LEARNING SCIENCE THROUGH THEATER

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General information
Title of the activity
Learning Science Through Theater
Subject
Physics, Mathematics, Biology, Chemistry, Arts (all STEM subjects applicable)
Keywords
Creative, Teamwork, transdisciplinarity, inquiry-based, interactive, versatile
Connected to/ nested with
LSTT can be easily connected to the Learning science though Humoristic stories activity.
Learning outcomes
Teacher learning outcomes: • Will be able to integrate transdisciplinarity in science education • Are trained in new methodologies for the creative teaching of science • Will create an educational community that will cooperate, exchange opinions, material and best practices for science teaching and learning • Become co-creators of educational material
Student learning outcomes: • comprehend scientific concepts and phenomena • develop a spirit of cooperation and teamwork • participate actively in the negotiation of scientific concepts • develop creative and critical thinking skills • participate in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance and they will contribute in further bridging school with society • develop their social and entrepreneurial skills • create an educational community that will cooperate, exchange opinions, material
Transversal skills
Creativity, Teamwork & Collaboration; Communication Skills
Number of participants and target age group
• Min number: 5, Max number 30 • Ages: 8-18
Duration
120 min
Short activity description

The main aim of this activity is the involvement of students in order to develop and perform their own performance based on a scientific concept.
The Learning Science Through Theatre (LSTT, www.lstt.eu) initiative uses Embodied Learning in inquiry-based science education. It aims to enhance the participants' cognitive, physical, and emotional involvement, as well as their social interaction and communication between them. It leads students and participants to analyse and dramatize relevant information and concepts related to science. As a result, participants manage to constructively build on each other's ideas, enhance their learning of scientific concepts, develop and co-create potential solutions, coming up with strategies on how to communicate them and perform theatrical plays; overall fostering their transversal skills.

Preparation

Materials

List of materials:	**Technical backline:**
LSTT is suggested to be implemented as a self-funded activity, meaning that the students and teacher will be engaged in approaching contributors (such as parents, the wider community and using already existing school's materials) for the preparation and realization of their performance – the aid can be in the form of either money or material needed such as costumes, props, etc. The development and need of materials are directly linked with the theatrical play and the creativity and imagination of the participating students and teachers. A suitable space (either indoors or outdoors) in the school is partly required in order for rehearsals to be possible. An auditorium or theater in the school facilities would be ideal in order for the students to present their final performance.	• At least one PC/laptop • Internet connection • Projector • The evaluation questionnaire

Announcement

Announcement for teacher trainings:
Art meets Science: How to motivate and involve students in creative STEM activities through the means of theatre

Announcement for students:
Innovate, create and learn by performing scientific notions!

Hook

Co-create scientific knowledge by artistic development and practice

Activity type/strategy

Lower order thinking			Higher order thinking		
Knowing / remembering	**Comprehending / understanding**	**Applying**	**Analyzing**	**Synthesizing / evaluating**	**Creating**

• Lecture • Illustrations	• Questions • Discussion	• Practice • Demonstrations • Role play	• Problem solving • Critical Incidents • Discussion • Questioning • Test	• Problem solving • Plan development • Constructing • Simulation	• Simulations • Design/ development • Producing

Epidemiological suitability			
☒ Yes ☐ No ☐ Partly **If changes should be made, please state them here:** The activity could be executed with small groups of students physically present in a classroom (while wearing protective masks). Also, various small groups of students could be connected online by the teacher's hosting in a platform such as Zoom or Skype, in order to create a bigger group. For the teacher seminar, the activity could be executed completely online			
Is the activity suitable for execution in an online setting?			
☐ Yes ☐ No ☒ Partly			
Can the activity be sequenced? I. e. divided into smaller parts which could function as standalone parts which could maybe even be integrated into other activities.			
☒ Yes ☐ No ☐ Partly			
Step 1			
Step type/strategy:	Presentation & Interactive workshop	**Step duration** (minutes):	45
Step title: (if applicable)	Introduction & Phase 1: Feel (Discover)		
Keywords:	Overview, transdisciplinarity, STEM, Inquiry based science education, research, critical thinking, transversal skills		
Subaims: What teaching aims are you fulfilling with this part of the sequence?	Introduction: To familiarise participants with the concepts and practices that are going to be described such as the open schooling approach, design thinking methodology, inquiry-based science education, and the integration of arts in science teaching. Also, to demonstrate how these will support the learning process and foster students' transversal skills Phase 1 Feel: What is the problem demanding action from the schools/education communities? The main aim is to coordinate the group of participants in terms of identifying the scientific question/issue to be negotiated and in terms of searching and collecting the necessary information related to the issue in question		
Step by step description:			
Introduction …… 15' (Presentation)			

Presenting the main aims of the activity: the involvement of participants in order to develop and perform their own performance based on a scientific concept as well as the main concepts behind its practice: Creative Science Education, Embodied Learning, Inquiry Based Learning and Open School approaches combined with Design thinking.

Presenting the overall workshop's structure which is based on the **four-phase open schooling approach** (Feel – Imagine – Create – Share), according to which schools and educational communities act as co-creation knowledge hubs that propose solutions to local issues, therefore linking education, research and real-life problems. This approach is also interlinked with the four phases of the **Design Thinking process** (Discover – Define – Develop – Deliver) which LSTT integrates in the educational environment. Last but not least it follows the seven steps of the Inquiry-Based Science Education model, with specific steps allocated to each of the four phases.

PHASE 1: FEEL (DISCOVER) …….. 30'
(Interactive)

IBSE Step 1 - Question:
Participants are divided into groups. Each group will decide on posing a specific question drawn from the school science curriculum. Through discussion and collaboration participants select one straightforward question (*eg. How does a light switch work? eg. 2 Why does it rain?)* that can be connected to the official curriculum of any STEM subject.

IBSE Step 2- Evidence:
At this stage, individual and teamwork plays an important role, aiming at finding and gathering the necessary information about the main inquiry question that has been asked. It is also important to strengthen and empower the participants to produce individual queries and discuss the evidence they found in the various sources they sought to look for. Access to information on the exploratory question, is granted either via the internet (eg. YouTube videos, information from scientifically valid websites, etc.) or through other material provided. The main aim is to coordinate the group of participants in terms of searching and collecting the necessary information related to the issue in question.

- **Notes:** A ppt presentation is necessary for this step as is at least one PC/laptop/tablet for the participants too browse the internet
- **Tips & tricks:** Although a ppt will be used, the presenter is advised to just use it as a supplementary visual support and try to explain the concept as interactively as possible
- **Online environment adaptation:** the introductory presentation can be easily adopted to the online environment as is phase 1

Interpretation & analysis (for teachers)	• Overview of the concepts and introduction to the key practices • This is the overall research phase where students are guided towards collecting the relevant scientific valid data and information about the

	science topic that is selected. The science topic should be part of the official school curriculum
Interpretation & analysis (for students)	• Overview of the concepts, introduction to the key practices and summary of the steps to be followed • Select a topic to be negotiated and through discussions and teamwork decide on posing a tangible question related to the scientific topic. Research is needed through all available means (school guides and books, internet) to collect data relevant to the topic selected

Step 2			
Step type/strategy:	Workshop/interactive teamwork	**Step duration** (minutes):	30
Step title: (if applicable)	Phase 2: Imagine (define)		
Keywords:	Creativity, critical thinking, empathy		
Subaims: What teaching aims are you fulfilling with this part of the sequence?	Foster communication and critical thinking skills towards selecting the most relevant information and data to be used towards developing the performance. Creativity is also fostered as participants start developing the play.		

Step by step description:

IBSE Step 3 – Analyze

The main characteristic of this phase is the organization and analysis of the data collected during the previous phase and sessions as well as the dialogue between the participants to categorize the data. Importantly, the students need to link this analysis to their project. Which data can be useful in the development of potential solutions/ideas addressing the scientific issue selected? How could those be integrated in an effective and scientifically valid script? Tutors at this point act as facilitators, as the creativity and critical thinking of participants is fostered. At this stage, participants analyze and categorize the collected data while filtering those that they find useful for the play's development. Then they make a first attempt to capture the idea and create the scenario on which their theatrical performance will be based. Improvisation also plays an essential role in this step as they attempt to set up a basic skeleton of their performance in a spontaneous way.

IBSE Step 4 –Explain:

A key feature of this phase is the dialogue between participants in order to extract and decide on the possible explanations and answers for the exploratory question that have been raised and which make sense to the participants themselves. Participants collaborate and talk about making decisions about the basic explanations they will adopt to answer the question they have asked and then proceed with the creation of their theatrical performance.

○ **Notes:** In the classroom environment the teacher guides the students during the analysis of relevant information and acts as a check for the scientific validity of the final explanation. ○ **Tips & tricks:** Always have in mind that the analysis and explanation is directly linked to the performance, so while formulating the explanation start igniting the curiosity and imagination of students towards thinking about roles, dialogues and potential personification of concepts that are revealed in the explanation ○ **Online environment adaptation:**	
Interpretation & analysis (for teachers)	This phase constitutes the identification of valid and useful sources related to the scientific topic. Critical thinking and creativity skills are fostered while students try to extract information and data from various sources (school books, internet, etc). The teacher should guide the procedure of identification but at the same time let the students' creativity flourish
Interpretation & analysis (for students)	Selection of relevant information to be used and integrated in the performance while at the same time, the scientific validity of the information and subsequent explanation should be checked.
Step 3	
Step type/strategy:	Workshop/interactive teamwork — **Step duration** (minutes): 30
Step title: (if applicable)	CREATE (Develop)
Keywords:	Collaboration; transdisciplinarity; communication skills; creativity
Subaims: What teaching aims are you fulfilling with this part of the sequence?	Describe and develop the activities through collaboration and transdisciplinarity Creativity skills and imagination are fostered as well as interpersonal and communication skills
Step by step description:	
IBSE Step 5 - Connect This step constitutes the dramatization phase. Each group will proceed with the dramatization of the given explanation: short story/script will be developed with characters, dialogues or pantomime. Key feature of this phase is interdisciplinarity, as students conquer scientific concepts and knowledge, interconnecting scientific knowledge with various forms of art. To achieve this, each group should allocate specific tasks to each member according to their interests and talents, as theatre is a collaborative art practice and requires teamwork and coordination from different fields (script, acting, directing, music, etc). Also, communication and consultation with specialists in the fields is pursued (specialist scientist in science education, specialized director, musician, etc.). Participants use all their imagination and creativity to achieve the best possible result and produce the final products in each category	

	○ **Notes:** For the implementation in the classroom**:** communication and consultation with specialists in the fields is pursued if possible, during the classroom activities (artists, musicians and scientists). Consideration of props or potentially costumes are to be made. Also, rehearsals should take place at the end of this phase ○ **Tips & tricks**: In the classroom environment, the teacher should identify if there are any potential problems during the division of tasks among the students and discretely guarantee that each student is involved in a role that best suits him/her. Also, props, costumes and any other material requirement can be balanced by the teacher. All relevant material can be found either by the contributions of parents or by the school itself.
Interpretation & analysis (for teachers)	This is the phase where creativity and embodied learning take place, as students are dramatizing their final explanation by finalising the play as well as the division of roles related to the final performance
Interpretation & analysis (for students)	Teamwork, final division of tasks and roles (script, actors, music, dance, narration etc) as well as rehearsals take place

Step 4			
Step type/strategy:	Performance	**Step duration** (minutes):	15
Step title: (if applicable)	Share (Deliver)		
Keywords:	Collaboration; communication skills; creativity; presentation skills		
Subaims: What teaching aims are you fulfilling with this part of the sequence?	How do you plan to share the outcomes of your activities and build new partnerships? The aims are to foster the confidence, interest and participation of students in the STEM subjects and fostering their transversal skills by embodied learning and communication. Students not only perform their newly developed play but also draft an outreach strategy for the activities they have developed thus fostering their planning and entrepreneurship skills		

Step by step description:

IBSE Step 6 - Communicate

Each group will then perform the developed story in front of the rest of the groups. Both during their rehearsals and during their final theatrical performance, participants communicate through their bodies and through various gestures the scientific concepts and issues that they have explored throughout the process. After the end of the performance they will present a draft strategy plan on how to integrate this activity in their practice in the classroom environment.

- **Notes:** The performance duration should not exceed the 10 min mark. Video recording is advised and if possible, the performance can take place in front of

	a large audience of other students, teachers and parents in the premises of the school: for example, in the amphitheatre (if present) or even outdoors. If that is not possible (or if the epidemiological conditions do not allow it) the performance could be presented in the classroom to the teacher or online via live streaming. ○ **Tips & tricks:** in case of video recording of the performance, a signed parental consent is needed for each student participating
Interpretation & analysis (for teachers)	Participants perform and foster their confidence communication and interpersonal skills. They also embody the knowledge and information they acquired through the previous steps.
Interpretation & analysis (for students)	Students perform and foster their confidence communication and interpersonal skills

Step 5			
Step type/strategy:	Facilitated teamwork	**Step duration** (minutes):	20
Step title: (if applicable)	Reflect		
Keywords:	Reflection, transversal skills, collaboration, critical thinking		
Subaims: What teaching aims are you fulfilling with this part of the sequence?	The aim is to proceed to a facilitated self-reflection exercise where the group will analyse what they learned in terms of scientific content but also what transversal skills they gained during the implementation of the activity		

Step by step description:

IBSE Step 7 - Reflect

Participants reflect on the performance in relation to the theme and their project. Most importantly participant's reflection, as initiated by the tutors is focused on the process of LSTT and how this process and approach to educational and learning practices can be relevant for fostering 21st century transversal skills in the framework of science education.

- **Notes:** The tutor is facilitating the procedure; also, the use of a written, short and easy to fill questionnaire is advised in order to benchmark students' perceptions.
- **Tips&tricks:** The tutor is facilitating the procedure by asking relevant questions that ignite the reflection process of the participants while at the same time mentioning examples of the use of the activities in classrooms

Interpretation & analysis (for teachers)	Reflection plays an important role in order to identify if and how the activity met its aims and how the students perceived it.
Interpretation & analysis (for students)	Reflection is the final step towards internalising the learning experience and identify the skills acquired.

Wrap up & sequence interpretation	
Sequence interpretation & analysis (for teacher trainings)	Each step could be allocated to each day during the 5-day Summer School and could also be condensed during the 3-day local workshops as follows: Day 1: Intro – Phase 1 and Phase 2 Day 2: Phase 3, Phase 4 Day 3: Phase 5
Sequence interpretation & analysis (for the activity/sequence when held in classroom)	The proposed duration of the LSTT activity in the classroom is 3-5 months with one teaching session per week which includes the period of preparation and the performance time. The students work closely with the teachers (and/or team leaders) in a regular basis during these months (once per week is proposed), following the inquiry framework that will get them all the way to the final performance. In any case the duration can be decided by the teacher: teachers could use this activity for less time within their corricula and implement the activity in a more simple way by using the classroom hours (45 minutes) for 2 or 3 times in order the students prepare a present a sinlge scene that will explain a scientifyc notion (e.g. explain the how rain is created, the rotation of the sun, explain the close and open circuits), similar to the format followed for the teacher training events
Evaluation/assesment	
A thorough questionnaire, targeting the teachers can be used.	