



WASO Implementation Scenario: “Scarlet’s Choice”, a Science Opera

Project Reference:	539818-LLP-1-2013-1-NO-COMENIUS-CMP
Code:	D 3.1
Version & Date:	1.0, 1/8/2014

Name of institutions: Stord Haugesund University College (Norway) and instructors and participants of the Write a Science Opera (WASO) Summer School at Stord Haugesund University College, August 4th – 9th.

Title of the educational scenario template:
Creative Strategies, Inquiry-based teaching

Title of the educational scenario: Write a Science Opera (WASO) – “Artificial Intelligence”



Table of Contents

1: Introduction	3
2: Educational Challenges.....	3
2.1 Exploring Artificial Intelligence (AI)	4
2.2 Exploring the Functioning of the Brain	4
2.3 Exploring creative approaches in Science and Art Education	4
3: Scenario Characteristics and Needs of Students.....	5
4: Rationale of the Educational approach	5
5: Learning activities	6
6: Performing the Opera – Participating roles.....	14
6.1: Students.....	14
6.2: Project instructors	15



1: Introduction

The following Write a Science Opera (WASO) Implementation Scenario should be read together with the WASO Guidelines, which provide a detailed plan for the realization of a Creative Arts-Infused Inquiry-Based Science Teaching project within the WASO Case Study. These include warm-ups, a conceptualization of the cross-disciplinary project as Inquiry-Based Science Education, exercises in creative music, drama, costume-making, schedules for the project, evaluation, reflection and more.

Specific suggestions for meeting points between the science learning and the opera development are made throughout this scenario, yet this document is conceived as a “living document”, and teachers of each unique WASO project are free to design the schedule and creative exercises according to their needs and capacities.

Several *Teacher's Tips* are provided in this document. These tips suggest enhancements and optional activities, and are provided by teachers who have previously conducted WASO projects in their classes.

This Implementation Scenario is designed as a 2-3 week project, during which the first week may be preparatory (only 1-2 hours a day are dedicated to the project), while the entire second and third weeks should be dedicated to the project. *Note: In the WASO Guidelines, you will find suggestions for how to realize a longer, more detailed, project if desired¹.*

2: Educational Challenges

The following Educational Challenges are observed. Reasons for implementing WASO as a response to these challenges are provided.

¹ The CREAT-IT team looks forward to hearing about further WASO Implementation Scenarios developed by the teachers themselves. Please visit www.creatit-project.eu for further information.



2.1 Exploring Artificial Intelligence (AI)

Reasoning for choice of approach: AI is a complex concept and has technological and ethical issues which are in need of in-depth exploration. Through the opera creation process, pupils must learn basic knowledge regarding AI. Ethical issues concerning AI may be discussed throughout the whole creative process.

2.2 Exploring the Functioning of the Brain

Reasoning for choice of approach: Understanding the basics of AI requires a basic knowledge about the brain and how it functions. This can be part of the preparatory exercises or embedded in the creative activities. Furthermore, knowledge of the functioning of the brain is an important

Aims from the Norwegian science curricula:

- In body and health the pupils are to be able to:
describe the nervous system and the endocrine system and explain how these control body processes

contrast to AI. The difference between human communication and artificial communication becomes central to the project.

2.3 Exploring creative approaches in Science and Art Education

Reasoning for choice of approach: The Implementation Scenario offers an inherently creative design which stimulates creativity in the IBSE setting. Bridging arts and science approaches means focusing on 'inquiry' in itself as well as 'inquiry' as a basic requirement in creativity and in

Aims from the Norwegian science curricula:

- In the budding researcher the pupils are to be able to:
Teaching in natural science presents natural science as both a product that shows the knowledge we have acquired thus far in history and as processes that deal with how knowledge of natural science is developed and established.
- In technology and design the pupils are to be able to:
describe an electronic communication system, explain how information is transferred from sender to recipient and give an account of the positive and negative consequences related to this system.



different creative practices.

3: Scenario Characteristics and Needs of Students

The scenario will be an opportunity for students to solve problems related to Artificial Intelligence and its implications for basic human functions such as emotion and consciousness.

The approach is more direct than school textbooks, as pupils must directly engage with the material, acquire knowledge, explore ethical aspects and make their choices regarding these before the opera may be completed.

The exercise will also allow students to interact (e.g. by working in pairs) and develop social and collaboration skills, thus experiencing how science can be a group activity and not only a solitary one: Individual, collaborative and communal activities for change.

Pupils will be introduced to the common creative impulses of science and the arts.

4: Rationale of the Educational approach

The scenario is designed as a transversal meeting point between the Write a Science Opera (WASO) methodology and an Inquiry-Based science education model. It follows a scientific approach while opening doors to experiencing new possibilities on several levels. As part of the exploration towards the school opera's creation, students are asked to explore the scientific theme of AI and functions of the brain supported by indicative questions, all of which will infuse and inspire the opera's creation: The opera's design, libretto, characters, costumes, and music all represent potential ways of interpreting the students' inquiries. Based on those inquiries, the students are asked to come up with their own conclusions and compare them to their initial predictions, while engaging in Possibility Thinking (PT) regarding how the creative artistic process can act as a base for deeper inquiry as well as aesthetic mediums of communication of the various hypotheses and evidence-based conclusions. The complete activity, within both science and art, is based on students' creation and observing skills.

Students have the opportunity to work with Artificial Intelligence and the functioning of the human brain within hands-on exploratory science activities at the same time that they are experiencing a similar hands-on process with musical instruments, costume creation, lighting,



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

performance, etc. creating a deep understanding of the importance of materials within both disciplinary areas.

5: Learning activities

The CREAT-IT activities are conceptualized as Inquiry-Based Science Education (IBSE) activities. This is structured around the five IBSE phases suggested by the Cosmos project (2008):

Phase 1: Question Eliciting Activities/Exhibiting Curiosity

Phase 2: Active Investigation

Phase 3: Creation

Phase 4: Discussion

Phase 5: Reflection

In the following table, specific WASO activities are based on the CREAT-IT Pedagogical Principles and an understanding of Inquiry Based Science Education, as described in the CREAT-IT Pedagogical Framework (see "Recommended Literature" for further details).



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Implementation Scenario	
<p style="text-align: center;">Science unit topic</p> <p>Technology (Norwegian Secondary school curriculum)</p> <p style="text-align: center;">Class information</p> <p>Year Group: 8-10 grade</p> <p>Age range: 13-15</p> <p>Sex: both</p> <p>Pupil Ability: The scenario allows space for pupils of various abilities to participate, e.g. pupils with language difficulties may contribute on an equal level to others by performing in the orchestra.</p>	<p style="text-align: center;">Materials and Resources</p> <p><i>What do you need?</i> Various music instruments, materials for making costumes. Optional: Stage, lights</p> <p><i>Where will the learning take place? On site or off site? In several spaces? (e.g. science laboratory, drama space etc), or one?</i> Learning can take place in school and/or at science education center or museum. It is a good approach to have several rooms available during the phase where pupils are split into groups (see WASO Guidelines)</p> <p><i>Health and Safety implications?</i> In the case of sewing, it is important to ensure maximum safety by having a qualified teacher available at all times and corresponding instructions.</p> <p><i>Technology?</i> Computer with internet (searching for information),</p> <p><i>Teacher support?</i> Team teaching with both arts and science and arts (music\dance\design\drama) expertise is recommended.</p>
<p>Prior pupil knowledge</p> <p>No prior knowledge regarding the brain or Artificial Intelligence is required. Pupils can use this scenario in order to explore basic concepts in both fields. If pupils do have prior knowledge about the brain, they will still be able to profit from engaging with the scenario, but they will probably think about it in a deeper way.</p> <p>Optional: music lessons including composition exercises; basic drama exercises; dance; arts & crafts classes; experience with school stage performances is an advantage</p>	
<p style="text-align: center;">Individual session project objectives <i>(further details for these sessions are provided below):</i></p> <p>During this scenario, students will:</p> <p>Week 1): Engage in activities which inspire curiosity around the topic of AI and nervous system; Explore musical, visual design, drama techniques as tools for the opera. <i>Note: Teachers may decide the science opera's theme before the project or allow pupils to choose the scientific theme themselves. Each approach has its advantages: In the case in which the teacher chooses the theme prior to the project, it will be possible to realize the project during a shorter time-span. On the other hand, pupils may experience greater ownership and agency if they are allowed to choose the opera's theme themselves. In the case of the current scenario, participants in the WASO Summer School chose the scientific theme themselves by generating preliminary ideas and then engaging in a democratic process to finalize their choice of AI and the nervous system. In both cases (teacher choice or pupils' choice) it is important and</i></p>	



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

motivating that the pupils investigate their own questions connected to the chosen theme.

Week 2): Create specific synopsis, libretto, composition, scenography, costumes for the Science Opera. Continued exploration of scientific topics. *The libretto should include key concepts connected to the scientific theme. Scientific models and figures can be of great inspiration to scenography, costumes and music.*

Week 3): Finalize and perform a multi-disciplinary artistic performance (school opera) which demonstrates and deepens scientific and emotional understanding of the AI and nervous system learning processes, supporting discipline knowledge in both the science and arts educational disciplines.

Assessment	Differentiation	Key Concepts and Terminology
<p>The WASO Guidelines' Appendix 1 provides an evaluation plan for students who took part in the WASO project. This questionnaire includes questions about their level of enjoyment, level of difficulty, comparisons to more traditional teaching methods, etc.</p> <p>To record this, questionnaires will be filled out by pupils and collectively delivered to the CREAT-IT team.</p>	<p><i>How can the activities be adapted to the needs of individual pupils?</i></p> <p>Some pupils have had more training in arts disciplines (e.g. music, drama, costume-making). These pupils may be encouraged to do more advanced work. Examples: A pupil who has had piano lessons may be encouraged to compose an extra aria for the Science Opera; a pupil with good stage presence may be asked to assist the other performers in learning how to express the section(s) of the libretto which they will be performing.</p> <p>The creative process is in itself inclusive of all pupils. The more pupil voices there are with different thoughts and viewpoints (independent of level of understanding) greater the pool of ideas will be with more input to the opera's story.</p>	<p>Science terminology:</p> <ol style="list-style-type: none"> 1) Technology exemplified by Artificial Intelligence (motherboard; chip; processor...) 2) The brain and emotion (neurons; hormones; synapses...) 3) Exploring basic issues regarding consciousness <p>Arts terminology:</p> <ol style="list-style-type: none"> 4) Aria: Solo song by one character. The plot's "action" is stopped to allow this character to express a certain emotion and inner feelings. 5) Duet: Two singers, preferably each singing their own verse followed by a section in which they sing together. 6) Ensembles: Three or more singers 7) Choir: The choir can be used to "comment" during the other songs, or as simple choir pieces. 8) Overture: Instrumental (no voices) opening piece which sets the mood of the opera. 9) Interlude: Music performed between acts or scenes. 10) Recitative: "Spoken Song" which tells a story, and which propels the plot further by revealing action (what has taken place, what will take place, a secret, etc.). 11) Tableau– A dramatic activity in which a group of pupils are asked to physically construct an opera scene through body placement, facial expressions, and props



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Session Objectives:

During this scenario, students will

- Create a multi-disciplinary artistic performance (school opera) which demonstrates and deepens scientific and emotional understanding of the scientific themes, supporting discipline knowledge in both the science and arts educational disciplines.
- Learn basic concepts about the functioning of the brain.
- Learn basic concepts in technology, and specifically Artificial Intelligence and its meaning (technological and ethical) for human emotion.



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

IBSE Activity	Potential arts activity	Student	Teacher	CREAT-IT Pedagogical Principles
Phase 1: Question Eliciting Activities	<p>Begin cooperation with artists or the music/fine arts/drama/dance teacher at your school in order to generate ideas</p> <p>Discuss with your students the idea of creating a multi-disciplinary performance designed and inspired by a scientific theme.</p> <p>Define opera's theme based on scientific Question current knowledge</p>	<p>Generate and write down words\ideas about Artificial Intelligence (AI) and the human mind, and shares with others in order to learn from their previous knowledge</p>	<p><u>Activates previous knowledge</u> in the fields of Artificial Intelligence (AI) and the human mind, and motivates pupils to raise questions they are wondering about based on these.</p>	<p><i>Professional wisdom is respected and encouraged.</i> It is vital that CREAT-It has, at its heart, the wealth of teaching and discipline knowledge and expertise that practitioners bring to the project.</p> <p>The following are the CREAT-IT Pedagogical Principles which are realized within the "Scarlet's Choice":</p> <ol style="list-style-type: none"> 1. Individual, collaborative and communal activities for change 2. Risk, immersion and play 3. Dialogue 4. Interrelationship of different ways of thinking and knowing 5. Discipline knowledge 6. Possibilities 7. Ethics and trusteeship 8. Empowerment and agency



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Phase 2:

Active Investigation

Propose opera characters representing various entities in the learning process (e.g. Cyborgs, technologists, human characters which interact emotionally), etc.

Divide students into groups (orchestra/composers, librettists, stage design, opera chief, Public Relations, etc.).

Explore representing the chosen scientific learning theme as a dramatic storyline.

Explores the preliminary questions proposed by the students, defines ones to work with, and collects information aimed at responding

Leads a discussion based on the following questions: What do you want to find out about these questions? What are your predictions regarding these?



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Phase 3:

Creation

Main activity of opera creation and rehearsals, on all levels (costumes, music, staging, libretto, etc.).

Teacher's Tip: Sources of inspiration may include the actual equipment being used

Propose definitions and examples of potential science operas.

Explore various examples of expressing scientific concepts through the arts.

Social media: Students may document their investigation with video and photos to share on websites to open up further debate and feedback, they utilize these comments in their reflection

Leads a discussion based on the following questions: What is a science opera? How can you represent scientific concepts through arts? What do you observe in the way your knowledge is learned? What are the scientific key concepts in AI and nervous system?

Teacher defines central key concepts to be included in the process: What do you expect to learn about the scientific themes? How would you explain the way you are learning? What is expected/ unexpected in this way of learning? Can you think of a different /interesting way to approach this way of learning besides opera?



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Phase 4:

Discussion

Discussion of any challenges that arise as part of the working process.

("Which concepts should be included in the libretto?"
"What is the main difference between human and artificial communication? And how can we visualize that?").
Therefore the discussion and creation phase will necessarily be entangled.

Prepare their results for discussion.

Perform the Science Opera.

Possible use of social media:
Share video of discussion on Youtube to open up further discussion within the community;
Conduct the discussion with video / audio conferencing; Post images of the work taken on Instagram; Twitter for comment; Present results online using Prezzie or Glogster.

Helps students evaluate results.

Leads a discussion about how to produce different elements exposing the different science themes, and which science elements should be included.

Asks the following questions:
What is the relationship between Artificial Intelligence and the human brain with respect to emotion? Which are these the point about AI that we want to communicate? What information would you use to support your view? What remains unclear?



Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Phase 5: Reflection

Discuss various specific and focused issues (stage design, libretto, PR activity, group dialogue, ethical decision-making regarding inclusion of all students in the creative process, etc.).

Upload results (recordings, assessment) to the CREAT-IT portal (portal.creatit-project.eu)

Students write a blog post sharing their reflection with others in the community for feedback and further debate. This should include themes defined in the learning objectives.

Students prepare an online self-reflection presentation using Prezzie, Glogster, Scoopit.

Creates an overview of what has been discussed in the classroom during the project. You may focus on challenges which arose during the process or why various images were chosen as activity foci.

Discuss balancing a 'bottom-up' and 'top-down' approach.

Teacher leads a discussion including the following IBSE questions: Has your thinking changed through exploring AI and the nervous system by working in this way? What new question could you ask?

The teacher guides the student to further open-ended study.

The teacher can engage students in reflecting on the resemblances and differences of creating art and science.

6: Performing the Opera – Participating roles

6.1: Students

The maximum recommended group size for each WASO project is 25-30 divided into 6-7 groups of various functions, as described in the WASO guidelines. *Teacher's tip: additional students in other musical, visual arts, dance classes may take part in the final performance event by providing a warm-up act to the opera, for example. This engages the WASO class in a dialogue with a wider circle of pupils in the school.*

Students perform scientific prediction and realize creative, arts-infused case study scenario: Recording observations; Performing prediction compared to results; Developing experimental models; Participating in creative case study scenario (WASO)





Implementing Creative Strategies Into Science Teaching (CREAT-IT) Implementation Scenario

Students as Group Participants: Use or evaluate a technique; Use science to explain

6.2: Project instructors

External opera artists and scientists in collaboration with art, music and science teachers from the school. *Note: the number of external artists and scientists in each unique project will depend on various parameters such as budget, availability, length of project, available volunteering professionals, number of school teachers assigned to the WASO project, number of students involved, etc.*

Teacher: Presents ideas and evidence in science; Asks questions; Identifies misconceptions; Applies scientific methods; Develops experimental models; Provides historical and contemporary examples

School leadership: considering the nature of the WASO project, with regard to the need to orchestrate teachers and professionals from various fields, it is crucial that the school's leadership is involved in the project's planning, realization and evaluation. This is true due to the need for the WASO project to accommodate each unique school's schedule, specializations, students of special needs, geographical location, rooms, etc.