FEDORA

Deliverable 2.5

Framework for aligning science education with society: the search for new languages and narratives to enhance imagination and the capacity to talk about contemporary challenges

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Quality assurance

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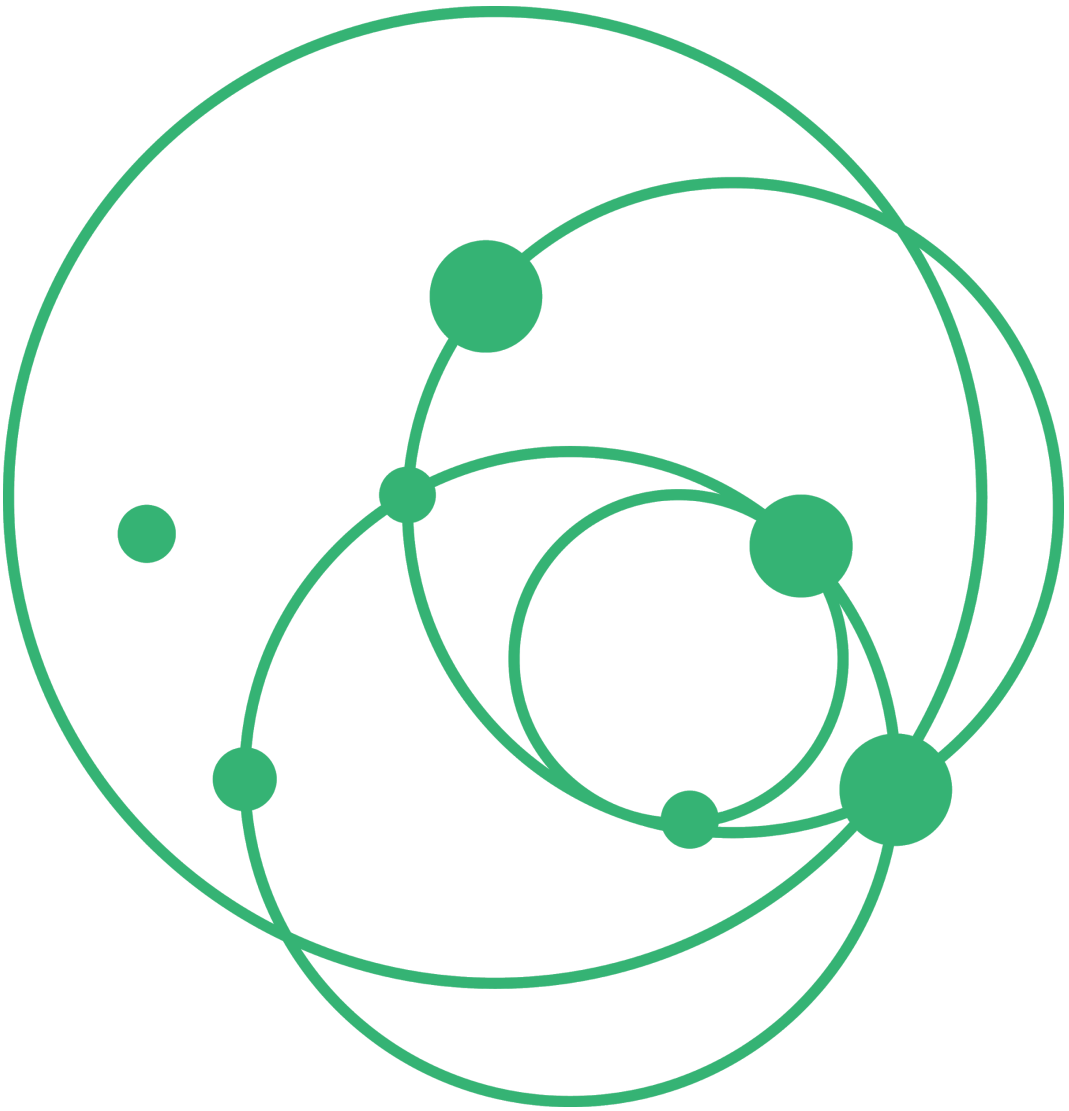

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Summary

Deliverable 2.5 “Framework for aligning science education with society: the search for new languages and narratives to enhance imagination and the capacity to talk about contemporary challenges” presents the results of the reflections, scoping actions, and dialogues fostered and executed by Work Package 2 (WP2).

It builds upon the workshops, consultations and desk research looking out for new languages that contribute to stimulating futures thinking in science education. This process is represented in the Framework for Unbound Languages, which represents a roadmap and a guide for the creation of new languages. The new languages suggested by WP2 want to convey actions to be deployed in different spaces, times, disciplines and contexts. Therefore, we named these languages as:

1. Languages for adaptation
2. Languages for foraging futures
3. Languages for uncharted territories
4. Languages for interdependencies

Together with the framework, a structure based on a card is proposed to showcase different activities to be tested by the Open Schooling Networks. In the last section, a set of recommendations for policymakers is presented, that can help foster a zeitgeist familiar with experimentation and freedom to try transdisciplinary ways in science education.

Because this document is about new languages, it includes pictures and illustrations that complement the messages communicated by the texts.

This document is the fifth deliverable of Work Package 2, “Exploring new languages, narratives and arts in science education - Analysis of Blindspot 2”, led by formicablu.

1. Introduction

"The universe is made of stories, not of atoms"
- Muriel Rukeyser

FEDORA's challenges are those of investigating, through research and co-creation, three blind spots in formal and informal science education. FEDORA's WP2 works on blind spot 2, exploring and co-creating ideas and strategies to adopt new languages and formats in science education. This work is not solely inspired by the realm of science but by breeding scientific knowledge with literary, artistic, narrative, and visual approaches.

There is a recognised need for new languages and formats to enhance imagination and the capacity to talk about those contemporary challenges and find ways to describe them, define them, and face them with creative solutions. The call for societal transformations made by the United Nations' Agenda 2030 cannot be achieved without transgenerational thinking, responsibility and transformative agency of the young (Unesco, 2017).

The most proficient way to discuss, define and collect insights, inspirations and ideas on how to foster these new creative approaches in science education is involving creators, artists, experts from different disciplines and fields in co-creation sessions inspired by the design-derived methodologies. This is what WP2 organised and this deliverable presents the results of this process.

The Framework for Unbound Languages illustrates the sessions carried out, and some key concepts that were considered when conceiving the four new language groups to better understand and better tune in with the requirements of contemporary societies. FEDORA has taken the interpretation of Hartmut Rosa and his society of acceleration to guide its work. Based on this, ambiguity, complexity and uncertainty are permanent states and perceptions of reality that need to be addressed in a way that gives a sense of agency and influence not only for students but also for teachers and the array of professionals and workers of society. Futures don't yet exist but they are yet to become, and we adopt this expression to signal that the framework is unbound, meaning free, flexible, unconventional, experimental and open to several interpretations. It has been informed by the above-mentioned sessions but also by several readings, including essays, research, novels and poetry, videos, music and visual arts.

We consider the role of researchers working in this present time to try new ways, move boundaries, use new languages, and inhabit the boundaries with the explicit intention of paving the way for the further development of the plausible and desired futures we are aiming for.

2. Overview of WP2 objectives and tasks

FEDORA WP2 addressed the following objectives:

- To analyse new languages and forms of knowledge transmission that will be useful to enhance imagination and the capacity to talk about the contemporary challenges, to equip teachers, teacher trainers and their students with linguistic, argumentative and imaginative thinking skills needed to face current challenges;
- To experiment with innovative communication approaches to future science education, giving the youth a chance to perceive, imagine and ultimately envisage and thus shape the future.

More specifically, these objectives were better defined as:

- detect, sample and analyse examples of contamination and cross the intersection of narratives about science and on science that use different epistemic approaches as well as a variety of languages, storytelling formats, registers and tools from the arts, music, photography, cinema and TV shows, graphic and written novels, fantasy and science fiction, design, theatre and so on;
- promote a common understanding of these alternatives, innovative, artistic and non-traditional languages and narratives within the consortium;
- foster and organise workshops to promote a lively and productive interchange among a range of professionals who inhabit these artistic and communicative territories;
- draft a series of raw prototypes to be used in innovative informal and formal science communication contests, such as the educational ones

One of the key tasks of WP2 was the organisation of two creative workshops involving an array of experts, creators, professionals, trainers and students to co-create the development of recommendations for education professionals and policymakers. Furthermore, WP2 led the prototyping of ideas to foster inter and transdisciplinarity. These ideas should help young people to develop argumentative and epistemic arguments to deal with the complexity and acceleration characterising the present times. They should also empower them to develop strategies and take action on their future, either as individuals or as members of a community.

3. The need and quest for new languages

"The limits of my language mean the limits of my world."
- Ludwig Wittgenstein

What is a language? A language is a system of conventional spoken, manual (signed), or written symbols by means of which human beings, as members of a social group and participants in its culture, express themselves. The functions of language include communication, the expression of identity, play, imaginative expression, and emotional release[1].

And what is a new language? This was the marrow of the question that searched for answers during the workshops organised as part of WP2:

- Internal workshops
- Consortium study groups
- Benchmark analysis
- Creative Workshop I and II

(See Deliverable 2.1, Benchmarking, Deliverable 2.3 Multimedia report of I Creative Workshop and Deliverable 2.4 Multimedia report of II Creative Workshop).

Innovation in language and format is a very broad concept, it can be sometimes too vague and a bit of a buzzword. Condensing results, suggestions and insights, WP2 has come to identify two major concepts to be used in future project developments:

1. Concept-challenge n° 1 - Triggering an epistemic emotion
2. Concept-challenge n° 2 - Going beyond dichotomous thinking

These two main core concepts can also be used as research lenses to be embedded in the local network of open schooling activities and in the design and implementation of materials and tools to be produced within each context. There are also two corollaries that result from cross-analysing the definitions of innovation, the demands in terms of how to bring innovative languages and formats into the development of new school programmes and the difficulties encountered by teachers when reflecting on their ability to read the needs of students and to respond with appropriate means:

1. Corollary n° 1: Visual culture is stronger
2. Corollary n° 2: European societies are profoundly changing.

[1] Encyclopaedia Britannica

We consider the two challenges and their corollaries can integrate the design and definition of guidelines for the policy and institutional actors to be reached and involved through FEDORA and beyond.

- **Concept-challenge n° 1 - Triggering epistemic emotions**[2]

The use of any artistic expression and language can be of very high value when it not only ignites emotions but manages to go beyond. We need to look at those artistic/creative formats and languages that can foster dialogue, analysis, openness, ability to talk/discuss/share. It's crucial to elicit the epistemic emotions that can contribute to developing, improving, and enhancing critical thinking. That's why it is so important to listen rather than talk and to develop a discourse with the students and not to the students, welcoming their inputs rather than leveraging on prior knowledge and authority.

- **Concept-challenge n° 2 - Going beyond dichotomous thinking**

Taking down the walls: need to crossover, to find common areas for sharing knowledge, to go over a binary vision of the world. Young people have much more nuanced identities and their fears, emotions, and thoughts reflect that. We should foster the ability to work on complexity and uncertainty, and nurture emergent systems rather than individual stories. We need to get over the transmissive and normative temptation, often masked by simple and reductive storytelling. We should foster bold grassroots ideas and projects and accompany and support youths, not lead them. In other words, we aim at overcoming dichotomies, crossing over the polarisation of the language to go over the binary vision of the world and embed in the language the complexity and the uncertainty of the world.

About the two corollaries that need to be taken into account:

1. Visual culture is stronger in teenagers. Using arts, images, video and digital formats will make students at home (in general) much more than having them write and read. Also, these formats tend to be native cooperative ways of expression more than individual writing/reading. This also refers to one of the main recommendations coming from storytelling: *show, don't tell.*

2. European societies are profoundly changing. Students are not (only) coming from one national culture anymore. There are second and third generations. There are students who are bilingual or more. And we are still very attached to our colonial past and national culture even in our education. There is a strong need to work and reflect on how to make students feel they are all part of the same community in dealing with uncertainty and future challenges.

[2] To read more about epistemic emotions, refer to the following paper: Epistemic Emotions and Epistemic Cognition Predict Critical Thinking About Socio-Scientific Issues: https://doi.org/10.3389/feduc.2021.669908

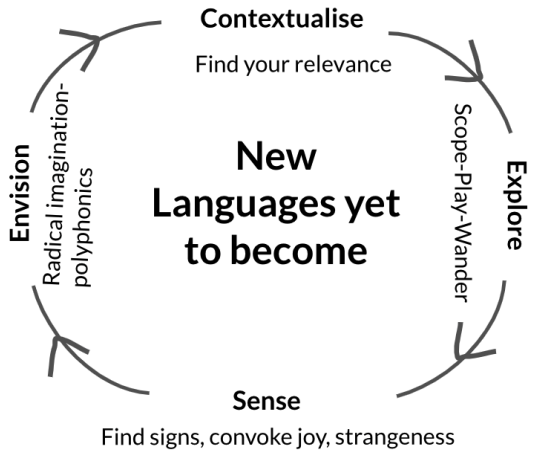
So, what is a new language?

Considering this journey and its several stages, we frame - intentionally not defining nor bounding - a new language as a combination of symbols - visual, written, spoken, enacted - that work as a means of transport for communicating a message to a social group that will receive it, understand it or will be stimulated by it.

New languages will combine, mix, experiment, consider silence as part of the process, invite mistakes as part of the learning, and acknowledge non-traditional ways of communicating. New languages are aware of colonising processes and therefore, intend to reveal them and undo them. New languages enable people to unveil boundaries and to move along them or inhabit them. New languages make use of the myriad of expressions human beings have created and can create, therefore, it nurtures art in all its forms, from science in all its disciplines, from daily life, from unexpected ideas, playfulness and imagination. New languages explicitly invite emotions as a system of symbols and recognise their role in challenging predominant systems of values.

New languages want to be the ink of the present to write the futures coming.

How to build unbound new Languages



Levers for new languages and format

Foster immersive experiences. To use multiple languages as a key to accomplishing complexity. Theatre, dramatisation arts, and music could be helpful to understand complex issues such as global health, climate crisis, and the impact of technology on society. To teach complexity, introduce several actors with different roles and points of view and stimulate engagement through play.

Align with relevance: To bridge the gap between formal and informal education and the critical issues of everyday life. Tackling themes and problems that students care about. Allow the outside world into the school, invite external experts and use sources coming from what is happening in our time.

Making use of traditional and digital tools. It is important to bridge the gap between teachers and students. To sustain the importance of sociability and relationships in building knowledge it is crucial to innovate language in school contexts. **The human mind is social.**

Going beyond frontal teaching. Planning lessons starting from the end-user (the students). Promoting peer-to-peer exchanges among students. Getting students to work in inverted classes (students study a subject and then teach it to their peers).

Inclusive programmes. Enhance teachers' ability to adopt collaborative and co-constructive strategies, taking into account capacity and differences among students to discover the richness of diversity.

When overlapping the other pillars of FEDORA with New Languages, what came out in a resumed way is the following:

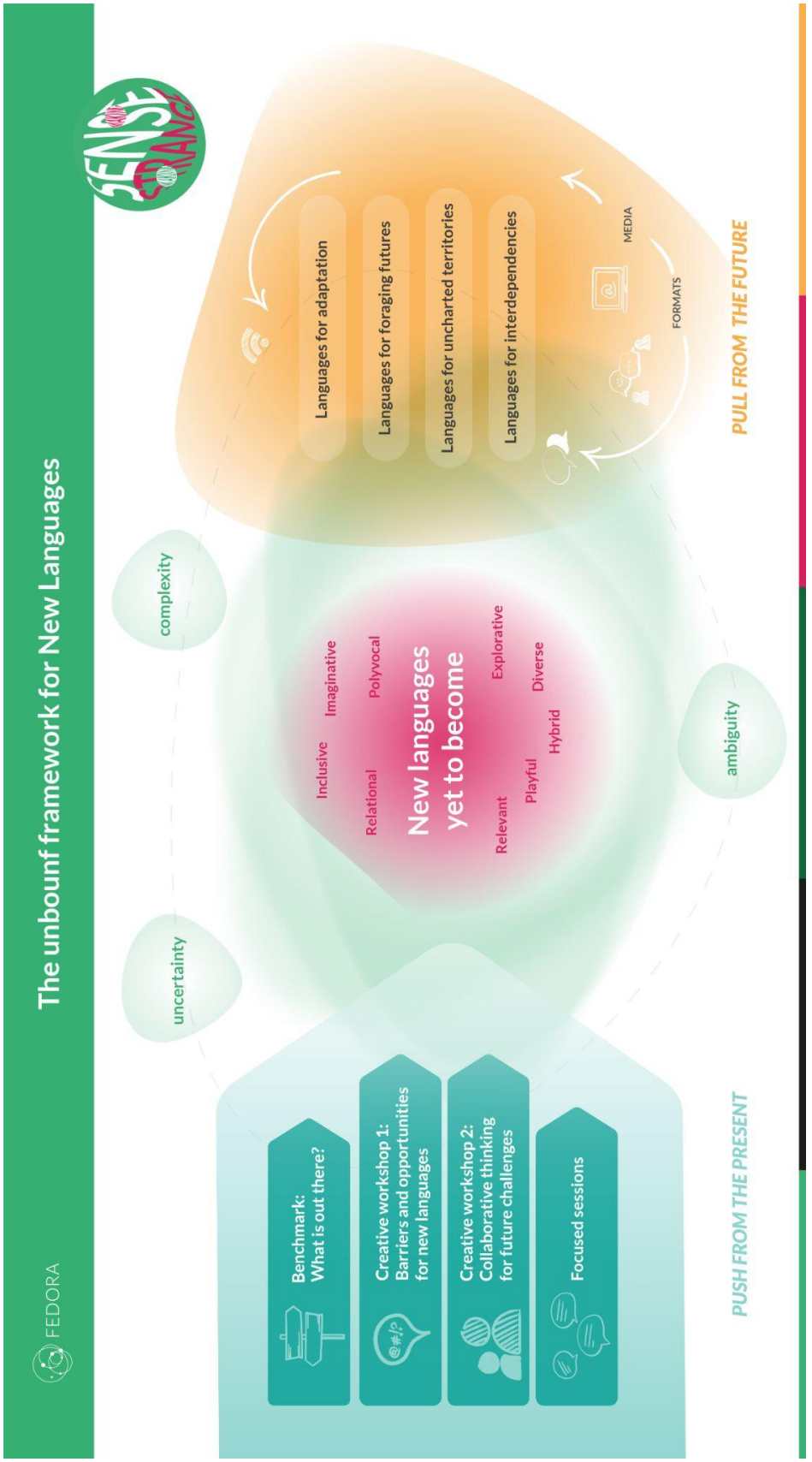
a) interdisciplinarity and new languages: interdisciplinarity requires the elaboration of new languages "to describe it and talk about it" and "to communicate on different theme areas"

b) future and new languages: we need to "generate the conditions to find words that build new realities", to find new ways to communicate or build the future and "new practices to imagine the future".

4. The Unbound Framework for New Languages

Searching new ways of laughing, ones whereby one could express and transform all the shattering, all the gratuitous

- Stereolab, Prisoner of Mars



The framework explains the sources and flows underpinning the co-creation of new languages. A linear trajectory transitions into multi-directionality. It avoids a prescriptive framework, therefore border lines are open and organic considering this representation unbounded. Languages "yet to become" embrace a constellation of desirable traces and they consider space, time, evolution and interactions for envisioning the future, while grasping and activating the present.

The central part of the framework depicts the languages yet to become and shows several traits and features that these languages should/could convey: Inclusive, imaginative, polyvocal, relevant, explorative, playful, diverse and hybrid. These traits are non-exclusive and the aim of this framework is to inspire collaborative creative work at a local level, aimed to be adaptive to different contexts. What comes from exercising in the quest for new languages can be framed in the types of languages that are shown in the yellow bubble. These are presented as the new languages we need to embrace, to bring into life. They include metaphorical features to better communicate their aims and facilitate reflection. As John Dewey said: "We do not learn from experience... we learn from reflecting on experience." [3]

1. Languages for adaptation: they relate to evolution
2. Languages for foraging futures: they relate to time
3. Languages for uncharted territories: they relate to space
4. Languages for interdependencies: they relate to interactions

Learning a new language - or creating it- is about acquiring tools that help us get a clearer understanding of the elusive parts of ourselves and our environments (natural and social mechanisms of our societies). In future thinking it becomes the medium that enables us to cross the doors for radical imagination.

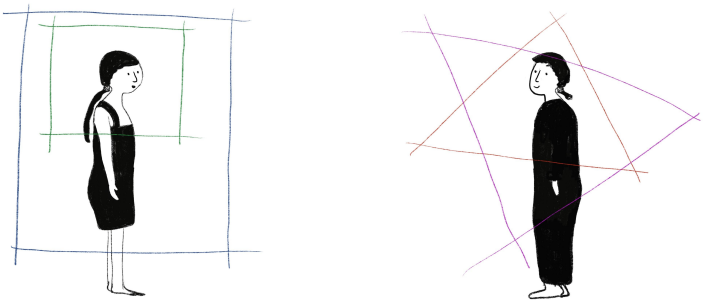
Acknowledging that it is not only our current culture which is highly based on visual representations but that they constitute the bedrock for common languages[4], visual representations are key for helping designing paths that envision futures that mingle sciences, arts and technologies. Therefore and aligning with FEDORA's core metaphors, languages are tools for crossing boundaries and inhabiting these frontier zones.

These "non-definite" definitions of the four types of languages recombine the results of the work done in WP2 that led to the indicators of innovation shared in the first draft for recommendations (D2.2). [5]

[3] "On experience, nature and freedom", John Dewey, 1960.
[4]Ludwig Wittgenstein We can say meaningless or modelled or unelaborated things which therefore can go nowhere in the minds of others (I need space / I am a spiritual type of person, we need to pursue fairness).
[5] It is important to remember that WP2 mismatch or blind spot has to do with the use of formalised and exclusive languages in schools, calling for the need for new languages and formats to enhance imagination and the capacity to talk about those contemporary challenges and find ways to describe, define, and address them with creative solutions. Therefore, this

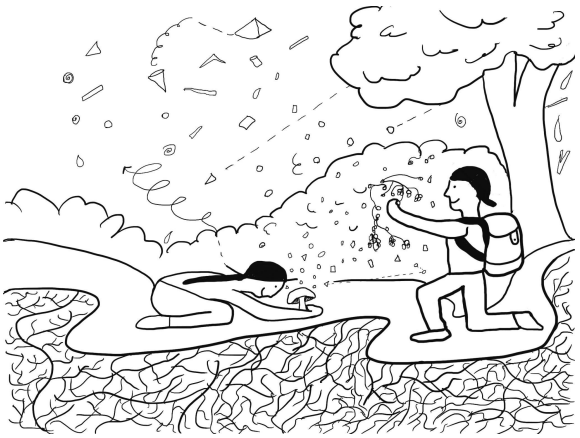
1. **Languages for adaptation - evolution**

These forms of communication can combine and integrate the cognitive dimension with political commitment, inspirational issues with foundational ones, referring to goals and indicators that address social dimensions, such as the sustainable development goals. Languages for adaptation mean deploying unconventional actions that communicate the constant state of change where we live. The poet Rumi wrote centuries before Darwin: "You were mud, originally. From minerals you turn into a plant, and from a plant into an animal and then, into a human being. During these periods, humans didn't know where they were going to and still, they were conducted on a long trip. And there are still many worlds that remain to be known."[6]



2. **Languages for foraging futures - times**

The activities gathered under this type of language have the ability to enlighten and inspire a cognitive journey towards something not obvious at first but that becomes essential once touched upon; something that is not entirely dependent on the people/situations proposing it but has a more holistic and universal value. The ideas, elements, situations found accept and embrace serendipity as a source for unexpected discoveries. One of the activities suggested by the II Creative Workshop - Deep walking- relates to this type of language. Author Keri Smith, presented in Section 4, also invites readers to wander to find.



deliverable has intentionally incorporated more images, illustrations and schemes than usually these types of documents present. It intends to practise what is preached in the different sets of recommendations branching out of this project and others, in relation to visual communication and brevity.

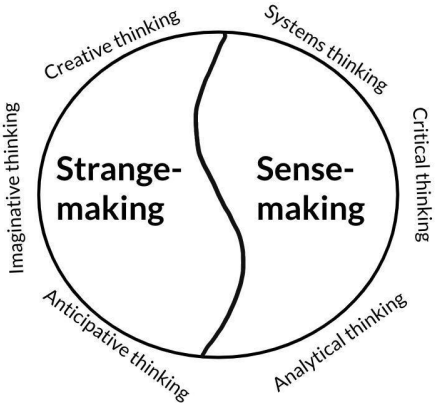
[6] Quoted by Sergio MIssana in his book "Last exit". Laurel Books, Chile, 2021.

3. **Languages for uncharted territories - space**

When summoning languages for uncharted territories, an invitation to explore is set up, together with a multilingual approach and transdisciplinarity. While bringing together perspectives from arts into scientific understanding or communication of science, the language for uncharted territories acknowledges the unknown, as a space to play with possibilities. Here, intertwining digital and manual or analog is encouraged, stimulating creativity and keeping multiple cultures and identities together, fostering a dynamic approach to learning and thinking.

4. **Languages for interdependencies - interactions**

This new language aims to explicitly show interconnections between science and other domains of knowledge, highlighting the connection to real-life questions -concrete actual issues, future issues, how deeply connected they are or will be. Fostering an understanding of science in its making, going beyond the boundaries of a conventional way of thinking and of linear reasoning. It is the sense-making and the strange-making playing unisonous.



The interdependencies between the sense-making actions and the strange-making actions are in constant movement, they are not static. In the practical world, this means a constant balance, a permanent questioning of to what extent the reflection/action/activity is taking into account the sense-strange-making (SSM) process. Exercising these types of thinking may allow us to boost levels of agency, because it is in this present when we are anticipating futures and imagining what might happen. Interdependencies are reinforced when they are accompanied by questions of the type: What if…? Students can be experts in futurising through new languages. Expertised understood as acting and creating confidently, and finding relevance in their doing.

4.1 Activators for fleshing out new languages

Creativity and invention think; imagination sees

- Bruno Munari

This section presents curated activities that are indicative of a whole idea: context, content and frame connected with the new proposed languages. This was considered a major recommendation that came from the different workshops organised.

4.1.1. Deeply play with creative writing

Creative writing is any writing that goes outside the bounds of normal professional, journalistic, academic, or technical forms of literature, typically identified by an emphasis on narrative craft, character development, and the use of literary tropes or with various traditions of poetry and poetics. Due to the looseness of the definition, it is possible for writing such as feature stories to be considered creative writing, even though they fall under journalism, [...]. Both fictional and non-fictional works fall into this category, including such forms as novels, biographies, short stories, and poems. [...] Creative writing can technically be considered any writing of original composition. In this sense, creative writing is a more contemporary and process-oriented name for what has been traditionally called literature, including the variety of its genres[7].

a) Think like a mountain (or a cloud, or a forest or an atom, or...)

Aldo Leopold, forester and conservationist, invites readers in his book "Think like a mountain" to embody an empathetic attitude, and being in the shoes of non-human living beings. Together with this, an act of deep imagination is requested. Actions like this can be facilitated and people who participate in this close encounter with elements of nature declare having discovered new connections and new knowledge [8]. When invited to think like...you can create new sustainable spaces through imaginative practices and knowledge exchange, in this case, scientific knowledge. By carefully observing how a mountain or a forest works as a system, we can use the whole system as a metaphor that searches for meaning. Strange-making and sense-making dance together in an exercise like this.

b) A dictionary for the unsaid words and for the future

A powerful exercise is to set the scene for the creation of new words, that either describe unsaid emotions, or phenomena or depict future professions, animals, plants, and landscapes.

For example, Corita Kent, an American artist and teacher from the 60s, created the word

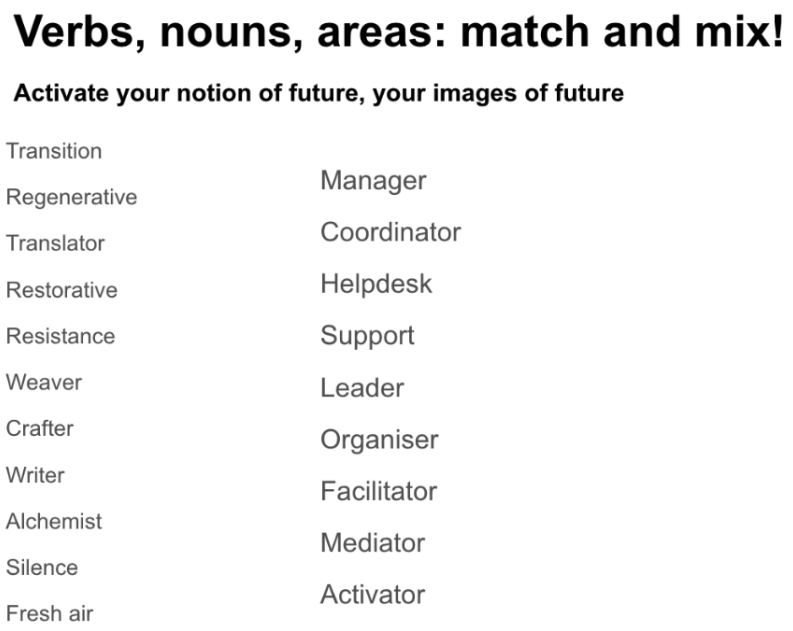
[7] Wikipedia: https://en.wikipedia.org/wiki/Creative_writing

[8] Note from one of the authors after participating with teachers in an alternative summer school in Spain, run by The Invisible Pedagogies school.

PLORK, which combines Play and Work, to describe how she felt about her artistic work, through silkscreen prints. Daring to combine words, or parts of them to invent new expressions invites playfulness and freedom into a learning experience. From creative instances with students, words like FOMM (Fear of making mistakes) can come out. The creative possibilities will differ among languages (English, Spanish, Lithuanian, Finnish, Italian, to name a few).

Leah Zaidi, a Canadian Futurist, in her work "Jobs Ads of the future" plays with words and the comprehension of the possible gaps in the future work landscape. That is how she comes up with, for instance, the role of a Re-Creationist: a person that creates again lost species. This means that extinction happened and with the help of genomics and artificial intelligence, species can be reborn[9].

What new roles can be envisioned by creating lists of adjectives, verbs and areas?



c) The Babel tower effect to provoke and unite

Arts of the working class is a science and arts collective that writes a magazine containing articles in different languages (between 5 and 7) and they are not translated. Every article is different, but there is an umbrella topic in each issue of the magazine that acts as a guiding thread. This shows diversity and stimulates strange-making, because there are languages that not all readers know. If schools now exist in multicultural contexts, is it imaginable to ask the students to write a short article about the future on a topic that they care about, in their mother tongue and publish it like that?

d) Combine and mix, get metaphorical

Make wild combinations: Bruno Munari, an Italian artist and designer, gives us the tools in his book Fantasy, to try and test imagination in the most unexpected ways. Combine the power of

[9] https://medium.com/predict/job-ads-from-the-future-a37d21dfecf9

sensing organs: a human turning into a superhuman, her/his eyes what would they be able to see, how? Repetition: what would happen if we would have more than one pair of eyes, in different organs? These are exercises that keep your imagination going. A very practical exercise: Imagine an object you love and place it in an everyday context to solve a need. This need can be an urgent need or an aesthetic need[10]. You are creating an object of the future.

Bagel lamp in Vilnius, Lithuania in a bagel shop that also had bagel cushions and bagel-style chairs.

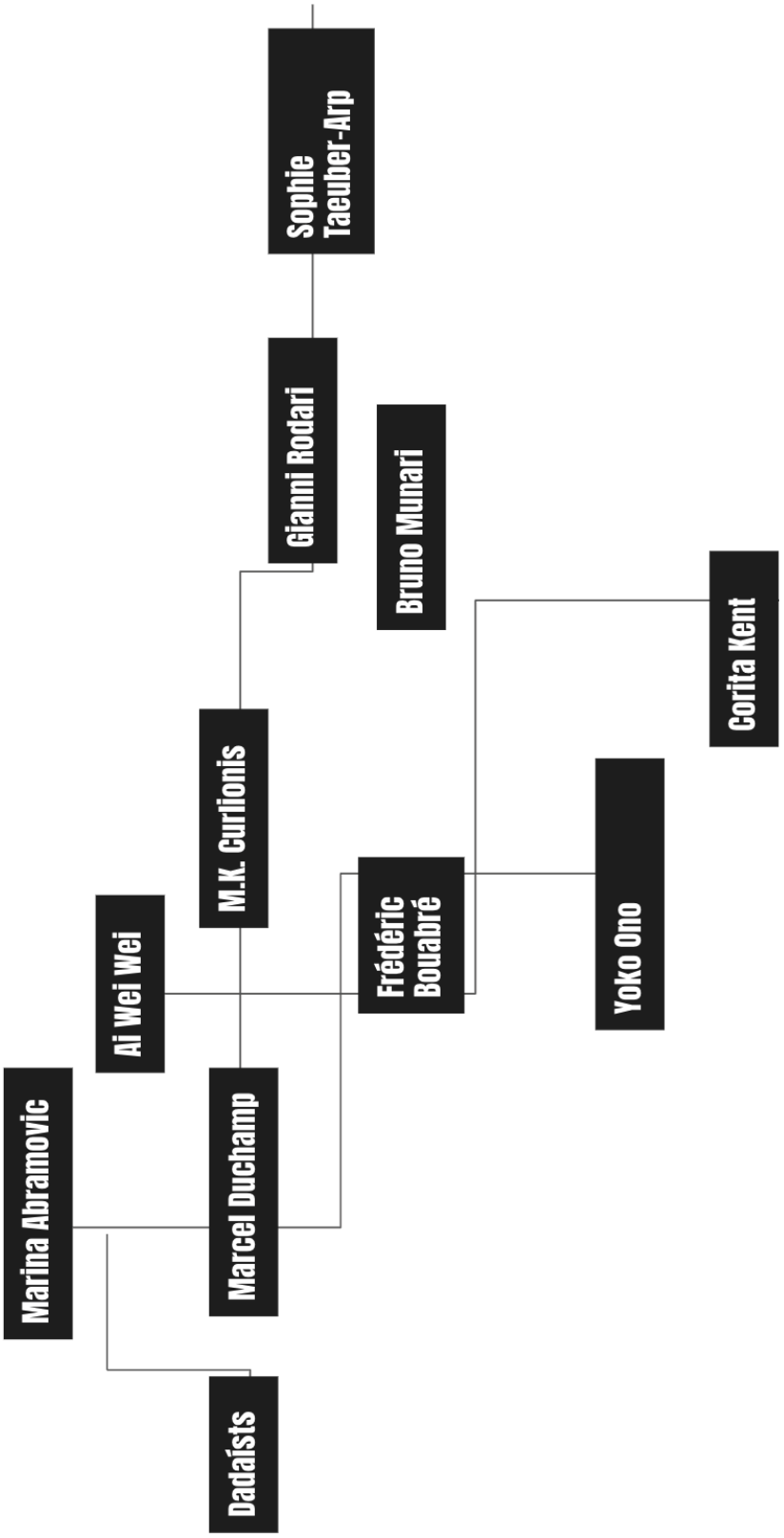
Metaphors are a form of figurative language, which refers to words or expressions that mean something different from their literal definition. They can become images that help us comprehend something more complex, bigger or unknown. To think of an ecosystem as an orchestra is a metaphor. Andri Magnusson, writer and climate advocate, tells in his book "About time and water" how he discovered a universal metaphor and describes Audumla as the sacred cow, whose milk becomes the rivers of the world. Audumla represents the glaciers and he, as an explorer deciphering signs, notices the existence of this sacred cow in many cultures of the world, simultaneously.

When Bob Dylan says *Chaos is a friend of mine*, he is using a metaphor. In FEDORA, we use the metaphor of a boundary, as an element and a space that divides but at the same time connects. The image for this is an important road in Naples, Italy, that represents a "common space and a division" for the inhabitants of the city.

Thinking about relevant metaphors in different contexts can help to realise, understand and communicate scientific endeavours and challenges.

4.1.2. Visual arts: a never-ending source of inspiration

[10] What are aesthetic needs? See Maslow and the pyramid of needs



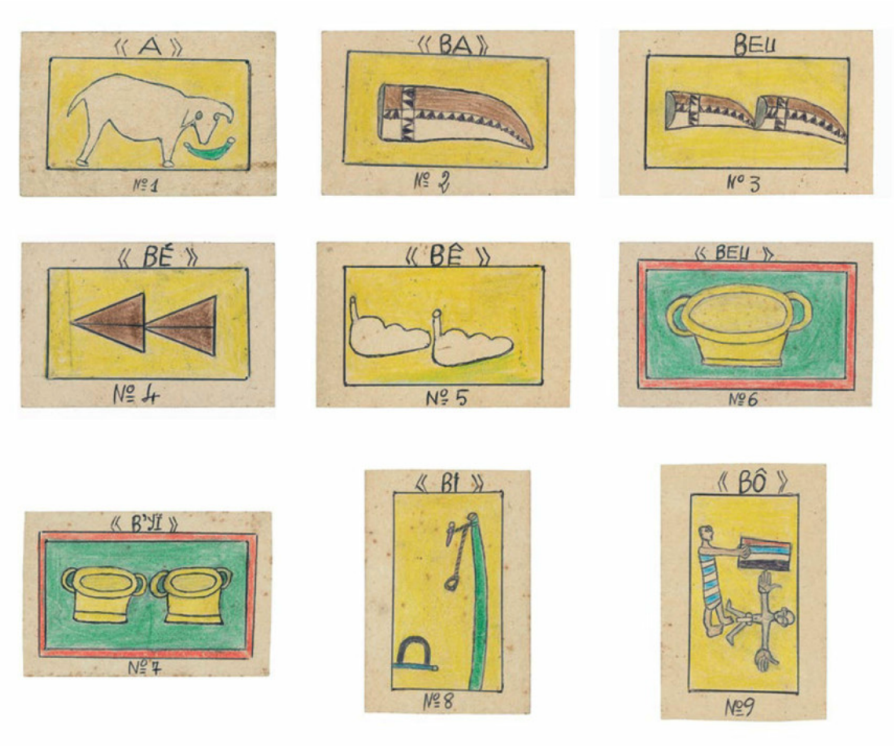
This is a selection of artists, most of them contemporary, that have looked into the future in various ways: disrupting, questioning, embracing and doubting the future. There was also an artistic movement called The Futurists. Artists can question, resignify objects and create visual metaphors to illustrate a determining issue. In our case, future thinking means also a look into

the unknown and a set of wishes to fulfil.

Japanese artist Yoko Ono invites people to hang their wishes into an Olive tree. In this case, the Olive tree symbolises wisdom, and people having desires for their future, represent a pure realisation that the present is not enough for our scope of thinking. The invitation that Yoko Ono makes to make a wish is an invitation to name something that doesn't exist yet and to hang it in an old and resilient living being: a tree.

Tree of Wishes, Yoko Ono. Guggenheim Museum, Bilbao, Spain.

Frédéric Bruly Bouabré was an Ivorian visual artist most famous for the creation of a visual alphabet, a 448-word alphabet to describe the oral tradition of his people. It is called the Bété syllabary. To honour and embrace our fundamental interconnectivity and interdependence as human beings.



Part of the Alphabet Bété

4.1.2. Explore everything, as if you are encountering things for the first time.

In her book "How to be an explorer of the world" writer and thinker Keri Smith invites everyone to open up for marvellous and extraordinary everyday things. Her starting point is that artists and scientists analyse the world around them in surprisingly similar ways, by observing, collecting, documenting, analysing, and comparing. In this captivating guided journal, readers are encouraged to explore their world as both artists and scientists. The invitation is to get closer, very close to objects, or process or concepts. Dissect them, change the perspective and invite awe. Developing a curious mind that values questions and observations is imperative to develop a critical and imaginative thinker that will dare to question the present and the possible futures.

Dörte Fuchs is a German jewellery artist based in Munich. Through her works, she tells stories. Her current work is part of the exhibition Memories of places, Memories of the future. Her works invite visitors to look closer and immerse themselves in possible stories told by the intricate jewellery. This is an exercise that empowers imagination.

4.1.3. Dig into the past, pull from the future, and get wild portraits

By reading the personal stories and biographies, recognising traits in the scientists and creators that we admire is a way to get closer to the conditions and contexts where they develop their work. Read personal stories and then get wild in using unconventional adjectives that bring more energy and expression to the personal traits that resonate with you. For example, the Batterist Makaya MacCraven is described as an astronaut of jazz, scientist of rhythm, and cosmic explorer. Many adjectives can be given to this virtuous musician and producer from the United States.

Photography and the exercise of doing double exposure give the possibility to show in a compelling way how two different, opposite, separate things can come together. This technique can be used to talk about a scientist and their past, background, worries or passions in a visual and stimulating way.

Example of double exposure in photography

4.1.4 Storytelling

Storytelling is the practice of sharing stories. It is a social and educational practice that predisposes us to "making a memory", sharing collective experiences from learning to

entertainment. In past times, stories were shared by the fireplace (even though they can still take this form). Stories direct attention, trigger emotions, and prompt understanding. Therefore, it has been widely reshaped or tailored to convey messages in different contexts. Marketing makes wide use of it. History and philosophy of science have used it to teach the backgrounds of our current systems of thinking, conceiving and practising science. Citizen science has recently promoted the narrative approach of storytelling[11] as a means of engagement of people of all ages and backgrounds in scientific research processes[12]. In a narrative, the emotional tonality is powerful. It stimulates creativity and curiosity and is essential for developing empathic and listening skills. Storytelling is the message, and the way to communicate it can take different forms: visual, audio, graphic, musical, and photography.

Andri Magnusson tells the story of the moment he realised that he should advocate for climate change, specifically for glacier awareness through stories, and it was a scientist that compelled him to take an active and "serious role" as a storyteller, during a conference in Munich. Wolfgang Lutch, director of the IASS in Potsdam, interpellated him, saying: "You don't dare to write about the biggest changes in the planet since humankind on earth and pretend to leave that responsibility to a handful of scientists? Without help, they are condemned to preach in the desert". Magnusson then remembered the myth of Cassandra[13] and wrote about "collective apathy". He decided to write on climate change and he is now a bestselling author.

In the FEDORA Manifesto[14], one of the 10 statements is "Create engaging narratives"

Thinking about the futures triggers interesting ideas. Students should be encouraged to share their ideas in a variety of ways, such as through visuals, plays, songs, games, or whatever helps to make these futures scenarios come to life. Moreover, by being creative in the way we share our ideas we can engage others and stimulate them to envision more sustainable futures.

Complementing this statement/invitation, researcher and PhD candidate Tapio Rasa, who is part of the University of Helsinki group working in FEDORA, described 16 different narratives of science in an unpublished work, from where we have selected some of them to illustrate starting points for story creation [15]:

In Rasa's work, the "narrative connotations" of science are situated in a taxonomy of meanings. These are the meanings we give to science in discussions and representations – to e.g. build or

[11] To know more about the efforts to link citizen science and storytelling, visit this padlet: https://padlet.com/amountainwithwings/storytelling4citsci
[12] Anett Richter et al
[13] https://en.wikipedia.org/wiki/Cassandra
[14] https://www.fedora-project.eu/our-future-oriented-science-education-manifesto-is-out/
[15] Rasa, Tapio (2022). Narratives of science and socioscience: a preliminary taxonomy. Unpublished manuscript.

question trust, motivate students to learn something, to give meaning to a science communication message, or to tell a story, and so on. Here are some examples:

1. Wonder - Science is looking at the stars and knowing some of them are so far away; perspective, the beauty of patterns…
2. Curiosity - Science is asking questions, child-like insistence on asking 'why'
3. Problem-solving - Science is curing cancer, solving COVID-19, designing better systems, etc.
4. Progress - Science takes us "forward", whatever that is
5. Science-fiction drama - Science makes us confront ourselves: Science asks existential questions; science is looking for meaning; etc
6. Loss of humanity - Science makes us non-natural, non-human
7. Transcending anthropocentrism - Science shows that we are not the centre of the universe; science shows we are not special and have no special meaning
8. Innovation - Science is needed to create new products, drive markets, etc.
9. Elites - Science as an elite institution; science as a way of oppressing others; science as a political excuse

These narratives can be a starting point to create stories that are relevant to different educational contexts and could be the vehicle to explore desirable or possible futures, question the boundaries and invite experts from different disciplines to converge in a common story, coming from different perspectives. In fact, as the list provided above shows, negatively connotated narratives and discourses of science (such as "science as oppression" – see narrative 9) do exist. The analysis, and in some cases critical dismantling of such narratives, may first require an awareness of the narrative's existence. This issue is argued in detail in the upcoming research paper.

Consider that in most stories, there is a recognisable pattern: characters, a problem or challenge to be solved, obstacles to overcome and an end, where the main characters managed or not, to overcome difficulties and succeeded. The story archetypes vary. These templates, designed by Keith Yamashita, will guide the creative process for anyone adventuring into writing stories that matter: Crafting stories that matter

Stories can also come in the shape of a poem. Overlapping with creative writing, the Little elevens are a simple yet powerful way of writing a poem that conveys a message. It is a 5-step recipe that will lead to a short form, Haiku-like poem.

Entangled
The paths

Offered by modernity
Nothing looks really certain
Present

The instructions are to be found here.

4.1.5 Listen to the music[16], look through a video camera

Recording sounds that surround us can be an exploratory exercise that brings students, teachers and researchers to uncharted territories. By creating concepts like Future"phonas", Future Sonics, the sounds of the future, future landscapes stories can be created. This can be complemented with other media: films, mockumentaries, and video installations.

Video installation by Grace Euna Kim, Berlin-based Korean-American performance and visual artist, choreographer, and researcher

Johan Rockström' s compelling video and message about the planetary boundaries and how a countdown is giving us the opportunity to undo the negative effects of our model of development is a good example. He is one of the most knowledgeable climate scientists.
https://padlet.com/amountainwithwings/fose/wish/2386775044

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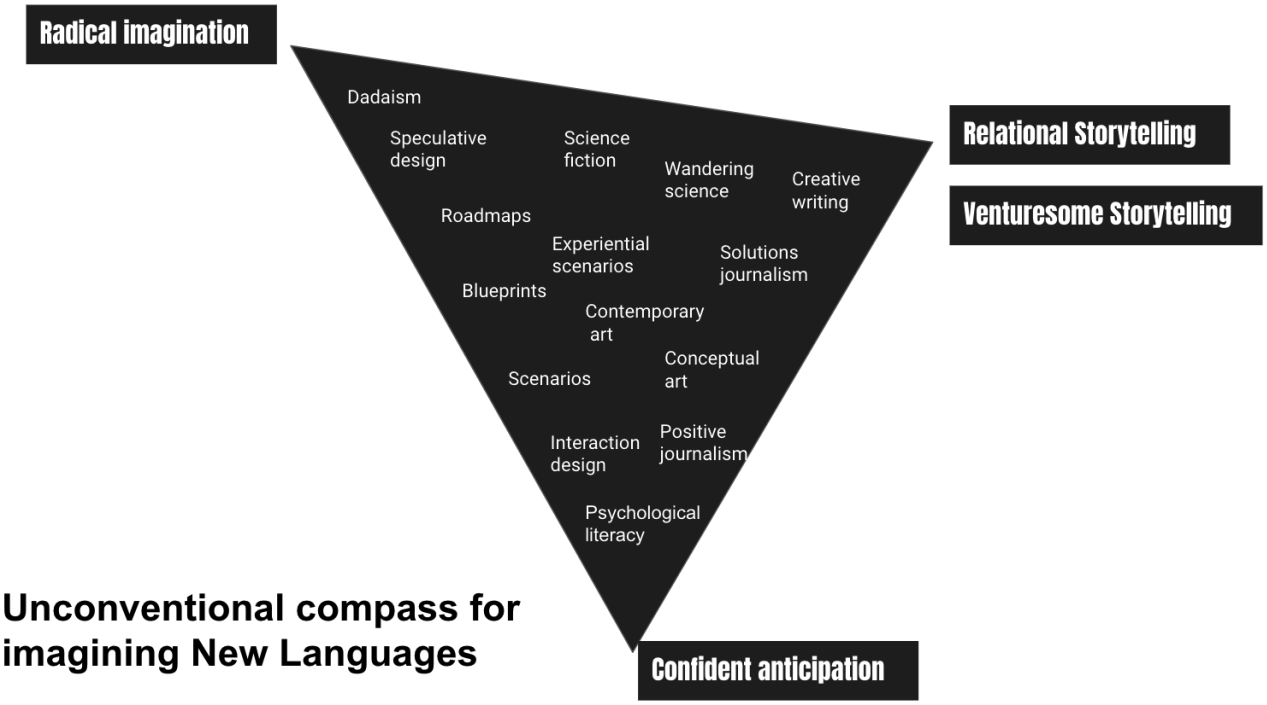
[16] Listen to the music, The Doobie brothers



This figure summons different elements that can spark ideas for the creation of new languages.

As a final remark, it is worth mentioning that in his paper *"All I Really Need to Know (About Creative Thinking) I Learned (By Studying How Children Learn) in Kindergarten"*, MIT researcher Mitchell Resnick[17] explains and shows how creativity is smashed in the school years after Kindergarten and elementary school. Just when we most need to find solutions in an open way, students are narrowed in their way of thinking and uniformity -instead of diversity and divergent thinking- is praised. Science education is no exception.

4.2 The Prototype card

As a way of guiding the adoption of specific activities coming from the benchmark study and workshops, a visual card was created to show the main components of the experiences suggested as activities to try, named prototype for future-oriented science education.

What is a prototype? Prototyping is a process in which design teams ideate, experiment with, and bring concepts to life, ranging from paper ideas to digital designs. At its core, a prototype is an early sample of a design that allows users to visualise or interact with it before a final product is developed.

[17]https://web.media.mit.edu/~mres/papers/kindergarten-learning-approach.pdf

The following diagram presents the format in which prototypes will be presented to be tested with the Open Schooling Networks.

Description of the activity
Contains an overview of the aims of the activity, how will it activate present and future-related knowledge and science education.
Issue
The issue indicates the topic that activity will be able to introduce to the students: ambiguity, complexity or uncertainty.
New Language
The new languages proposed by FEDORA are Languages for adaptation, Languages for foraging futures, Languages for uncharted territories and Languages of interdependencies.
Media
The media refers to the tool that will be utilise for the activity: Video, photography, podcasts, collage, among many others.
Format
The format informs about the shape of the activity: A workshop, an outdoor experience, an excursion, are some of them.

4.2.1 Three examples and case studies from the Benchmarking report (Deliverable 2.1) to use as 'prototypes' to inspire the design and development of future tools and activities

It is very difficult to find all the suggested ingredients reflected in one single experience. In most cases, the activities listed and described hereafter will have some of the characteristics and of requirements that respond to the above definitions. They might serve as starting points, to inspire, ignite, and suggest the first steps of future co-design processes to come up with innovative, transformative and useful activities to experiment with the open schooling local networks.

Key features that are shared by most of the listed activities are:

- unconventionality
- value-laden engagement
- an active role for participants, starting from the students
- focus on process and not merely on results

1. Prototype card to describe future-oriented activities adapted by FEDORA that will be tested in educational contexts

a. Postcards from the future

Features	Description of the activities
Link	https://climateimagination.org/postcards-from-the-future/
What it is	This is an initiative from the Center for Science and the Imagination of Arizona State University. The project has produced a number of graphic postcards that should inspire a reflection of one's vision of the future. The postcards are published on a website and can be selected and used by people who get on the page. They can select the image they prefer, and write a postcard trying to share their ideas and anticipations of the future. Finally, they can either print the postcard and send it over to other people, or share it, with its content, on social media. Their choice and post are also shared through the original website when they pick the postcard
How can you use it - what can you do from it	- you can replicate this project very easily focusing either on art creation, as these ones, or on pictures taken and modified by the students, to try and create their **vision of the future** in their community - collaborating with local artists to create **postcards** to be shared through **Ig or other social media** or your website (alert: the community dimension is very important here, so it has to be a very visible and shareable page) - build a website with postcards and also students' posts/writings as a repository for them once they'll be in the future - make sure that other schools and or communities are involved so the game and the narrative will continue
	Issue
	Uncertainty
	New language
	Languages for uncharted territories
	Media
	Postcard + Website
	Format
	Drawing and writing laboratory

b. Example: Play decide

Features	References
Link	https://playdecide.eu/
What it is	PlayDecide is a discussion card game that allows people to have a respectful, informed and yet lively conversation and discussion on controversial issues. Originally funded by the EU, the PlayDecide mechanism and dynamics are now well-seasoned and have been used many times to facilitate discussion and deliberation over a range of controversial topics, such as GMOs, nanotech, biotech, synthetic medicine, climate change, and many more. There are a number of games on different topics already available on the website, with easy instructions on how to play. But there is also the possibility to use the format and fill it with different ad hoc content produced by a team on a specific topic. The main dynamic of the game implies getting to know a number of facts and data on a topic, choosing a persona to defend a specific position and discussing within a group with very different opinions and goals to reach a trade-off and a common position with regard to a law, a regulation or a way to deal with the issue.
How can you use it - what can you do from it	- you can use some of the available topics or - you can pick a topic and work with the students to: - find data and facts to produce the problem cards - define profiles of a few different personas who have diverse interests, goals and stakes on the topic - define a scenario to set the conversation - organise an event where multiple groups can play on the same day and then compare the dynamics and the final results - experts and teachers can be involved all along in the research, design and production as well as in the final gaming session
	Issue
	Complexity
	New language
	Languages for adaptation
	Media
	Board game
	Format
	Discussion game - face to face activity

c. Example: Sound Reporting Labs and Workshops

	https://ecolocationsound.com/ https://thelookoutstation.com/projects/sound-reporting-co-lab-media-support-initiative-sound-and-science-based-storytelling Here examples of climate podcasts from NYT: https://www.nytimes.com/2021/04/17/at-home/climate-change-podcasts.html
What it is	There have been quite a number of experiences in recent times in reporting stories around a certain environment starting from the **soundscape** instead of the visual one. Sound has a **huge potential in engaging** with the public because we tend to rapidly respond, on an emotional before than rational level, to sound. Sound is a very **immersive** response system and it makes us perceive an environment and our relation with it even more than sight. The **success of podcasts** tells that a **well-crafted audio story** can be more effective than other media to convey a combination of emotion, reasoning, triggering thoughts and activating memory.
How can you use it - what can you do from it	- Choose the **type of environment** and situation you'd like to tell through a sound/audio story - Work with **local radio reporters and sound technicians** to learn how to record sounds and how to build a story based on audio (every town has a local radio station) - **Sound and recording apps on smartphones** are very powerful and students can learn how to build a narrative on an environment or a story through the presence or absence of sound (think of the different urban sound during the lockdowns compared to 'normal' times) - There is great **open-source software** to edit audio and audio editing is very easy to learn (Audacity) - Audio is great fun to put together and a **lighter, less invasive medium** than video/images with an easier entry-level than HD images - for some environments and stories is much easier to record audio than images (think of difficult marginal urban environments or of situations where people prefer not to appear with their faces and image online)
	Issue
	Complexity
	New language

	Languages for interdependencies
	Media
	Audio
	Format
	Podcast

6. Three recommendations from new languages for policy making

Part of this deliverable was meant to convey key messages intended as recommendations[18] for policymaking. Based on the work described above, the following are the recommendations related to new languages. They are framed within the two challenges and two corollaries described in section 3 of this document.

- Concept-challenge n° 1 - Triggering an epistemic emotion
- Concept-challenge n° 2 - Going beyond dichotomous thinking
- Corollary n° 1: Visual culture is stronger
- Corollary n° 2: European societies are profoundly changing.

1. Support the creation of experimental spaces

Aligned with WP1, fostering the creation of locations and institutional contexts that can act as spaces that do not belong to any disciplinary context, promoting a cultural change will help to perceive that changes are possible and encourage to "play with possibilities", the use new languages and the creation of languages that fulfil different needs.

2. Foster the use of "tridimensional" thinking

Overcoming a "binary perspective" (disciplinarity vs interdisciplinarity), and merging new professional identities that are based on interdisciplinarity is a cross-cutting need that requires decision-making support to promote them and bring them to life. This entails the use of multiple languages as a key to accomplishing complexity understanding.

3. Keep Educating Yourself, KEY is key

To '*walk the talk*' about futures thinking and how to integrate this approach into school learning, -formal and informal-, there is a real need for capacity building. Considering that every human being is a creative and potentially transformative being is not enough to grant the changes needed. Creativity is a muscle that needs to be trained. Therefore, training instances to bring back imagination into our rational thinking are of the utmost importance.

A FEDORA policy brief about integrating futures thinking in schools provides examples that complement these recommendations. You can download it here:
https://www.fedora-project.eu/recommendations/

[18] A "recommendation" denotes an aim, a method or an action that should be adopted or taken to address said issues.

ANNEX 1

The II Creative workshop

The second FEDORA Creative Workshop was designed, organised and performed in Bologna, Italy, on the 21st and 22nd of April 2022, and gathered 9 experts from 4 European countries and 9 different knowledge and artistic fields. After 8 hours of intense work, the experts developed three prototypes that reflect the ethos of the FEDORA project and that could well be tested and tried in educational environments. The programme and a detailed description of the workshop is provided in D2.4. All experts were divided into three groups and each of them received a problem to be solved, based on the current situations that young students face. Each group was also given two sheets with a summary of "The Future thinking skills" and "Stimulating engagement and critical thinking around the future and the role of science in it: the characteristics of a good activity or prototype.

A detailed description of the three prototypes developed during the II Creative Workshop (Deliverable 2.4)

Video 1: Setting the scene

Video 2: The creative job

Video 3: Shaping and sharing the prototypes

- **The starting points: Problems to be solved creatively**

> **Problem 1:** My name is Mattia, I am 15 years old. My life is full of friends and people I interact with at school, doing sports, walking around town, and at the comic shop. I have tons of friends online and offline. I cannot even conceive my life without my devices. I use my phone to do everything: to read my manga, chat with my friends, watch videos, see the homework I have to do, agree on where and when I have to meet people, to discuss with others the things I do. I spend hours on my phone and at my computer every day, some of them playing video games with other people from all over the world.

Now, the cost of energy is going up and my parents and teachers keep telling us we have to be aware of our energy consumption. We are also told that we have to curb our energy needs since we have to curb carbon emissions. And that we should be very careful to save energy and not depend on our devices so much. But in my mind, the future is an even more hyperconnected one.

So, how are we going to keep growing and being connected without destroying the planet?

> **Problem 02:** My name is Sara, I am 17 years old. I have taken part in the Fridays for

future movement from the beginning. And yet, I am growing more and more anxious about our real ability to deal with the climate crisis. I wake up during the night thinking that my hometown could easily be destroyed by a wildfire or by a hurricane. The scientific reports tell us we have no time left and judging from the news there are already many places where life has become difficult because of the heat, drought or flooding. I see that the governments are doing too little to stop the emissions and find solutions. The Covid-19 pandemic has even worsened the situation since for two years everyone was dealing with the virus and left climate change on the side.

How are we going to solve this problem? Is there going to be a future for me and my friends?

Problem 03: My name is Shambrin, I am 18. I come from South Africa and I have been living in Italy since when I was 10. In the country I come from people have been dying of Aids and malaria and many other diseases that do not yet have a treatment or a vaccine. These diseases rarely kill someone in Italy or in Europe. The Covid pandemic has shown us that when there is an emergency scientists can find a solution very quickly if they work together. We got a Covid vaccine in less than 1 year! So, why is it that diseases affecting millions of people in African countries, or in Asia or even South America still do not have any answer? These are also the countries facing the worst environmental consequences of climate change or of deforestation.

How can we look forward to a world where science cares only for rich people?

- **The prototypes**

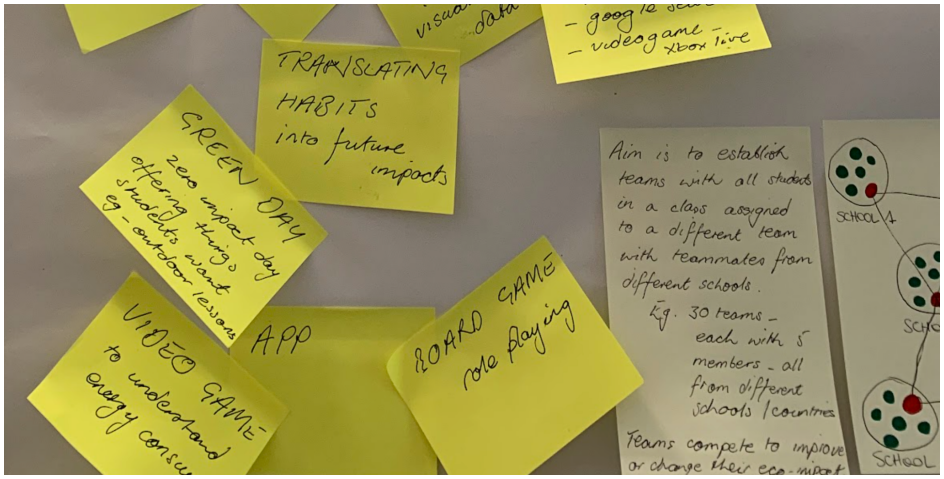
Each group worked in different phases, which considered a time for ideation, divergent and convergent thinking, intermediate round tables, refinement of the ideas, and shaping and prototyping of the final products, be it a methodology, a game, or an activity, etc…

It was intended to be a “mixing” exercise, where all the different skills of our invitees (poets, musicians, scientists, art mediators, and engagement experts) came together and intertwined in the prototyping process. Interdisciplinarity was stressed during the first workshop and futurisation during this second one.

After the two-half-days, each of the groups developed the following prototypes:

- Group 1 developed a prototype called “Data visualisation for social justice”
- Group 2 developed a prototype called “Deep Walking”
- Group 3 developed a prototype called “Students for Civic Science”

Group 1: “Data visualisation for social justice”



- The problem: He only sees loss in the lifestyle change

Passive engagement with the issues

He sees more connectivity in the future, not less connectivity

- The opportunities: seeing positive aspects of change

Being solution focused (owning the problem)

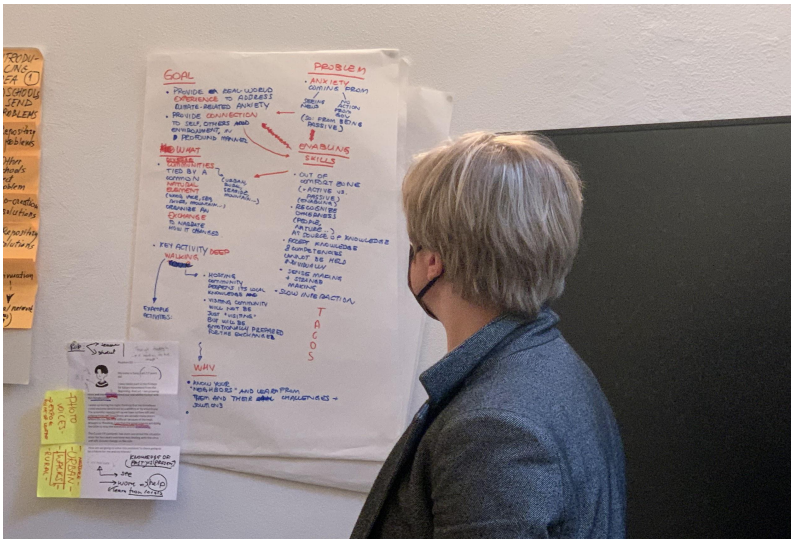
Using connectivity to motivate behaviour change

Personas: Students 11-13, multiple countries and cultures

- Key ideas:
    - Changing hyperconnection → from all the time to being connected to everyone
    - You are the hero: choice, following expert advice
    - From Hero to team
    - Moving from confronting data to visualising data
    - Moving from hero to team
    - Intercultural exchanges online/offline
    - Translating habits into future impacts
    - Board game, role playing
    - Zero impact day: offering things that students want, outdoor
- Teams that include 5 students, from different schools, they compete to develop eco-impactful solutions
- Preplanning and design:
    - Find schools globally
    - Mapping schools
    - Establish baseline
    - Curriculum connections
    - Programme the App
    - Create topic learning tree
    - Create spreadsheet and canvas to collect data (design), and compare visualisations
    - Research available data visuals we can connect with
- Training needed

    - Pre-brief teachers
    - Pre-brief parents
    - Plan curricular links
    - Data literacy -students and teachers-, data collection-students- and analysis -researchers and all_
- Shared outcomes
    - Every three months (M3, M6, M9, M12)
    - Talk about the impact on the planet
    - Pupils as mentors of the youngest
    - Create networks of schools after three years
- Experts and experience exchange: Interdisciplinarity, multicultural

➔ **Group 2: "Deep Walking"**



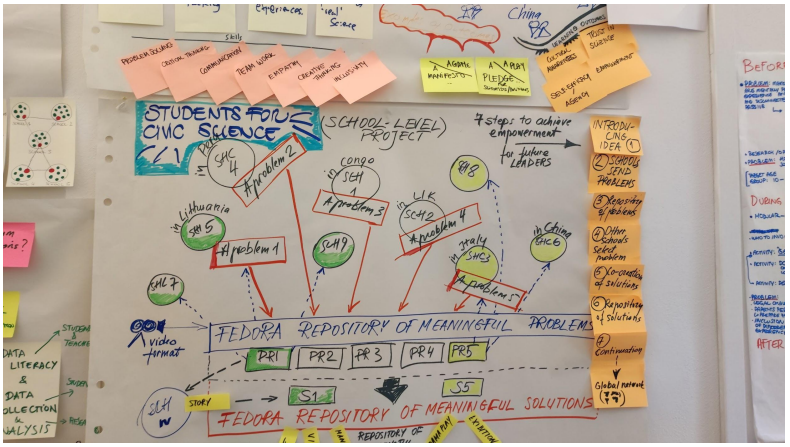
- The problem: Students feel anxiety, coming from seeing news and passiveness. Covid moved the attention from climate change, which was a burning topic to her/him
- The opportunities: Providing a real-world experience

  Provide connection to yourself, to nature and to others limit the anxiety, reconnect with nature, rediscover different ways of communicating
- Key ideas:
    - It is a model, not a service
    - It is introduced in the school's life and it's about the cooperation between schools in different locations.
    - One school must be located in a city setting and the other one in a rural, natural environment
    - Implies deep teacher connection, between the organiser teacher with other teachers, from different subjects
    - Implies discussion about interests and knowledge from the students, so there is a collaborative planning phase
    - Implies finding artists, workers and researchers from that area

    - For the exchange phase
    - 7 steps for schools, to plan the activity but there are some calls weaved in, so students can apply for exchanges.
    - Breath, walk and explore:
    - Get lost and find yourself. Students get in pairs into the forest.
    - Keep the walk simple and add instruments for music. Find the person that is playing a music instrument
    - After the getting lost experience, all participants eat together.
    - It creates the conditions for rooted and deep conversations.
    - It is not compulsory to walk
    - The experience has to happen in nature, mixing students from different backgrounds
    - To fill the connection, you don't have to fulfil a deliverable
    - When you find yourself, you are less anxious
    - When you are connected with nature, you are more aware
    - Connect with nature, connect with your peer pal and connect with the community
    - Connect with the environment through listening
    - Light your fire of curiosity, fuel that brings engagement with what you do and helps to know what you are looking for, or learn what you don't know, that push you to seek for something
    - Keep it simple
    - Peer to peer and participation are the bedrock
- Teams that include
    - Two schools and communities
    - Hosting community deepens its local knowledge and the visiting community prepares for an emotional exchange.
- Preplanning and design:
    - Decide a location and theme
    - Check legal constraints, paperwork can be a burden
    - Make an open call, so it is voluntary
    - Connect with other teachers for interdisciplinarity
    - Network with the local environment and people
    - Contact and evaluate with other schools
    - Evaluate if it is useful to integrate the deep walk into the traditional curriculum
    - An NGO organises and prepares the workshop
    - Customise, based on time and resources available
    - Involve local experts, alternative knowledge holders
    - Keep sense-making and strange-making having a dialogue
- Training needed
    - Deal when moving from the comfort zone
    - What is otherness? And how can it be a source of knowledge?
    - Prepare teachers to move away from the checklist tick
- Sharing outcomes

    - Transform it into a learning module
    - How to introduce a subject through an experience
    - Accept that knowledge and competencies cannot be held individually
    - Know your neighbours and learn from them
    - Learn how to focus: deep observation
- Experts and experience exchange: Interdisciplinarity, multicultural, slow interaction, sense and strange making

➔ **Group 3: "Students for Civic Science"**



- The problem: Western dominance of science, lack of awareness of global issues, applied science follows only money, breakthroughs only in emergencies
- The opportunities: Open a problem to the global community, explore non-western perspectives, explore strategic and system thinking, real science
- Key ideas:
    - Skills to foster:
        - Critical thinking
        - Problem solving
        - Communication
        - Teamwork
        - Empathy
        - Creative thinking
        - Inclusivity
    - School-level challenge
    - Cross-cultural
    - Cross-disciplinary
- Teams that include
    - 14 years-old and more
    - Different schools from different countries
- Preplanning and design:
    - 7 steps to achieve empowerment:
        - Introducing the idea to the teachers and school leaders team

        - Students send problems: FEDORA repository of meaningful problems
        - Creation of the repository of problems
        - Other schools select problems
        - Co-creation of solutions: FEDORA repository of meaningful solutions
    - Pre-populating the platform
        - Selecting pilots
        - Monitoring and evaluating
    - Full launch and marketing
    - Dissemination and exploitation
        - Reaching out external stakeholders
        - Funding opportunities
    - All stages have the active input from students
- Training needed
    - Building the platform: with existing tools, Open source
        - Upload, download activities, repository
        - Network takes place elsewhere: slack, facebook, etc…
        - One problem, “n” solutions
- Learning outcomes
    - Cultural awareness
    - Trust in science
    - Efficacy
    - Empowerment
    - Guidelines, videos with problems and solutions

- Experts and experience exchange: Interdisciplinarity, multicultural, slow interaction, sense and strange making

ANNEX 2

The Unbound Framework for New Languages

This is the **Learning Brief for WP2** in its printable version. It is an A4-page that introduces the topic on the front page, then the middle displayed page shows the Framework and the back page shows the prototype card template and gives some references for further reading.

Prototype card

This card represents the information displayed by each of the future-oriented activities adapted by FEDORA that will be tested in educational contexts

Description of the activity

Contains an overview of the aims of the activity, how will it activate present and future-related knowledge and science education.

Issue

The issue indicates the topic that activity will be able to introduce to the students: ambiguity, complexity or uncertainty.

New Language

The new languages proposed by FEDORA are Languages for adaptation, Languages for foraging futures, Languages for uncharted territories and Languages of interdependencies.

Media

The media refers to the tool that will be utilise for the activity: Video, photography, podcasts, collage, among many others.

Format

The format informs about the shape of the activity: A workshop, an outdoor experience, an excursion, are some of them.

Get inspired, learn more, and expand your views!

S+T+ARTS project - www.starts.eu
Futures for Europe - www.futures4europe.eu
Lifecompetences for uncertainty
www.publications.jrc.ec.europa.eu/repository/handle/JRC128777

FEDORA - Future-oriented Science EDucation to enhance Responsibility and engagement in the society of Acceleration and uncertainty - This project received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement n° 872841
www.fedora-project.eu

FEDORA LEARNING BRIEF
on new languages yet to become

FEDORA

It might not be the robots we need to worry about, but rather the air, water, and soil we need to live
- Leah Zaidi

As global citizens, we are facing challenges that need our attention, creativity and intention to create stimulating visions of desirable futures, therefore, new languages that resonate with transformative experiences.
How to create these innovative ways to communicate, foster and imagine is one of FEDORA's objectives.

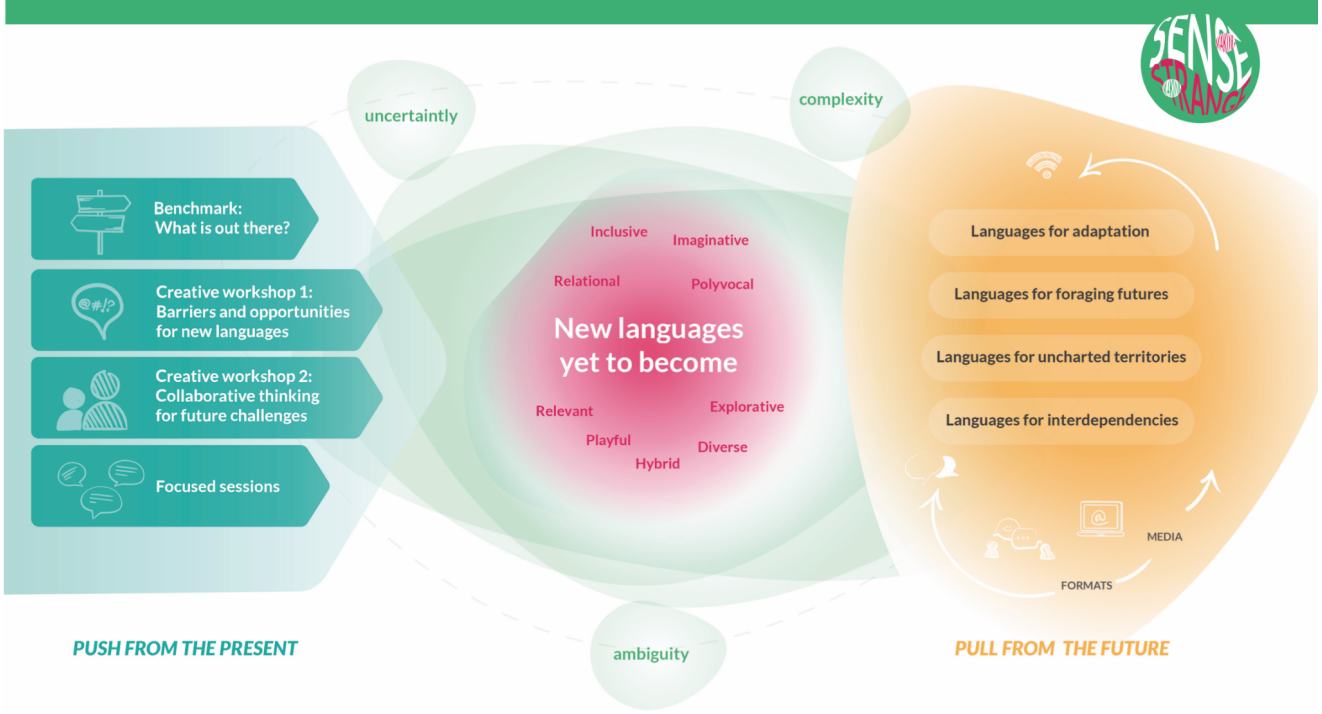
Invention, fantasy and creativity think, imagination sees
- Bruno Munari

Foraging futures through new languages is what we are encouraging by providing learning ideas that help students, teachers, policymakers and educational professionals wear new lenses and develop a sense of confidence and agency towards possible futures.

A benchmark study was the starting point enriched by internal sessions and followed by two creative workshops that gathered experts from different disciplines.
How to create new languages?
What makes them innovative?

And how can they be utilised in order to cope with complexity, ambiguity and uncertainty?
The ideas collected and the discussions held were analysed and provided the core components for the framework and the recommendations shown here.
We intend them to help us step out of our echo chambers and capture the subtleties that surround our learning environments in the uncharted territories of the futures yet to become. To perceive, imagine and ultimately envisage and thus shape the future.

The unbound framework for New Languages



This framework explains the sources and flows underpinning the co-creation of new languages. A linear trajectory transitions into multidirectionality. It avoids a prescriptive framework, therefore border lines are open and organic considering this representation unbounded.

Languages "yet to become" embrace a constellation of desirable traces and they consider space, time, evolution and interactions for envisioning the future, while grasping and activating the present.