change (13)	Commitments (6)
			Constructive action (17)
			Policy and advocacy (6)
		Usefulness (6)	Understanding (10) (13) (17)
			Knowledge (6)
			Social phenomenon (17)
		awareness (6)	
		accessibility (6) (11) (13)	
		response (13) / debate and dialogue (6)	
		engagement (6) / involvement (17) / fascination (10) / interest (14)	
		New knowledge (4)	the field (4)
			concept (4)

Figure 4. Performative criteria

3 FUTURE STEPS: FINETUNING THE FRAMEWORK

To further adjust the framework, we will organize face validity checks in the form of workshops. Not only do these workshops bring in new insights and expertise from practitioners and academics, but they will also be a way of valorizing the framework. One of these face validity checks is planned on the ParCos consortium meeting in November 2021. The framework will also be applied to case studies in the ParCos project for feedback.

There are also several educational activities planned wherein the framework will be used and checked. A group of bachelor students (KU Leuven) will use a part of the framework in their research on science communication and mediatization in the course ‘kwalitatief seminarie 1’ (B-KUL-S0E44A). There will also be a co-design workshop on visual literacy with a group of students of the postgraduate cultural curatorship (University of Antwerp) and the students will use the framework to translate their co-design insights into a science story.

For the future envisioned iterations and revisions, several steps will be taken to finetune, adjust and expand the framework and develop a user guide.

1. *Accessible language and coherent terminology*
    - The current framework is embedded in academic speech. It will be a challenge to translate it in an *accessible* manner for a broader audience of science storytellers without losing the nuance and complexity of the terminology
    - We will further combine and define the different categories and labels to create a more *coherent* and logical terminology throughout the framework. The vocabulary within HCI is very different from ABR, for example. While ABR articles refer to an audience and visitors, HCI will refer to users.
2. *Translate theory into practice*
    - Our framework has some guiding questions to help the science storytelling to translate the theoretical criteria into practice. We will also add some *working examples* as an additional support.
    - In some cases, we will add *visual materials* to the user guide as an additional support to visualize terminology and concepts.
3. *Review and restructure the criteria*
    - In the next phase of our framework development, we will look for *additional*, *supplementary* criteria to enrich the framework. Especially artistic oriented knowledge is underrepresented in the review generated articles. This might be due our focus on ‘scientific’ storytelling. There is also a need for nuancing and expanding

the performative criteria section of the framework. We will also simplify criteria by merging them or leaving them out if they can be substantiated from a particular perspective.

- We will ask experts in the field (such as VRT, KWMC) for recommendations and suggestions in both literature and *practice*. Our current framework is based on publications and could benefit from analyzing other dissemination forms. Including other dissemination forms could be a way to cope with the underrepresentation of more artistic oriented knowledge.
- Furthermore, we will include the insights from a co-creation workshop with different museum professionals.

The adjusted and enriched framework that results from these workshops will be integrated in the Training Packages of WP4.

4 REFERENCES

Giang, C., Piatti, A., & Mondada, F. (2019). Heuristics for the development and evaluation of educational robotics systems. IEEE Transactions on Education, 62(4), pp. 278-287.

Giannakos, M.N. (2010). The Evaluation of an e-Learning Web-based Platform. *Proceedings of the 2nd International Conference on Computer Supported Education*, pp.433-438.

Green, D.N., Du Puis, J.L., Xepoleas, L.M., Hesselbein, C., Greder, K., Pietsch, V., Getman, R.R., & Guadalupe Estrada, J. (2019). Fashion exhibitions as scholarship. Evaluation criteria for peer review. *Clothing and Textiles Research Journa*l, 39(1), pp. 71-86.

Glover, J., Izzo, D., Odato, K., & Wang, L. (2006). *EBM pyramid and EBM page generato*r. Trustees of Dartmouth College and Yale University.

Hainey, T., Connolly, T., & Boyle, L. (2011). A refined evaluation framework for games-based learning. *Proceedings of the 4th European Conference on Games Based Learning*, pp. 97-105.

Korzybski, A. (1933). *Science and sanity. An introduction to non-Aristotelian systems and general semantics*. International Non-Aristotelian Library Publishing Company.

Kukkonen, T., & Cooper, A. (2017). An arts-based knowledge translation (ABTK) planning framework for researchers. *Evidence & Policy*, 15(2), pp. 293-311.

Lafrenière, D. (2012). If you can call it a poem. Toward a framework for the assessment of arts-based works. *Qualitative Research*, 13(3), pp. 318-336.

Newell, R., Dale, A., & Winters, C. (2016). A picture is worth a thousand data points. Exploring visualizations as tools for connecting the public to climate change research. *Cogent Social Sciences*, 2(1), pp. 1-22.

Nsangi, A., Semakula, D., Rosenbaum, S. E., Oxman, A. D., Oxman, M., Morelli, A., Austvoll-Dahlgren, A., Kaseje, M., Mugisha, M., Uwitonze, A.-M., Glenton, C., Lewin, S., Fretheim, A., & Sewankambo, N. K. (2020). Development of the informed health choices resources in four countries to teach primary school children to assess claims about treatment effects. A qualitative study employing a user-centered approach. *Pilot and Feasibility Studies*, 6(18), pp. 1-15.

Perry, M.S. (2020). Multimodal engagement through a transmedia storytelling project for undergraduate students. *GEMA Online® Journal of Language Studies,* 20(3), pp. 19-40.

Piercy, F.P., & Benson, K. (2005). Aesthetic forms of data representation in qualitative family therapy research. *Journal of Marital and Family Therapy*, 31(1), pp. 107-119.

Polman, J.L., & Gebre, E.H. (2015). Towards critical appraisal of infographics as scientific inscriptions. *Journal of Research in Science Teaching*, 52(6), pp. 868-893.

Semakula, D., Nsangi, A., Oxman, M., Rosenbaum, S.E., Oxman, A.D., Austvoll-Dahlgren, A., Glenton, C., Lewin, S., Kaseje, M., Morelli, A., Fretheim, A., & Sewankambo, N.K. (2019). Development of mass media resources to improve the ability of parents of primary school children in Uganda to assess the trustworthiness of claims about the effects of treatments. A human-centred design approach. *Pilot and Feasibility Studies*, 5(155), pp. 1-17.

Sylaiou, S., Mania, K., Paliokas, I., Pujol-Tost, L., Killintzis, V., & Liarokapis, F. (2016). Exploring the educational impact of diverse technologies in online virtual museums. *International Journal of Arts and Technology*, 10(1), pp. 54-84.

Tahir, R., & Wang, A.I. (2017). State of the art in Game Based Learning. Dimensions for

Evaluating Educational Games. *11th European Conference on Game Based Learning*, pp. 641-650.

Trigano, P. C., & Pacurar-Giacomini, E. (2004). Toward a web-based environment for evaluation and design of pedagogical hypermedia, *Educational Technology & Society*, 7 (3), pp. 21-37.

Van Even, P., Zaman, B., Hannes, K. (2020). Protocol for a systematic review on evaluation criteria for creative and interactive dissemination practices. *Deliverable 3.2. report of the Horizon 2020 project ParCos, EC grant agreement no 872500*, Lappeenranta, Finland

Vervoort, J. M., Keuskamp, D.H., Kok, K., van Lammeren, R., Stolk, T., Veldkamp, T.A., Rekveld, J., Schelfhout, R., Teklenburg, B., Cavalheiro Borges, A., Jánoškóva, S., Wits, W., Assmann, N., Abdi Dezfouli, E., Cunningham, K., Nordeman, B., & Rowlands, H. (2014). A sense of change. Media designers and artists communicating about complexity in social-ecological systems. *Ecology and Society*, 19 (3).

Wernbacher, T., Wagner, M., Rusch, D., & Hofsstaetter, J. (2011). Learn by playing. *Proceedings of the Vienna Games Conference*, pp. 775-777.

Wirth, V., Prutsch, A., & Grothmann, T. (2014). Communicating climate change adaptation state of the art and lessons learned from ten OECD Countries. *GAIA*, 23(1), pp. 30-39.

5 APPENDIX

Evaluation Framework				
Normative criteria (13) Data and Scientificness of the Science Story	Methodological (13)/ Research methods (4)	Relevance (5) (10), purpose and message (10)	Rationale (10)	What is the rationale behind it?
			Meaning (10) and value (17)	Is it meaningful for society? For science?
				Does it touches upon important, relevant issues? Is the **research worth doing**?
				Does the science story point to a better world?
			Appropriatness (10) (13)/ feasibility	Is it appropriate in the context? Is it appropriate in the setting? Is it feasible?
		Scientific soundness of data (re) presentation (10) (12) / curation	Context (10) (14) (17)	Is there sufficient context provided to understand it?
			Scale/magnitude (3) (10)	If the research presented in a balanced way? Is the information in proportion?
				Is the research represented in a holistic manner? Is it pluralistic? (e.g. to avoid lying with statistics)
			Rigour (1) (3) (10) (12) (13) (17)	Are the used sources credible? (**credibility**) (1) (3) (10)
				Is tthe research transferable? (**transferability**) (3)
				Is the research replicable? (**replicability**) (3)
			Completeness and suffiency (10) (17)	Was sufficient data collected and analyzed?
				Is cherry picking avoided?
			Clarity (8) (10) (11) (13)	Is the used data clear and understandable?
			Accuracy (10)	Is the used data accurately depicted?
			Scientific control (4)	Is the used data peer reviewed, member checked, triangulated or based on thick description?
			Transparency (3) (4) (5) (11) (13) (17)	Is the research process transparant? Do you know how it was researched?
				Do people have access to the data?
				Do you know how it was funded and who the partners were?
				Can the audience retrieve the used sources? (**retrievabilitty**)
			Background researcher / positionality (4) (17)	Does the researcher locate him/herself in the work? Are opinions transparant?
			Scientificness data (12)	Is the used data scientifically sound?
			Primary sources (12)	Does the used data derive from correct, primary sources?
			Lived experience (4) (12)	Is the lived experience of those who are presented represented? Is the story grounded in the data?
			Trustworthiness (17), reliablity (13) and robustness (1) (12)	Are the accepted opnions and views trustworthy?
				Is the used data reliable?
				Were the procedures trustworthy?
	Ethical dimension (13)	anonymity (13)		Are those that are represented anonymous? If not, do they want to be visibly represented?
		assessment (13)		Is the representation of the science story assesed before - during and after?
		integrity (13) (17)		Is the research conducted according to the principles of integrity?
		authorship and contributon (13)		Do the authors and contributors get proper acknowledgement?
		harms and benefits (13)		Does the science story bring benefits to society or does it bring harm?
		voices of represented (4)		Are there people represented? Are their voices included?
		sensitivity (17)		Is the science story approached in a sensitive manner?
		accountability (17)		Do the science storytellers take accountability for the impact they want to make?
		respectful (17)		Is the science story respectful?

Substantive criteria (13) Design and Curation of the Science Story Data Translation and (Re)presentation	Curational Selection	Reach / resonance (4)		Does it resonate with a broad audience?
		Display order and organization (10)	Organization of information (10) (11) (18)	How is the information structured, grouped or organized? Is the information structured in a way that it leads to the purpose? To interactivity?
				Does it convey the right amount of information?
			Critical (4)	Is the displayed order critically constructed?
			Intentional (10)	Is the displayed order intentionally ordered by choice? Is it logically ordered?
		Evidence (4)	Ethical selection (4)	Is there evidence of an ethical selection present?
			Scientific dimensions (4)	Does the design presents the different dimensions of science?
			Display Process (4)	Is there an explanation on the display process? Is the relation between the different elements explained?
		Modes of meaning (2)	Visual (2) (18)	didactical pictures, photography, drawing, animation
				colour, images
			Textual / linguistic (2) (10) (18)	writing , speech, dialogue
				redaction, typography, page design
			Gestural / kinetic / embodied / haptic (2)	body language, physicality
			Sound/audio (2) (18)	voice, tone, sound effectt
				speech, music, sound effects
			Technical/digital (2)	camera angle, distance, brightness,...
			Interdependency (18)	choices, competition, complementarity, redundancy, supplementary
		Theoretical engagement (4)		Is a theoretical foundation (named or unnamed) within, or produced by, the story or display?
				How has theory been applied and implemented?
				Alternatively, how has new theory emerged from the research process and critical curatorial practice?
Substantive criteria (13)	Designed outcome(s) of the Science Story (4)	Appropriate form (4) (12)		Is the format, form or channel appropriate to convey the information?
		Cohesiveness (4) / allignment (10)		Is the information well-integrated in the design? Is there cohesiveness from a conceptual perspective?
				Is there correspondance or allignment across the various parts?
		Space (4) (10)	accessibility (4)	Is the exhibition accessible for individuals with disabilities?
				It it accessibie for those who cannot physically travel to it?
			virtual spatiality (9)	Is there an (virtual) extension to the physical curation space?
			effectiveness (10)	Is the space effectively used? (utilization)
		Iterative revisions (4) and reflection	outcomes (4)	Are there outcomes from the iterative process from which others can gain knowledge?
			original concept (4)	Where did the original concept begin, and where is it now? Is the original concept still linked to the outcome?
			internal reflection (4)	How was the curation critiqued and revised internally throughout the process?
				Was there an openess for revision and critique in the process?
		Retrievability (4) (8)		Will the designed outcome be retrievable in some form after the physical closure? How?
		Aesthetic merit (8) (17)	attractiveness (8)	is the curation of the science story attractive?
			aesthetic standards (17)	Does it meet the standards of good art, writing or drama?
			data and art spectrum (8)	Is the spectrum between data representation and artistic freedom in balance?
		Vividness (8)		IS the designed outcome vivid?
		Message translation (10)		Is the intended message clear? Were choices made intentionally?
		Complexity translation (8) (11)	Feedback loop (11)	Does the design grasp complexity by showing a feedback loop? Does it show the interconnectedness of things?
			uncertainty (11)	Does the design succeed in bringing in an element of uncertainty? Does it show that science works (based on plausibility and falsification)?
			nonlinearity (11)	Does the design succeed in avoiding a nonlineair representation? Does it succeed in assembling different elements into a whole?
			path-dependency (11)	Is the path-dependence transparant (positionality) in the design?
			openness / multiple perspectives (11) (17)	Is there an openness for multiple interpretations or perspectives? is there interpretative flexibility?
			scale dynamics (8) (11)	Is the representation dynamic or static? Des it capture dynamics and fluidity?
		Facilitating understanding (10)	Good examples (12)	Does the story relate to good examples? Does the design translation contains a good example?
			Avoidance of distractions (8)	Are there elements that distract people instead of support them?
			Clarity and Readability (8) (10) (11) (12)	Are concepts clear/explained? Are they **comprehensible**?
				Is the terminology understandable? Was there reflected upon **language and labels**?
			understandability (1) (3) (8) (10)	Can the audience recognize what it is?
				Can the audience understand the content?
				Is the text readible?
			Effectiveness communication (8) (12)	Is the lay-out effective?
			and display (10)	Is there an effective display of data in a clear way? Is there a capacity fo retrieving insights on data?

Substantive criteria (13)	Interaction with Science Stories via Tools	Personalisation (18)	local knowledge (12)	Does it connect to local knowledge?
			local identity (12)	Does it connect to local identity?
			elicit emotions (12)	Does it elicit emotions?
			existing norms and values (12)	Does it relate to existing social normS and valueS?
			everyday life (12)	Does it translate to everyday life?
			audience preferences (10) (12) (15)	Is it framed according to the (targeted) audience?
			audience perspectives (10)	Does it include the perspectives of the audience?
		Story support	design mechanisms (7)	Do the design mechanisms of the tool support the storytelling?
			narration (9) (18)	Is the narrative engaging?
			Visualizations (10) (12)	Do you use pictures and visualizations to support the information?
		level of automation (5)		Is the tool properly automated according to the needs of the users?
		Imageability (9)	perceptual quality (9) (10)	Is the perceptual quality good?
		attractiveness (12), motivation (7) (12) (14) (15)	desirability (1) (3)	Does it attract and keep the attention of the audience? Do you use stories? Is there something novel? Is there an element of surprise? Does it lead to an emotional response?
			aesthetics (5)	Is the tool aesthetically appealing?
			enjoyment (5) (7)	Will people enjoy their experience on the tool?
		Interactivity (5) (8) (9)	audience engagement (7) (9) (11) / involvement (17)	Is it powerful enough to engage audience? Is the audience involved?
			communication and collaboration (5) (8) (9)	Does the tool stimulate interaction between visitors/participants? Does the tool encourage communication between its users? Is there an element of interpersonal interactivity?
		playability (7) (14)	immersion (7)	Does it bring an immersive experience?
			fun of play (14)	Is it fun to use?
		technical quallity / realisation	sound (14)	Is the sound quality good?
			graphics (14)	Are the graphics of good quality?
			controls (14)	Are the controls working well?
			feasiibility (3)	Is the prototype feasible? Is it affordable?
			self-reliant (3)	Can the prototype be used without constant assistance?
			navigability / structural elements (9) (18)	Is it easy to navigate? Are the elements well structuredl?
		Usefulness of tool (1) (3)	practical value (1)	Is the tool practical designed?
			effectiveness and efficiency (16)	Is there a follow-up on the effectiveness and efficiency of the design based on the audience / user experiences
		identificiation with tool (1) (3)	familiarity (1) (3)	Does the design or tool give the user the feeling of something familiar or foreign? Can they relate?
			appropriatness (3)	Is the terminology appropriate? Are the examples of claims, stories and music genres appropriate for the target audience? Is it appropriate in the context?
		user-friendly tool (1) (3) (7) and usability (14) (15) (16) (18)	easy and satisfying (1) (16)	Is it easy to use? Does it meet the needs of the user?
			consistency interface (16) (18)	Is there consistency throughout the interface?
			guidance, efficient support and manuals (7) (16) (18)	Is there efficient help for the user? Is there a manual? Is there support for the user?
			user manipulation (18) / proactvity (16)	Can the user make decisions? Does the tool have options?
			Adaptability / flexibility (3) (5) (18)	Is the tool adapted to the need of the users? Is there a level of flexibility?
			clear error messages (16)	Are the error messages clear?
			exit (16)	Is there an easy and clear way to exit/escape the tool?
			avoid unnecessary elements (11) (16)	Is the tool minimalistic? Do all elements have a function? Are there distractive elements? Are all elements supportive? Does it convey the right amount of information?
			comfort of physical setup (5)	Is the tool comfortable in use? Can the tool be used in a comfortable manner?
			shortcuts (16)	Are there shortcuts?
			minimalize cognitive workload (5) (16) (18)	Are the not related learning activities minimalized?
			level of difficulty / situation (5) (14) (15) (18)	Is the tool adjusted to the learning environment / situation?
			comprehensive language (3) (16)	Are the instructions of the tool easy to understand?
			intuitive design (11)	Is the design intuitive? Can the user easily work with it without an explanation?

	Affect indicators	attitudes towards design / tools (15)		How did people react to the design? How dit they react to the tools? How were they affected by them?
		attitudes towards taught subject (15)	reflection (3) (5) (17)	Does the design support reflection? Does the science story support reflection?
		emotions (13) / feeling (1) (18)	reassuring - disconcerting (18)	
			innovating - traditional (18)	
			playful - serious (18)	
			active - passive (18)	
			simple - complex (18)	
Performative criteria (13)	Effect (12) indicators	reach (6)		How many people were included? How many people did it reach? How many stakeholders were involved?
		partnership and collaboration (6) (15)		Is there a co-production and dissemination with different partner and / or target audiences?
Impact of the Science Story		Change (13)	Commitments (6)	Does it practice, programme or service change? Do you measure the commitment to change, proces measures and outcome measures where possible?
			Constructive action (17)	Does it lead to constructive action?
			Policy and advocacy (6)	Do these measures influence and bring changes in policy debate, formation and implementation?
		Usefulness (6)	Understanding (10) (13) (17)	Does the audience understand the content, purpose or message?
			Knowledge (6)	Was the audience satisfied? Did they gain knowledge? Do they intend to use it? Do they adapt information?
			Social phenomenon (17)	Did the audience understood the social phenomena?
		awareness (6)		Does the experience lead to critical thinking? Does it lead to awareness and consciousness?
		accessibility (6) (11) (13)		Was the story accessible? Was the space accessibile? Was the tool or design accessible?
		response (13) / debate and dialogue (6)		Did it lead to debate and / or dialogue? Is a rresponse possible?
		engagement (6) / involvement (17) / fascination (10) / interest (14)		Was the interest of the audience maintained? Was the audience captivated or fascinated?
				Was the audience engaged?
		New knowledge (4)	the field (4)	Does the curation contribute new knowledge to the scientific or artistic field?
			concept (4)	Is the concept of the design novel, innovative, or unprecedented? Is the concept of the curation or science story novel, innovative or unprecedented?