The Global Science Opera Leverage students' participation and engagement in science through art practices

O2 The GSO4SCHOOL

Teachers' Guidelines

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Short Description: This document shares a practical approach to the methodology of the GSO4SCHOOL, a "how to"-guide in working interdisciplinary between arts and science when making a science opera or a scene for a science opera.

During the project lifetime this document will be updated according to the findings from the implementation activities in order to conclude with a final version concerning the proposed GSO4SCHOOL Guidelines.

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GSO4SCHOOL has been funded within the framework of the European Union Erasmus+ programme

1. Introduction

1.1 What is GSO4SCHOOL?

GSO4SCHOOL is an international project that involves 5 countries (Norway, Greece, Portugal, Italy and Cyprus) in which will be created a network of teachers who connect, collaborate and create innovative, interdisciplinary contributions to a bigger, common creation: a scenic expression of scientific and artistic value for the participating students, teachers and their audiences. The artistic expressions range from music, drama, dance, song, ecoscenography, filming and editing, puppetry, composition, etc. It is an Erasmus+ project that can be defined as the teacher-training-program of the Global Science Opera.

GSO4SCHOOL is a living project, constantly shaped, reshaped and developed by all its contributing participants.

GSO4SCHOOL trains teachers and students through workshops, multiplier events and one-week summer-school courses, where collaborative networks are established and nurtured.

GSO4SCHOOL will also provide a context for the understanding of the strengths and weaknesses of the Global Science Opera initiative and propose new ideas to improve it.

1.2 What is the Global Science Opera?

The Global Science Opera (GSO)[1] is a global creative educational initiative in which science and arts are explored simultaneously in an interdisciplinary framework. It transcends boundaries such as national borders, cultural conflicts and age-differences. It aims to connect and celebrate human beings as creative creatures. Annually, students from elementary to university-levels collaborate with teachers, researchers, artists and scientists to create and perform a unified artistic performance on the world-wide stage of the internet. Song, music, dance, drama, eco-art, animation, puppetry, and other artistic expressions, seamlessly interact with, and become integral parts of, the scientific inquiry in which pupils engage. These melt together in the annual opera productions.

Each year a new over-arching scientific topic provides the opera´s inspiration, and each participating school/country works with a sub-topic for their artistic and scientific inquiry. The project is adaptable, engaging, innovative and inspiring.

This document details a recommended structure which describes how you can use the GSO4SCHOOL methodology and become part of the GSO4SCHOOL network.

1.3 What is the goal?

The GSO4SCHOOL project's main aim is to propose an innovative method to motivate school students and teachers to participate in interdisciplinary science-and-arts initiatives and to develop and establish a network that will work together, exchange practices and maintain the Global Science Opera activities

[1] More information on www.globalscienceopera.com

in the Future. The project aims to foster both school students' and teachers' skills in social, science, cultural and arts aspects. This will be achieved through the development of training materials, the training of educators, scientists and artists, and the implementation and evaluation of project activities.

2. The GSO4SCHOOL Framework

2.1 Introduction

The main pillar of the project will be students' collaboration and co-creation. School students will have the opportunity to develop services, products and operate the network as a learning organization that will produce annual performances, educate other school students and teachers at the local and/or national level. This will be achieved through the cooperation of relevant stakeholders and promote the creative methods of GSO4SCHOOL in Europe and beyond. You will find a more thorough presentation of the framework here: http://gso4school.eu/gso4school-framework/.

2.2 Aspects of GSO4SCHOOL

2.2.1 The STEAM-approach

STEAM is an acronym used to describe the collaboration between the fields of science, technology, engineering, arts and mathematics. By emphasizing inter-disciplinary collaboration, the GSO4SCHOOL values each field as equal and aims towards a mutual gain for all subject fields. We believe that all fields can enrich each other through intertwined collaboration (Chappell et al., 2018).

2.2.2 The international dimension

GSO4SCHOOL is an extended collaboration defying national and cultural borders, across ages and societal status, between students, teachers, scientists and artists.

The project adds a new dimension to the Global Science Opera (GSO), by bringing a teacher training approach. Every year, around twenty countries, of all inhabited continents participate in the GSO, thereby constituting a big international effort. As some schools collaborate with other schools in another country, this communication is a great contribution to international friendships and understanding. Joining this collaboration with a higher emphasis on the teaching practice, GSO4SCHOOL creates a framework within the GSO for teachers to more systematically work within the curriculum.

2.2.3 Promoting students´ skills and connecting with the curricula

Creativity, curiosity, critical thinking and collaboration, which lead to experimentation and inquiry, are some of the skills STEAM-fields share. Being open-minded towards new ideas, willing to explore and

ask critical questions, are all part of being creative and effectively learning.

The creative inquiry-based science education is innovative, and GSO4SCHOOL seeks to evolve it into something even better. Applying technical media to reach students in remote places is one example. Having students collaborate simultaneously across the continents is another.

One of the strongest advantages of the teaching-methodology of the GSO4SHOOL, is the encouragement of co-creation by the teachers using it, as it is adaptable to all national curricula, ages/classes, cultures, languages, etc.

2.2.4 The sustainability and environment focus

Through a focus on environmentally friendly design-practice and through addressing scientific issues connected with climate change, ecological sustainability is an integrated part of GSO4SCHOOL. It equips young people with important additions in their educational toolbox when meeting a complex and polluted world. It may also give hope by teaching eco-friendly alternatives to traditional solutions and designs.

In sum, GSO4SCHOOL is an inclusive, STEAM-education initiative that embraces the methodologies of Design Thinking, Wise Humanizing Creativity and (posthumanizing) Creativity. One of the project's priorities is to address diversity in school education, developing social, civic, inter-cultural competences and media literacy by providing an innovative integrated approach.

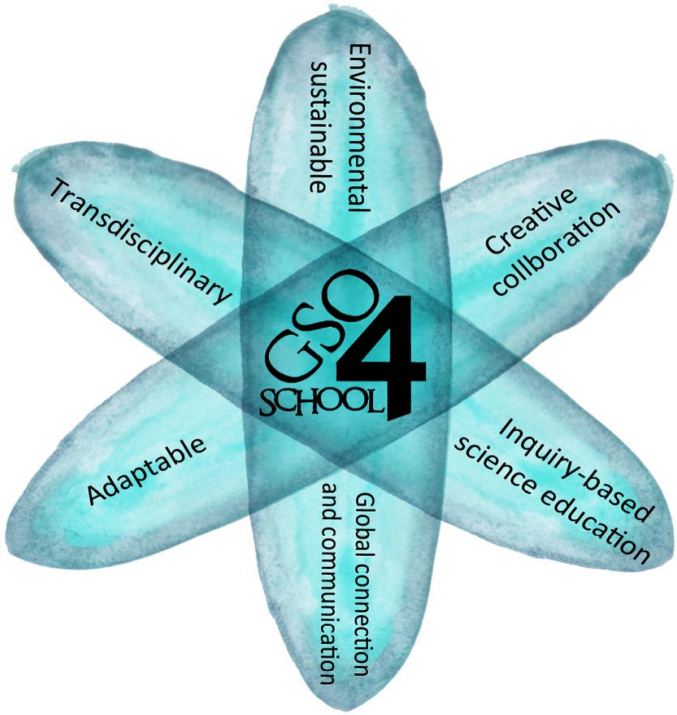


Figure 1: *Model illustrating some of the core aspects of the Global Science Opera (Janne Robberstad 2020)*

3. How to implement the GSO4SCHOOL approach in your class

It is important to underline that there are several variations when implementing the approach, however there are some core elements in the recipe presented below that should always take place.

The GSO4SCHOOL approach provides a section of practices that a school, teacher and students could follow according to their plan and time that are able to dedicate throughout a school year, although performances in the global GSO environment occur in November. There are two main categories of practices and activities that a school can choose: i) the Macroscopic and ii) the Microscopic.

The micro-level entails a science opera realized at your school only. The macro-level entails you and your pupils participating in the collaborative creation of an artistic product in the context of an international network who, together, are creating a science opera, known as the Global Science Opera.

3.1 Macroscopic implementation

The Macroscopic approach of implementing the GSO4SCHOOL activities is when you and your students participate in the collaborative creation of an artistic product in the context of an international and/or national network who, together, are creating a science opera production. This production may be the Global Science Opera. The GSO4SCHOOL engages students and teachers from Greece, Italy, Cyprus, Portugal and Norway, but other countries may also be participating, especially in the context of GSO productions.

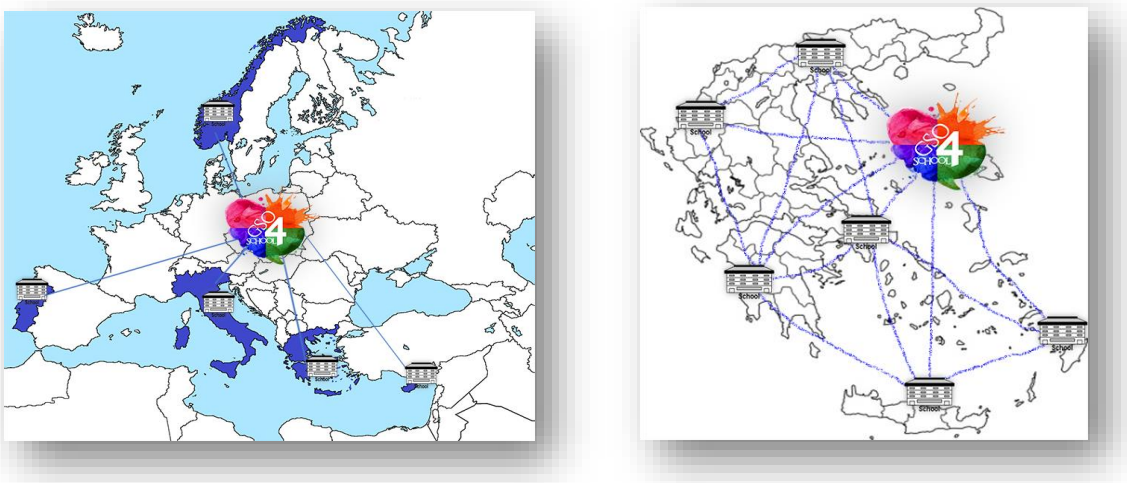


Figure 2: *Illustration of the macroscopic level at international and national level (Menelaos Sotiriou 2021)*

The macroscopic level should adopt all the aspects of the Feel, Imagine, Create and Share approach (see Chapter 5).

International collaboration is an important aspect of the GSO4SCHOOL, and one of the main aims of the macroscopic implementation level. Schools might choose to follow a national collaborative network. We encourage a wide creative collaboration by co-creating with students from another class in another country in addition to the cultural exchange. The GSO initiative and GSO4SCHOOL project coordinates this effort and will help teachers find a class with a similar age-level as their own class. If you wish to participate on a macroscopic level, it is an advantage to make contact early with a collaborating partner, to have plenty of time to plan together. Perhaps one class will make music and sing, and they collaborate with another group who can dance to the music.

When your class has finalized a scene or contribution, you may also participate in the Global Science Opera´s annual performance, by sending in a filmed version of your scene.

Through the Macroscopic implementation, GSO4SCHOOL will involve the school students in activities where they will collaborate, lead and co-create their own performances from scratch, while investigating specific issues related to science subjects of their curricula. Based on science themes they are going to go through all the steps of an opera/theatrical production while the consortium will support them with all the relevant scheduled activities. Through this approach the participants will learn to collaborate, lead and manage in order to develop a full-scale production. This process will require innovation, exchanging of new ideas and development of cross-sectorial skills such as entrepreneurship skills, teamwork, communication skills, while at the same time they will become more motivated and familiar with concepts of science.

You are free to choose how much time you will use on this process, but we recommend a time-frame of 2 hours a week for 4-5 months to implement this approach. When you spread the timeframe over the course of several months, you increase the possibility of arranging online meeting-points with another class in another country to collaborate with. A cultural exchange by letting collaborating classes meet in a live session gives an added value. For older students who can communicate in a common language, they can have a common kick-off session online, and even collaborate through a Google doc or similar in the planning and creating-process. We believe it is peace-work in practice to have friends from different cultures.

3.2 Microscopic implementation

The main aspect of microscopic implementation is that the school/classroom will implement its activities only within that school/classroom without collaborating with other schools.

It is up to school to decide the amount of time it will dedicate to the process, and to adapt the length of the performance accordingly. You can choose either to use a few hours a week over some months, or one or two whole, compact theme-days. For example, in the microscopic approach, a school is able

to dedicate only several hours within a year. The time dedicated could follow the form of 2 hours per week for several months or could be limited to a few hours within the classroom (e.g. 2-3 hours).

The final output from this implementation approach could be a short performance or even only a science opera scene. It will not necessarily result in a full opera production but results will be shared with other stakeholders within the school or local community in any case.

The microscopic level should adopt all the aspects of the Feel, Imagine, Create and Share approach (see Chapter 5).

On the GSO website you will find a link to a The Write a Science Opera Guidelines in several languages: https://globalscienceopera.com/resources-media/, that could support your efforts.

There is also available a number of more specific GSO4SCHOOL tutorials, addressing the different subject-approaches, like GSO4SCHOOL music, GSO4SCHOOL dance, GSO4SCHOOL ecoscenography, GSO4SCHOOL drama, etc.

4. The general recipe

The model is a visual recipe highlighting the different steps in the process towards making a GSO4SCHOOL scene on a macro-level. The same process is followed in a local micro-level complete science opera. We connect the different steps of the process with the methodology, as described in Figure 3.

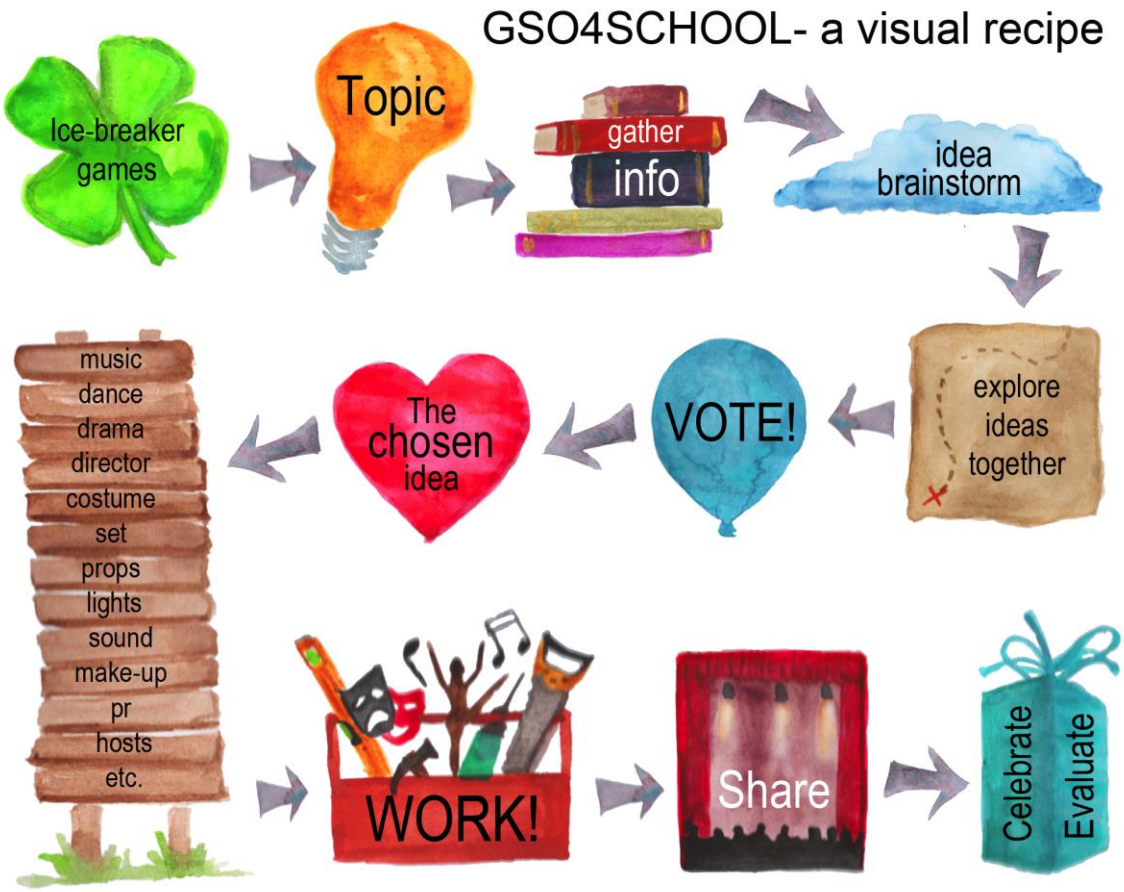


Figure 3: *GSO4SCHOOL – a visual recipe (Janne Robberstad 2020)*

5. The GSO4SCHOOL approach

The GSO4SCHOOL methodology uses the following four steps as a practical base to encourage and describe the creative process: Feel - Imagine – Create – Share. These steps are based on the **Design Thinking education** (Gudipati & Sethi, 2016), a design methodology that provides a solution-based approach to problem solving. These four steps have the ability to lead a process where human beings are seen in a holistic, creative and respectful manner and where any given process is developed in an inclusive way. The methodology is also influenced by **Wise Humanizing Creativity** (Chappell, et al., 2016) and **(posthumanizing) Creativity** (Chappell, 2018), which emphasizes the importance of collaboration and ethics in collaborative creativity. We need to actively choose to use our creativity wisely and for the benefit for all: for the planet and all its inhabitants.

Figure 4: *The Four steps of Design Thinking: Feel - Imagine – Create - Share*

The following is a short explanation of what each step of the process means and what it contains. These steps are the same, whether you conduct a macroscopic implementation (collaboratively) or short-term or long-term microscopic implementation (be it 2 hours, 2 days, 2 weeks, 2 months or a whole year!).

It is important to note that, like all creative processes, this is not necessarily a strict linear process, sometimes you may go back-and-forth between the different steps of Feel – Imagine – Create and Share.

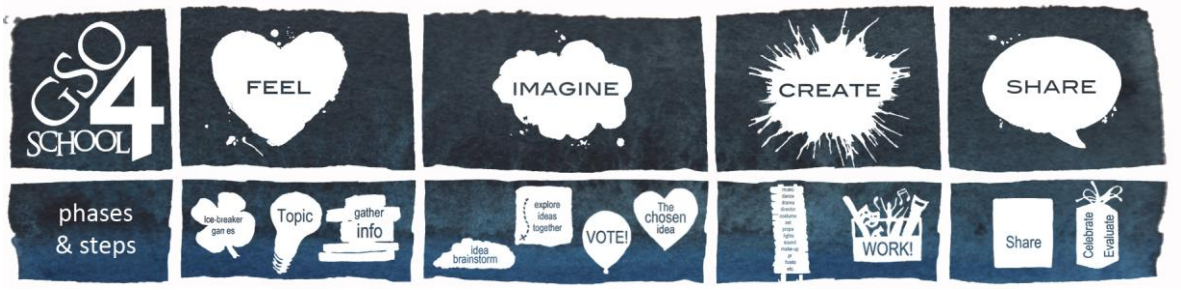


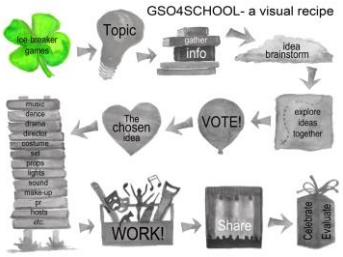
Figure 5: *shows which recipe-steps are connected to each methodology-phase in the process.*

5.1 Step 1: FEEL

FEEL is the first encounter that students, teachers, researchers or anyone has with a given topic. It is the moment where a deep investigation is made in order to collect all meaningful information about the subject at hand as well as about all those affected by it. In GSO4SCHOOL, specifically, it will be the moment when the students will learn all about the scientific theme of the opera, its implications in their daily lives, the way it affects their community locally and humans globally. It will also be the phase where students and teachers together decide on which artistic approach they will choose to explore, and it will mark the beginning of the creative process. Students can learn about the topic through simple research, but they can also engage in surveys to the community, visits to expert facilities, etc. It is up to the teachers to decide how they will guide the students into their learning journey. The three first steps in the recipe are connected to the Feel-phase: Icebreakers, Topic and Gather information.

5.1.1 The FEEL – recipe

5.1.1.1 Icebreaker games

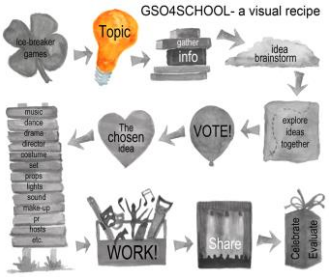


Not all students are used to working together creatively and expressing themselves artistically in a collective setting. Some students can be shy, others silly and making fun of themselves and others. In order to establish a safe environment without any bullying, playing games related to drama is an integrated part of the methodology. Games can serve as icebreakers for groups where the participants don´t know each other at all, but also for groups who know each other well, albeit not in this type of setting. It can also serve as a change of gears for the mind, to "set the mood". Small games and physical exercises should be continued throughout the process, as warming-up exercises. Some examples can be found in the appendix.

Warming up

At the start of each session, take the time for a short warm-up. This can be physical and playful; it can help loosen the vocal cords and release stress. Create a safe environment where the students are expressing themselves artistically. Exercises can be directly connected to drama, for instance training students in facial expressions, speaking clear and articulately, or to drawing, painting dancing, etc. all that has to do with inspiration-unlocking exercises. Some examples can be found in the appendix.

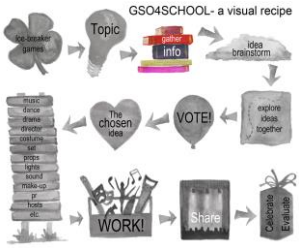
5.1.1.2 Idea / Topic



On a micro-level you and your students can freely choose the scientific topic you wish to explore. The topic can be from the national curricula or it can be an issue that the students are concerned about on a local level. By connecting larger global issues to local issues, the students may become empowered in their attempt to find solutions, instead of feeling discouraged and overwhelmed.

On a macro-level the main scientific topic is chosen by a consortium of partners or the GSO4SCHOOL summer-school participants, and sub-topics connected to the main topic are delegated to the participating schools in order to develop a whole meaningful story with as many aspects of the scientific topic as possible.

5.1.1.3 Input / gather info



Encourage students to pose questions connected to the topic or issue and guide them in their scientific search of gathering information to answer their own questions. This process is inspired from the Inquiry-based science education model. It is essential that the science presented throughout the process is correct, which is why it is important to start the process by gathering and sharing information with your students in an inspiring kick-off session. Feel free to add elements that can stimulate several senses.

For Macro-level Implementation

Decide with your collaborative colleague at the other school if you want to do some of these steps together. The more meeting-points you manage to organize, the larger the cultural outcome. You can invite an external expert to present the scientific topic in a kick-off session, and have both classes join online. You can also organize an online collaboration via a shared document or in a live session, where the students from the different groups can share their ideas and background information with each other. Idea/topic: You can arrange a circular creative session online with the other group. This requires some planning and needs to coincide in time.

Practical tips for teachers

- Start by presenting the theme to students in an engaging way (ex. through a video, a challenge, an enigma, a debate, inviting an expert, etc.)

- Make sure you use multiple ways of representation (video, graphics, text, images, etc.). Each student has a different way of learning and different means of representation are effective for different people. By using several, we increase the chances of effectively engaging more students.
- Don't give answers to the students, instead ask them questions that will make them think. Spark their curiosity, let them make their hypothesis and make their own research to find the answers.
- Guide your students with meaningful questions that foster their critical thinking and creativity.
- Learn all you can about your students and let them have an active role in the decision about the artistic approach to follow. If students are engaged, they learn much more. Throughout the project the students will train their skills in independence, in taking initiative and being responsible.
- Use creativity and inspiration games to help students begin their creative process.
- If students feel lost in the process, be a present guide and research together with them.
- Make sure you provide the opportunity for all students to be involved, including the shy and the hyper-active, respecting all types of personalities: the visual, the auditory, the haptic, the multimodal; the refugee with another language, the impaired or handicapped. You can find examples in the tutorials.

5.2 Step2: IMAGINE

IMAGINE is the step where students will imagine possible solutions to the problem / topic at hand. If during the FEEL step, they have learned all about the topic, this is when they start imagining what they can do about it. In the case of the GSO4SCHOOL, it will be the moment where students start imagining what type of creation they will make, how they can make it, what it will include, which students will do what, etc.

The first thing to consider in this phase is "who is the target audience of the creation". Knowing this, students will be able to decide what type of creation they will make and create much more meaningful contributions to the audience. On a micro-level the audience may be their parents or another class. On a macro-level, it is potentially the whole world, but they should then use their own age-group as a guideline for the scientific level, being aware that there is also a young audience. In both cases be aware of and avoid language and certain topics (like speaking ill of another religion) that may offend others. After deciding the audience, the timeframe and the dimension of the project, students can start using their imagination.

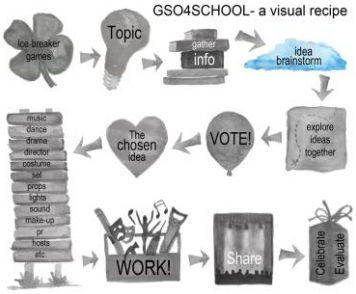
In this phase, it is important to promote brain-storming moments where all students can explore their imagination and give all their ideas. Teachers can participate in this process as part of the teachers-students team and collaboration among schools is encouraged (macro-level). By discussing with other schools what they will create, students can provide a much more meaningful contribution to the opera. This is also the phase where each team will decide whether they need help and/or collaboration from other schools at a national or international level. This is basically the difference between the micro- and the macro-level, if you choose to make a small opera on your own (micro-

level), or if you collaborate with international colleagues (macro-level). This can be arranged via the network, the national and the international opera coordinators. In either case, every group will go through the following process, weather they are creating a short scene based on a sub-topic for a macro-level contribution, or a whole micro-level story around a scientific topic.

The Imagine-phase contains the next four recipe- steps: Idea-brainstorming, Explore ideas together, Vote and Chosen Idea.

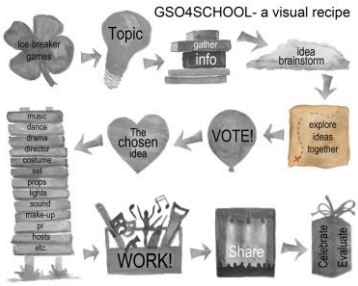
5.2.1 The IMAGINE – recipe

5.2.1.1 Brainstorm



Once the theme is set, and a presentation of scientific facts are presented, all students are asked to share all the things they are intrigued by, fascinated by and want to know more about in the form of questions. The questions are written down on the black-board (micro-level) or a shared online document (macro-level) so everyone can see. Discuss in the class which are the most interesting questions. Some may be similar, try to connect them. On a macro-level, you can do this partly in your own classroom, and partly by sharing the questions and answers with the other group via a shared online document or an online live-streaming session.

5.2.1.2 Explore Ideas together



In order to make the creative process democratic, divide the students into smaller groups (4-7 in each group), where it is easier for all students´ voices to be heard. Depending on how many groups you have, you can choose to combine or add to the tasks asked of the groups. Make sure to check if the science is correct as the stories develop. On a macro-level, this can be done via a shared online document. Alternatively, some online streaming software have break-out rooms, like Zoom, where the groups can gather from different places or schools and discuss.

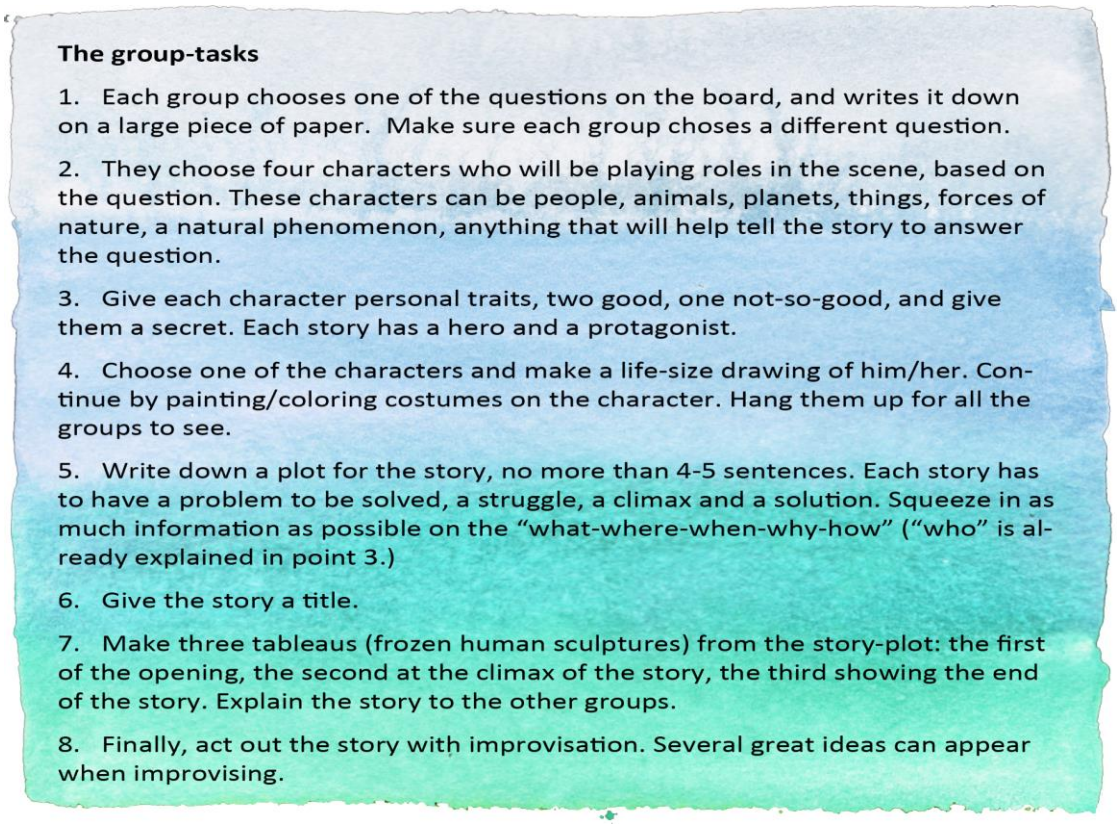
Circular creative collaboration

Between each step in the story-making process, forward the paper to the next group in a circular matter, for them to continue the creative process. Group 1 gives their paper to group 2, which hand their paper over to group 3, etc., until the last group hands over their paper to group 1.

Continuing this circular sharing of ideas, ensures that each group contributes to every idea. So at the end, all ideas are a result of a collective creative process. Which in turn, when at the end of the process one idea is chosen as the base for the continued work, no-one "looses" and everyone "wins". On a macro-level, this can be done via an online shared document. You can also use online streaming services with break-out rooms, like Zoom, where the groups can gather from different places or schools and discuss.

The group-tasks

You may have to adapt the number of steps and tasks in this list to your class/group, but make sure you get the essential part of the story-developing. Once the group has completed their task, they give their paper to the next group in the circle. If you choose to work online with another group on the macro-level, a combination of live sessions (like Zoom) and shared documents (Google docs) are a good option. The groups need to talk with each other in the break-out rooms, and write their ideas in the Google-doc, as they need to circulate to the next group. This has some limitations when you get to the more practical "on-the-floor"-exercises, like point 7 and 8 below. But then you may shift the groups around, to make sure that all members are in one class/place, if you have had combined groups from the two schools.

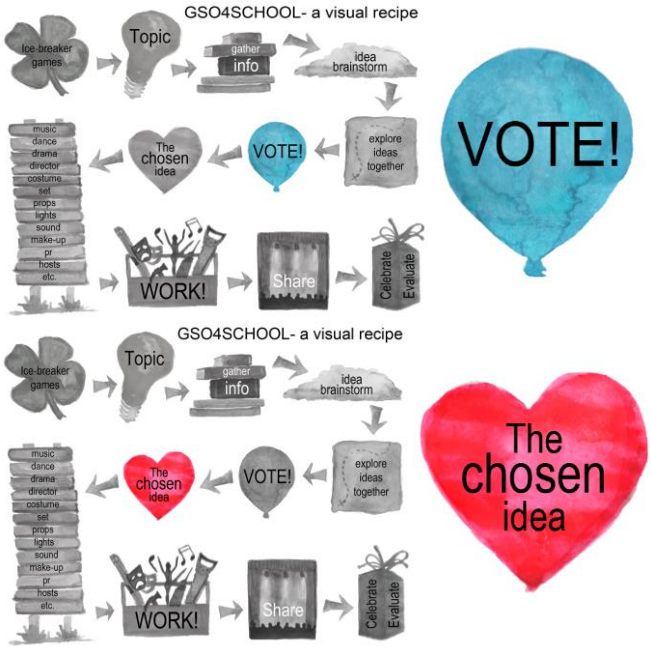


The group-tasks

1. Each group chooses one of the questions on the board, and writes it down on a large piece of paper. Make sure each group choses a different question.
2. They choose four characters who will be playing roles in the scene, based on the question. These characters can be people, animals, planets, things, forces of nature, a natural phenomenon, anything that will help tell the story to answer the question.
3. Give each character personal traits, two good, one not-so-good, and give them a secret. Each story has a hero and a protagonist.
4. Choose one of the characters and make a life-size drawing of him/her. Continue by painting/coloring costumes on the character. Hang them up for all the groups to see.
5. Write down a plot for the story, no more than 4-5 sentences. Each story has to have a problem to be solved, a struggle, a climax and a solution. Squeeze in as much information as possible on the "what-where-when-why-how" ("who" is already explained in point 3.)
6. Give the story a title.
7. Make three tableaus (frozen human sculptures) from the story-plot: the first of the opening, the second at the climax of the story, the third showing the end of the story. Explain the story to the other groups.
8. Finally, act out the story with improvisation. Several great ideas can appear when improvising.

More information on all these steps are found in the WASO guidelines (www.globalscienceopera.com/resources) or in the WASO-book (Smegen & Ben-Horin, 2020).

5.2.1.3 Choose the idea(s) - Democracy in practice



Now that all the stories are presented to the whole class it is time to choose one of them to continue working on. Since everyone has participated in creation of all the scenes, the choice is more likely to be of the best idea, rather than "my" idea. The vote should be secret, just like in a democracy. And as in a democracy, the idea with the most votes, is elected. On macro-level, make sure all votes from both/all collaborating schools are counted.

Practical tips for teachers

- Collaborate with fellow teacher colleagues from different disciplines to promote an interdisciplinary view of the project.
- Mind maps are a great way to promote brainstorming with the students.
- Collaborative digital tools like Padlet[2], Mindomo[3], allow for distance collaboration.
- The more ideas students suggest, the better the outcome will be, so foster the idea that ALL ideas are welcomed, even if they don't look possible to begin with. The "impossible" and weird ideas often turn out to be the most exciting!
- After brainstorming, collaboratively organize the ideas into categories (e.g. You can divide the ideas into: Simple-Complicated-Easy-Difficult-Crazy-Possible-Outside comfort zone-adventurous, etc.). This is a fun way to start selecting the ideas to be followed.
- Make sure you don't categorize students' ideas as good or bad. No judgment should be made as students should feel secure and comfortable to be able to use their inspiration and creativity.
- Encourage ALL students to share their ideas and foster an environment of respect and collaboration.
- Use self-assessment tools like journals to evaluate each student's skills, expertise, passions, etc. that can be useful in the project. Every single student will have at least one unique contribution to the project, given the opportunity.

[2] https://padlet.com/
[3] https://www.mindomo.com/

- Embrace "crazy" ideas and allow students to work to achieve them.
- Be open to the possibility of combining some of the ideas that can complement each other.

5.3 Step 3: CREATE

Creativity is the most sustainable and renewable source of energy one the planet! Let´s use it! (Alison Tickell, 2012)

The **CREATE**-phase is where all the ideas and imagination come into form and where we concretize our ideas. While in IMAGINE, students and teachers brainstormed and explored ideas about what they could create, this is the moment where they actually create something. In this phase, students will put their work into action, make a concrete plan of how they will work towards their goals and collect all the materials they need. Students should be organized, plan everything in advance and predict possible challenges and how to overcome them. That being said, sometimes, great artistic ideas evolve as a result of a process, just like in science: when a scientific thesis is refuted through experiments, an artistic process can develop in an unprecedented direction. A brave teacher may follow the flow in an organic matter while still "keeping an eye on the ball". An experienced teacher learns to trust the creative process, though it may seem chaotic and scary when you are in the middle of it.

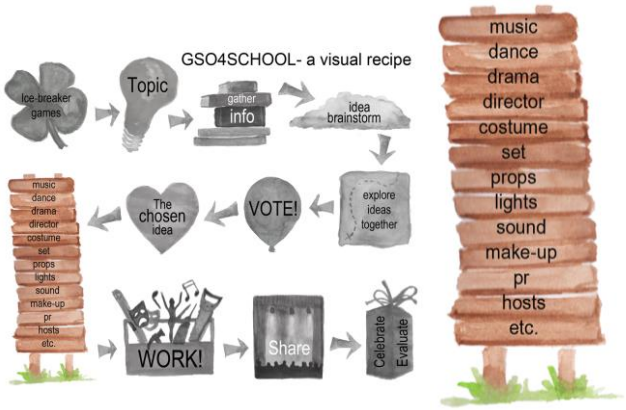
The process can be fluid and teachers and students can have their own strategy. Considering that during the IMAGINE phase, students have already decided on what they will create, one example of an organized strategy can be:

- Design a concrete plan with a step-by-step approach and an inventory of the materials you will need. This plan should already describe the tasks attributed to each team member.
- Make a prediction of possible challenges and ways to overcome them.
- Collect all the necessary materials.
- Put the plan into action.
- Take time to analyze the progress, take notes and re-adjust the plan if necessary.
- Register the progress, the challenges and how you overcame them (this diary may be useful to future projects and/ or other to teams trying to create a similar project.
- Take pictures, make videos and use creative ways to register the whole progress.

The Create-phase includes two recipe-steps: the Groups and the Work! On a macro-level, this is often when the schools separate and work with their own part of the project. One school may be responsible for the music, another school the dance to the music. In these cases, you have to plan for a time-shift, to keep one group from waiting for the other. There are many other tasks that can get attention while one waits.

5.3.1 The CREATE – recipe

5.3.1.1 Group-work



Staging a Science Opera requires a lot of work! And in a lot of different fields. Not everyone can or need to be on stage. There are plenty of tasks waiting. Depending on your access to the three main resources: time, funding (or material) and people (expertise), divide the students in the groups you need. Each group chooses one leader, who is in the artistic team with the opera-director. This process is the same for both micro- and macro-level.

Here is a list of potential groups:

Drama – this groups further develops the plot in the chosen idea, write the text, divides roles between them and rehearse until they know everything by heart.

Music – this group will compose the music in the scene. They can both be composing a melody with lyrics and/or create a soundscape of sound-effects to help tell the story. It can be a basic rhythm banging on found objects in the room, or it can be a full composition for a youth orchestra or a choir-song.

Dance – this group can choreograph movements to the music that the music-group creates or can even dance to spoken words or silence. When performing in the macro-level, make sure you have license to use borrowed music that you have not created in the group.

Directing – the director or opera manager is responsible for coordinating the groups, making sure everyone is pulling in the same direction. The director is the artistic team-leader that coordinates the effort of each team and the teachers. (S)he is also the one who makes the final artistic decisions together with the teacher. Often (s)he will also be responsible for directing the filming of the scene.

Costume – this group is responsible for creating, finding, borrowing (and returning!), and sewing the costumes (the clothes) for the actors.
Creative challenge: How do you make a girl look like a volcano? How do you make a boy look like the planet Jupiter?

Scenography – this group is responsible for the visual physical world surrounding the performance. They will find the best location (site-specific), find and borrow (and return!) elements that can be used as set, they will create, build, paint the things necessary to explain the world where the story takes place.

Props – A prop is anything the actor carries and uses during a performance. This group is responsible for finding, borrowing (and returning!), or creating props needed by the actors in the scene.
Creative challenges: Find out which props are essential, and avoid overdoing it.

Make-up – this group is responsible for accentuating the actor's features, so they can be seen from afar (micro-level) or will show well on film (macro-level).
Creative challenges: how do you paint the face of a cat? Of an alien? Of gravity?

Technical – this group is divided into several smaller groups: lights, sound, filming, editing. Lighting and sound are necessary for both micro- and macro-level. Film-editing for the macro-level: All filmed scenes containing spoken or sung words, must contain English subtitles, even if they are spoken or sung in English.

PR – on a micro-level this group is responsible for making a poster, a program, for possibly finding sponsors for the performance. Sponsoring doesn´t have to mean cash, it can also be borrowing a specific piece of clothing or equipment or being gifted a special prop that is needed. Remember to thank properly!
On macro-level this task requires promoting the local participation at your school for the parents, perhaps in the local newspaper.

Eco-art – this group can be part of the set-design group or it can work independently. Their main task is to ensure that the whole production-process is as environmentally-friendly as possible. It is a positive effort in seeing possibilities in what is available to be creative with.

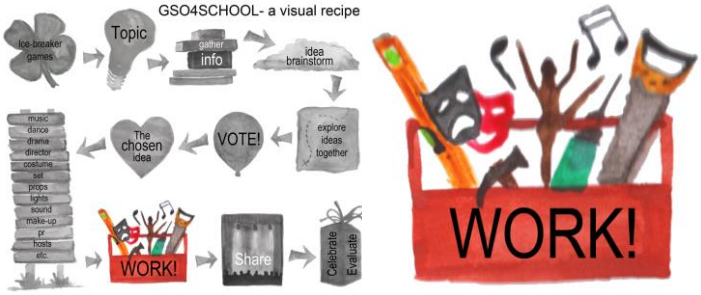
For micro-level:

Hosting - this group welcomes the audience to the venue and help out with practical issues like seating arrangements. During the production-process they serve as a social-group, making sure everyone is ok and enjoying themselves.

Integrating sustainability

All groups should bear in mind to be as environmentally-friendly as possible during the process. Being sustainable means to take care of people, planet and prosperity. This means not wasting and being resourceful. Use things you already have access to, rather than buying new thing. Take care of what you have, wash and mend costumes, clean props, store set-pieces, so they can be used for future performances or projects. Avoid using toxic materials and save energy when possible. Being planet-friendly also mean being people-friendly, take care of each other during the process, even if stress-levels rise.

5.3.1.2 Work



Assembly

Once all the different groups have worked on their creating, rehearsing, composing, playing, dancing, making, building, sewing, painting, fixing and mixing, it is time to pull it all together on stage in common rehearsals. For a micro-level performance, which is usually a much longer performance than a scene on macro-level, it is a good tip to divide rehearsals into focus-areas: a run-through, a run-through with costume & make-up, a run-through with focus on the technical. Also, when scenes are filmed for the macro-level, prepare students for several takes, perhaps from different angles, so it can be edited together in a combination of close-ups and overviews.

Dress-rehearsal

The final rehearsal includes everything, on-stage, back-stage, front-of-stage. This is important so everyone can get a practice-run and feel safe in their own contribution.

Practical tips for teachers

- Help your students find the right tools to design their plans. These can either be on paper or digital. e.g. Trello[4], mind-mapping tools, tables, etc.

[4] https://trello.com/

- It is normal that students aren't used to designing a plan so make sure you supervise and guide them with questions instead of giving them the direct answers.
- Allow your students to make mistakes and figure out the solutions on their own, by trial and error. This is the most effective way of learning.
- Teach your students efficient economic principles when using materials to avoid unnecessary waste
- Ensure a creative environment where students can listen to music, put pictures on the walls, etc., anything that promotes inspiration and creativity.
- Promote the participation of all students, according to their skills and personality.
- Whenever something goes wrong, promote a positive approach. Let students understand that mistakes are part of any learning journey and a positive attitude is very productive.

5.4 Step 4: SHARE

SHARE is the final phase of the process. It is the moment where students will share their work with their target group (other colleagues, other classes in the school, the whole school community, families, the whole science opera community, the world!). In this phase students develop their communication skills by presenting their work to others in an effective and creative way.

Students and teachers will decide how they want to present their work to others and to whom they want to present it to. They can also put together a dissemination plan and start developing marketing skills. Students will feel proud to have their creations shared, so they can create a poster, leaflets, social media strategies, etc. to bring visibility to their creations (this is, however, optional).

In GSO4SCHOOL the share-phase can have two dimensions (and both can happen simultaneously):

1. Sharing locally to fellow colleagues, school community, families or local community. (Micro-Level, see section 3.2)
2. Sharing internationally by integrating the work in the Global Science Opera (Macro level, see section 3.1).

"Sharing is caring" is a saying. But more than that, it is a good way for students to internalize their knowledge through sharpening their message by way of their creative output. Sharing your creation with others, showing what you and your students have made, can add an extra joy to the creative process. The process is more important than the finished product, but the finished product is an important part of the process. Creating a good product, something to be proud of, should be taken seriously by the teacher, as it enhances the experience of the whole project for the student.

Big or small audience, it is important that the scientific content is correct. The learning-process is

mainly for the participating students, but it doesn´t hurt if the audience learns something new too!

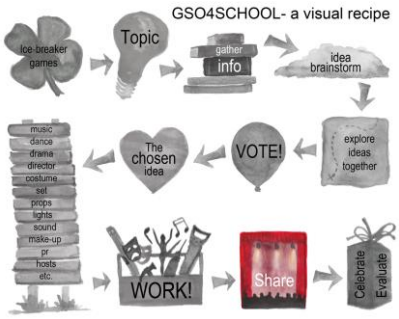
Involving the local community and families has value beyond using them as a passive-supportive audience. Students may pass on scientific and other knowledge that their audience may not be familiar with, and as such the audience can increase their knowledge-horizon.

It is also about sharing the students' engagement for and with the local community and the original scientific topic that they addressed in the Feel-phase. Many of the sub-topics the students are working on, are directly connected to local issues and challenges, and actively trying to solve them may empower the students´ confidence in their ability to influence their own surroundings and future. This effect may increase when they are allowed to share their thoughts and visions with the audience.

The Share-phase includes the Share-step and the Evaluate & Celebrate-step.

5.4.1 The SHARE – recipe

5.4.1.1 Sharing through showing



In an artistic setting we would call this the *show* or the *performance*. In an educational setting we want to call it *sharing*. When the students show what they have created, they are sharing it, either with a local audience of parents and fellow students on a micro-level, or via film to a global audience on a macro-level. The ultimate ambition of the GSO4SCHOOL project is to elevate students learning, so the students are the actual target-group. But by inviting students to share what they have learned through creative and artistic expression, can deepen the experience and in turn the knowledge.

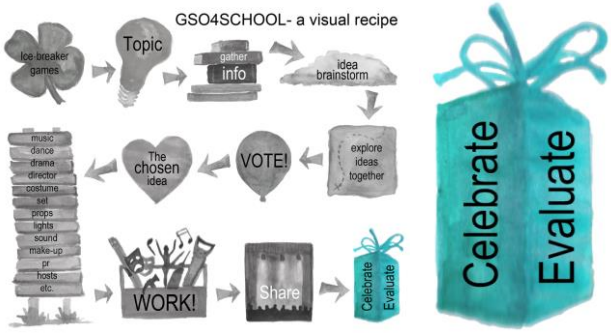
The finished result, producing a show, may sometimes steal focus from the process. And in GSO4SCHOOL, the students learning-process is the most important. This does not mean that one should be indifferent with the quality of the final product. For the process to be motivating, one must work towards a holistic product of high quality. Where the science is factual and the artistic level is good. Being co-creators of something the students are proud of, builds their confidence as well as their knowledge. The creators of the show are in that sense the aimed focus-group for the show, not the audience per say. The students are creating the show by themselves, with themselves and for themselves. And they invite an audience to join in celebrating the sharing of knowledge.

This is valid both on the micro- and macro-level.

For the macro-level, the scene will be filmed and this will be shared with the national or international group and become part of a whole opera. If it is an international collaboration you may need to add subtitles, to increase the understanding for the audience. Students often find filming and editing

exciting work, so don´t hesitate in inviting them into taking responsibility here. It is important to pay attention to the technical quality of the recording. The students can sing their song perfectly, but if the audio is one share microphone many meters away outside in the wind, the audience won´t hear this. Audio, picture and editing of film is worth paying extra attention to, to emphasize the quality of the students´ work. Prepare the students for more than one take, to have several options to choose from. You can combine over-views and close-ups when you film.

5.4.1.2 Celebrate and evaluate



The end of the GSO4SCHOOL process doesn´t end after the applause has silenced. The aftermath of the process has two important aspects: evaluate and sustain.

Celebrate and sustain

At the completion of the performance, it is nice to show the students appreciation of their effort. A celebration means recognition, and giving credit where credit is due. Some of the essential contributors to the performance may be "invisible" for the external audience, as they are not performing on-stage, but should nonetheless be *seen* and complimented for their effort. It is often the off-stage crew that makes the show possible, and every part of this effort is valuable.

It is also important to teach the students that the project is not over as soon as the audience starts their applause. Everything they have created, must be cared for. Costumes must be cleaned, props must be stored, set might be recycled, everything must be tidied, returned and looked after. Give all the students their special task in this part of the process that they are responsible for, and praise them for their work!

On both macro-level and micro-level it is important to follow the schools policy on personal data sharing. Are the students' names going to be published in the program or in the credits-roll? If yes, you will need the parents´ signatures in a letter of consent.

Evaluate

It is important to give the students time to evaluate the process and what they have learned through it. Give them a chance to reflect over their own personal process within the groups process. Not only *what* they have learned, but *how* they learned. How do they reflect on their own learning-process? Have they learned in a different way? Have they learned other things through this way of working? At this point of the process, the students become our teachers, and we can learn much from their feedback. On a macro-level, ask the students what they have learned from the cross-cultural collaboration and how this possibly differs from conventional class-room teaching. Ask about challenges and benefits.

Practical tips for teachers

- Make sure there are enough rehearsals so all students feel comfortable in their presentations.
- Make sure you have signed consent-letters for all your students, if they are being filmed for a national/international macro-level participation.
- Borrow proper recording/filming-equipment for a good result. Ask colleagues for technical assistance if you feel you need it.
- Film close-ups in addition to overviews and edit them together. This can make a scene more interesting to watch and easier to understand for an outside audience.
- Take time to make sure the film-footage and sound-recording is of good quality. Films should be 1920x1080 quality, with a bitrate between 10Mbit/s and 25Mbit/s. The audio should be 256Kbit/s or above. This makes editing easier and the quality much better. Films should be in .mp4 or .mov format.
- Involve the hosting-group in showing appreciation for the students´ contributions.
- Teach the students about the important "afterlife" of all the things that have been used on stage, and to take care of them.
- Encourage the students to reflect upon what they have learned and what they want to keep on learning.
- Encourage the students to notice and appreciate each other's effort.

5.5 Timeframe

Estimated timeframe

An approximate timeframe will be helpful for each phase. It is up to each teacher to choose how much time (s)he wants to use on the project, the methodology is adaptable for a timeframe from a week to a year.

However, we would like to address the difference in time required for the macro- and the micro-level participation.

The macro-level participation should be a multi-month effort as it will need the collaboration of schools either on a national or an international level. This means that a school team should collaborate with other school teams in order to create a common opera. A national macro-level means that many schools from the same country collaborate on a national opera. An international macro-level means many schools from different countries collaborate in creating an opera and/or participate in a GSO production.

The micro-level means that this should be a short "version" of the GSO. The school team do not need to create a whole opera, although if you want to, you can. If you do, it will still only be one school

participating, hence the micro-level. Depending on the size of the micro-level opera, it could be created in a day or over some weeks or longer.

The GSO4SCHOOL tutorials will provide more practical approaches to implementation on both macro- and micro-level.

Practical tips for teachers

- Leave room for improvisation, allow yourself time and space to follow up on interesting input from the students. This is important in all phases, but especially in the Feel-phase.
- Allow new questions to surface, curiosity for new knowledge should always be applauded. It is also the students´ questions that the creative work is inspired by.
- A collective creative process might sometimes feel overpowering, a good timeframe will help keep you and the students on track (while still leaving room for important input that needs attention).
- Once you share what you/ your students have created, leave room for feedback and reflections from audience (be it other students, parents, community), as well as students and other involved partners.

Below is a suggested timeline for a participation-process. This can apply to both the macro- and the micro-level. Even if the time spent on the project differs, be it days or months, the steps, the principles and the concept is the same.

Figure 6: *The GSO4SCHOOL recipe, gives a short overview of what is expected from the students and the teachers, and what the learning-aims are. It is thoroughly explained above.*

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7. Appendixes

7.1 Additional Global Science Opera activities

In addition to creating and performing a scene for the Global Science Opera, there are several other activities connected to the initiative. They are beyond the scope of this basic "everyday"-recipe, but they are shortly presented here, so you are aware of them. You can find more information about them at www.globalscienceopera.com

The Global Science Opera Innovation Lab – an inspirational and practical scientific tutorial is created and made available for teachers who don´t feel confident in teaching the science connected to the annual topic.

The Global Science Opera Choir – a song is composed based on the main scientific topic and a playback is provided, so all classes who want to contribute, can join in this low-effort participation. Special tutorials are available. All contributions will be edited together in a collaged film.

The Global Science Opera Dance Mob – a low-effort choreography is made for all to join in. Special tutorials are available. All contributions will be edited together in a collaged film.

The Global Science Opera Symphony Orchestra – a melody is composed based on the main scientific topic and sheet music is provided, so Youth Orchestras can contribute in this advanced participation. All contributions will be edited together in a collaged film.

The Global Science Opera Eco-art-gallery – a low-effort contribution for all to join in. It is an artwork created in connection to the scientific topic, for instance a land-art installation, or a sculpture made from recycled materials. The piece is photographed and presented in a slideshow or collage in the GSO. Alternatively/additionally, it can be projected onto a screen or wall and used as part of the scenography.

GSO4SCHOOL has been funded within the framework of the European Union Erasmus+ programme

7.2 Examples of Ice-breaker-games

1. Stand in a circle, where everyone can see each other. Each person in turn says their name and … "My ship is loaded with (something that begins with the first letter of my name)". The second person in the circle says "my ship is loaded with (whatever the person before him said, and then a new thing that begins with the same letter as his own name)". This goes all around the circle, until everyone has participated. Who can remember all the things?
2. Groups of 3 or 4 students. Each group creates an improvised little story, where they use the names of the people in the group as much as possible. All groups show each other.
3. Sit in a circle. Say your name and something you are good at. The next person repeat the previous person(s) name and talent, before adding his/her own. This is a good exercise because it focuses on the positive traits of the students. Sometimes it can be surprisingly difficult for young people, especially teens, to say something positive about themselves.

7.3 Examples of warm-up exercises

1. The rhythm of the tropical rainforest

This is a physical warm-up exercise that also requires concentration and observation.

Stand in a circle. Gently tap one finger onto the palm of your hand. Then two fingers a little faster. Snap your fingers even faster. Tap 4 fingers onto the palm of your other hand. Then clap. Then use both hands to slap your thighs. Then stomp your feet. Finally stomp your feet and use your hands to make as much noise as you can by slapping your whole body quickly (it shouldn´t be painful, but make noise!). Gradually reverse the stages until it is a very soft, soft sound of one finger gently tapping onto the palm of the other hand and then complete silence. The entire exercise is done without the use of voice, which means concentration is needed for when there is a shift. This exercise will increase blood-circulation, and awaken the class!

2. Calming concentration and breathing exercise

Fill your body with air, and say the entire alphabet (with sound) on one exhaling breath to the beat of one letter pr. second. The teacher marks the beat. When you are out of breath, stop talking and wait. Can anyone reach the Z? Do it one more time. You will probably see that everyone reaches further the second time around.

3. Follow John

One in the group leads the others, they copy the movements. Find as many different movements as possible. Use music. Change the leader who is being copied.

4. Dance!
Put on some music that the students have not heard before, and ask them to use the entire space when they are dancing. They should use all levels: near the floor, knee-height, above their heads, they should use the corners of the room, the walls, not just the middle of the floor. Step one is to ask them to be expressive in their dance and movement. Can they dance like they are tired? Happy? Angry? In love? Etc.

5. 1-2-3 red light!
All but one stand against the wall, their task is to reach the other wall first without being seen moving their feet by the one student who is at the wall. He turns against the wall so he cannot see them while shouting "One, two, three, RED LIGHT!", then turns back again. If he sees anyone move their feet, they have to go back to start.

6. Concentrated arguing
Ask two different students to a discussion around a mundane, non-important topic for example toast or ties or tractors. One student is pro, the other against. They should talk simultaneously, eagerly trying to convince the other part without shouting. They one who can argue the longest without being distracted, wins. Let the other students be judges, to make sure no dirty tricks are being played.

7. Concentrated movement
This is an exercise that is totally quiet. Two and two students together, mirroring each others movements in slow motion. At first, let one lead and the other follow. The advanced version has no defined leader, but can be a smooth transition between who leads.

8. Stand in a circle.
Throw a ball between the participants while creating a story using short sentences. Each person says only one word when the ball is thrown. Try to get a rhythm of one word pr. Second.

7.4 Evaluating and Assessing your activities

See Chapter 4 of the document "**The GSO4SCHOOL Framework and Master Plan"**, http://gso4school.eu/gso4school-framework/.