

Creativity, Arts and Science In Primary Education

CASE Toolkit



Creativity, Arts and Science in Primary Education CASE Toolkit



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



Published by Science View

Editor

Menelaos Sotiriou
Science View

Co-Editors

Oded Ben Horin
Western Norway University of Applied Sciences

Irma Smegen
Speel je Wijs

Fanny Seroglou, Vassilis Koulountzos
Aristotle University of Thessaloniki

Sofoklis Sotiriou, Ioannis Alexopoulos
Ellinogermaniki Agogi

Artwork

Giannis Kostikas
Science View



CASE has been funded within the framework of the European Union Erasmus+ programme, under grant agreement 2017-1-NO01-KA201-034133

The content of this publication does not reflect the official opinion of the European Union. Responsibility for the information and views expressed in the document lies entirely with the authors.

ISBN: 978-618-84415-0-7



© 2019










Reproduction or translation of any part of this work without the written permission of the copyright owners is unlawful. Request for permission or further information should be addressed to Science View.

Science View
2 Missaraliotou & Veikou str
117 42, Athens, Greece
E-mail: info@scienceview.gr



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

CONTENTS

	EDITOR'S NOTE	4
	INTRODUCTION.....	5
	1. THE CASE FRAMEWORK.....	7
	1.1 Introduction	8
	1.2 Creative STEM Education	8
	2. THE CASE METHODOLOGY	13
	2.1 Creative Inquiry Based Science Education	14
	2.2 The CASE Method	15
	2.3 Structuring the CASE Material.....	17
	3. THE CASES.....	23
	3.1 "Learning Science Through Theater"	25
	3.2 "Learning Science Through Puppetry"	35
	3.3 "Learning Science Through Slowmation"	53
	3.4 "Learning Science Through Digital Storytelling"	65
	4. REFERENCES.....	79
	5. ANNEX.....	82





EDITOR'S NOTE

In this book, the authors have tried to include the results of their efforts for many years working with students and teachers of primary and secondary education levels. The main effort is to present the methods and the activities that teachers could implement within their classrooms in order to follow the Creative Inquiry Based Science Methodology proposed Framework.

CASE project is trying to present and offer all the needed instructions, material and tools in order to achieve the integration of art and innovation in science education from the early school years.

Education policymakers all too often narrow teachers' focus to lists of facts and formulas, which become tempting to resort to so-called “drill-and-kill” teaching methods that cover information in a generic, surface-level way. Unsurprisingly, instead of fostering curiosity—which is much more important in the long term than rote memorization—this approach often causes students to “tune out”. Under this framework enhancing teacher skills, strengthening their ability to motivate innovation and creativity is crucial. It is precisely the enrichment of the creative elements in Inquiry Based Science Education (IBSE) as an integral part of such a system, based on a wealth of existing European knowledge, which is the cornerstone of the CASE approach.

Having the honor to represent the group of the authors of this book, I wish that you will find this approach and the examples presented useful in your day to day teaching.

Enjoy reading!

Menelaos Sotiriou

Athens, Greece, June 2019



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

INTRODUCTION

CASE will contribute to teachers' professional development and to the development and sustainability of creativity of young people and propose creative pedagogies. Embedded within this is the vitally important notion that young people are creating wisely and humanely, and that cyclical development occurs between their creativity and their identity. As they generate new ideas; this in turn generates change in them as 'makers'; they are also developing or 'becoming' themselves. Slowly, small changes accumulate to contribute to 'journeys of becoming'. These individual journeys accumulate together, embedded within an ethical awareness of the impact of creative actions on the group.

Creativity, Arts and Science in Primary Education (CASE) Approach includes:

- training materials aimed at training of primary teachers. These include user-friendly manuals, guidelines, learning scenarios, open educational resources and social-media tools available on the project's web platform.
- a wide-spread training approach for teachers, facilitating intake of creative Inquiry Based Science Education practices in primary schools. This is supported by numerous international mobility activities for primary teachers.
- an assessment methodology which provides all the needed steps to measure the impact of the activities.
- guidelines for continued communication and exploitation of results by the primary education community.

CASE is proposing its approach by providing specific examples on how this could be implemented. Up to now there are 3 main categories of creative science education activities. These are:

Learning Science Through Theater:

Students will perform theatrically a story related to scientific themes and will learn science in a creative way. This case promotes the comprehension of scientific notions and phenomena, development of a spirit of cooperation and teamwork and the development of creative and critical thinking skills. The specific objectives of the activity have as a central axis the interdisciplinary connection of science with aspects of art, aiming at the enhancement of students' interest in science.



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



Learning Science Through Puppetry:

In this case, inquiry-based science education will be combined with puppetry. In every activity, a puppetry story will be played by the teacher. In this story the puppets have a problem or a question. This will arouse children's curiosity, which instantly will stimulate them to discover. Children will help the puppets to find a solution or answer. All activities will be challenging tasks in the field of STEAM education and every process can have many different results. Children will research like scientists and design like artists.



Learning Science Through Digital Narratives & Storytelling: This CASE includes 2 sub cases.

Digital Narratives - Slowmotion: This activity aims to transform science presented in curricula (usually strict, stiff and boring for young people) to open, friendly and interactive communication supported by the re-contextualization of science content in digital narratives created by learners. In order to do that a simple animation technique is used called slowmotion: a slow and simple animation using only 2 photos per seconds.



Slowmotion movies are created in a creative learning environment where science concepts meet with art, music, literacy, society, history and philosophy of science. The developed digital narratives highlight and present the abstract science concepts and theories in a creative and original way. Furthermore, the presentation of the developed digital narratives on the web provides a meeting place for learning and cooperation between young people.

Digital Storytelling: The overall concept of the digital storytelling case is to provide the means and the tools along with the necessary collaborative and personalisation functionalities to introduce students in extended episodes of deeper learning in STEM combined with Art-related activities (visual and performing arts, music, movie making, 3D design). The specific case will introduce students in a progressive exploration of the different technologies that can be accommodated from the provided system, from simple text and video uploading to advanced augmentations of students' artifacts.



1.THE CASE FRAMEWORK





1.1 Introduction

This section describes the framework in which the CASE project is based on. It will present the concept and the approach that is used in order to introduce Creativity and Art in Science Education in the Primary Schools. It is based on already existing approaches that have been tested for many years (since 2014) mainly in secondary schools as well as in approaches that were used in Primary Schools settings. The combination of this approaches consists the CASE Framework.

1.2 Creative STEM Education

Figure 2 offers an overview on the CASE project approach. At the core of the approach are the **Cases** and the accompanying **pedagogic principles** (see Figure 1). The aim of the project is to be able to describe and inform these cases via the inquiry and creative learning approaches in order to generate innovative practice and creativity in STEM related activities in the primary education. Figure 2 therefore represents the CASE understanding of how the theories and ideas can be synthesised together conceptually, uniquely in order to achieve this.

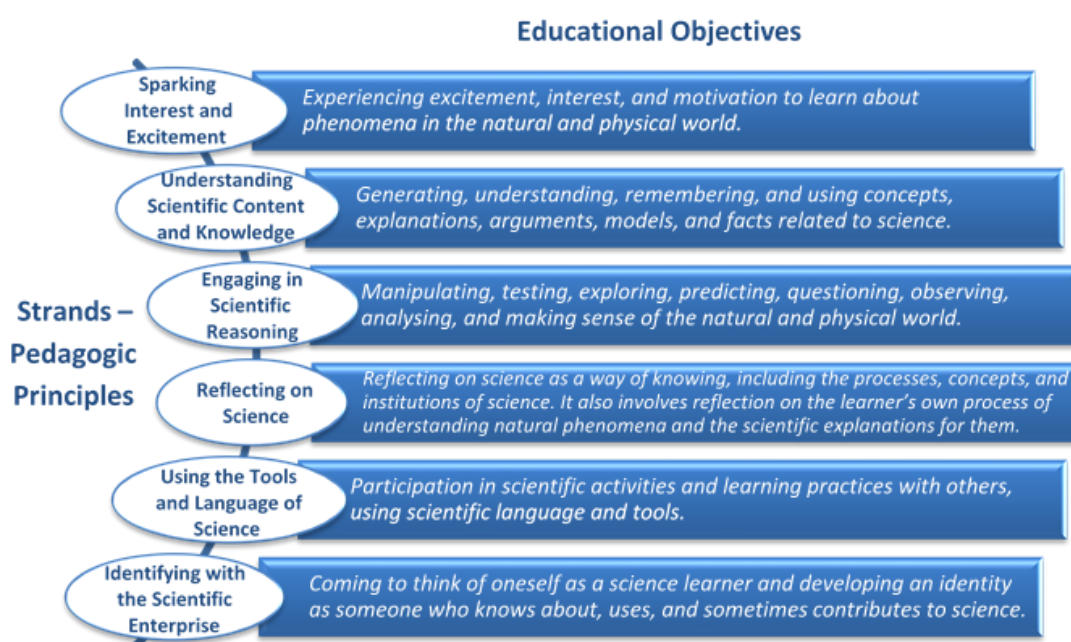


Figure 1: The main Pedagogic Principles and the Educational Objectives for the design and implementation of the creative cases in the framework of CASE project.

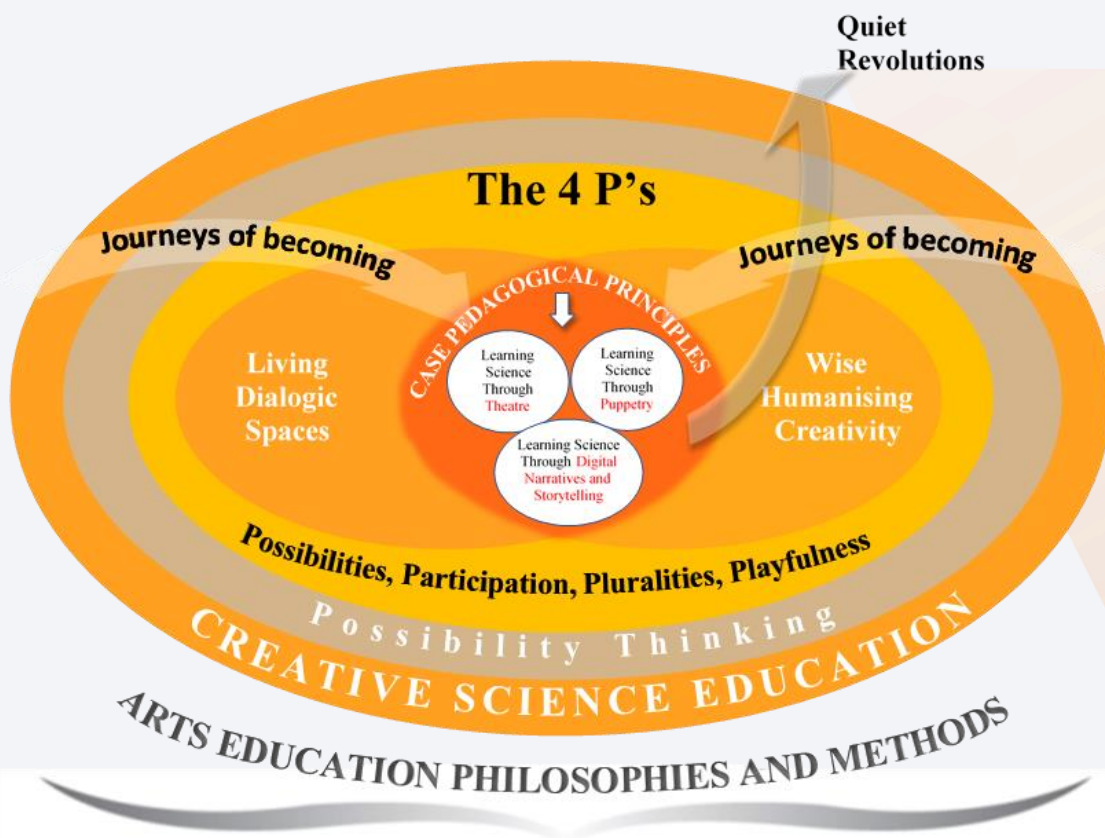


Figure 2: The **CASE** approach that is based on the integration of arts into STEM activities, simulating the ways in which subjects naturally connect in the real world¹

Creative STEM education is the main context within which CASE project has been developed. At the bottom of the graph **arts education philosophy and methods** is positioned as a “holder” within which creative STEM education (as opposed to all STEM education) is being nurtured, grown or “encultured” via arts practice. As we move in towards the centre of the graph we can see that one of the main drivers for CASE creativity is **possibility thinking** for all involved. This means being able to ask “what if” and “as if” questions:

- what if I/we choose to explore this scientific question rather than that one...?;
- what if I/we use this arts approach to help me explore my question...?
- how can I/we imagine this as if I were...?;
- what happens if I as student collaborate with that artist as if I...?.

¹ This approach is based on the framework of CREAT-IT project (<http://creatit-project.eu>) and its update from the CREATIONS project (<http://creations-project.eu/>).



This will be strongly encouraged in the way the CASE pedagogic principles are ultimately employed in order to help learners and adult professionals imagine new ideas in STEM education; to shift from “what is” to new possibilities of “what might be”. As we move in another layer towards the centre of the graph, we can see four key defining features of CASE classroom environments. These are the **4Ps** of engagement in creative STEM education (Craft, 2011):

- **pluralities:** opportunities for students and teachers to experiment with many different places, activities, personal identities, and people
- **possibilities:** opportunities for possibility thinking, transitioning from what is to what might be, in open possibility spaces
- **participation:** opportunities for students and teachers to take action, make themselves visible on their own terms, and act as agents of change
- **playfulness:** opportunities for students and teachers to learn, create and self-create in emotionally rich, learning environments.

We then come closer to the heart of the CASE graph and find **WHC (wise humanising creativity)** and **LDS (living dialogic space)**. The WHC that is being sought in CASE is not only an individual activity, but also happens in **collaboration** with fellow learners, teachers and other adult professionals (artists, researchers, science experts). These individual and collaborative creative activities form part of a wider web of ethically-guided communal interaction geared towards both helping children and young people become more creative and assisting teachers in becoming more creative in how they teach science. For this reason, WHC is positioned very close to the heart of the CASE graph as it is one of the core aims of the CASE pedagogic principles. Alongside and integrated with WHC, is LDS, always a partner to WHC in terms of conceptualising ideas and developing practice. Again, LDS is at the heart of the CASE graph because its methods (participation, emancipation, working bottom up, debate and difference, openness to action, partiality, and acknowledging embodied and verbal modes of knowing) are fundamental to allowing WHC to happen. Chappell et al, (2012) have evidenced the importance of dialogue at the heart of engaged, creative learning in the arts and it is this kind of dialogue that has been highlighted and applied within the CASE approach. Students’ stories will promote the idea of dialogue between people, disciplines, creativity and identity, and ideas. This dialogue acknowledges and allows for conflict and irreconcilable difference. It might be argued that facilitating open discussion of the problems pupils are facing in understanding scientific concepts and in solving scientific problems is key to a pedagogy which acknowledges their values, needs and expectations as citizens of the European Society.

As detailed above all of these layers of conceptual ideas have been synthesised together not only to develop this CASE graph and accompanying narrative but also to generate CASE own set of unique working **pedagogical principles**. Hence the connector in the image between WHC and LDS, and the students’ cases are these principles. The principles represent the unique way that the consortium ideas come together in order to underpin the CASE pedagogies.

So, via these processes the CASE project will contribute to developing creative young minds with deep knowledge in STEM and creative STEM teaching pedagogies. Embedded within this is the vitally important notion that students and teachers are creating wisely and humanely, and that cyclical developments occur between their creativity and their identity. As they generate new ideas; this in turn generates change in them as 'makers'; they are also developing or 'becoming' themselves. Slowly, small changes accumulate to contribute to "**journeys of becoming**" (shown developing across the layers in Figure 2). These individual journeys accumulate together, embedded within an ethical awareness of the impact of creative actions on the group. Through this process small-scale creative changes or "**quiet revolutions**" can take place for the group as a whole (shown as emerging from the heart of the project's cases).

The CASE approach is based on the fact that ideas generated through **individual, collaborative and communal activities** have a potent capacity to contribute to engagement and change. The layer of communal engagement is particularly important in terms of the societal level of the Responsible Research and Innovation, and the idea that innovators need to be mutually responsive within and beyond their communities. The idea of communal engagement (Chappell, 2008) acknowledges that when working creatively people exist in groups with shared identities which shape their ideas and thinking and which may be challenged by the thinking of other groups. This raises ethical questions which need consideration if these challenges are to be overcome (Craft, Claxton and Gardner, 2008) and people are to be genuinely engaged in scientific debates and questions via education.

Of vital importance to nurturing **empowerment and agency, dialogue, individual, collaborative and communal activities for change** and **ethics and trusteeship** are two more CASE principles which finally resonate with the way the scientific issues are research outcomes have to be communicated to the students. The first is the importance of rigorous **Discipline knowledge**. This means STEM disciplines knowledge but it is also embedded in the idea that there are different ways of knowing in the world, alongside those prioritised within the scientific realm which scientists must engage with in order to generate conversations between their ideas and those of the "public" in order that a shared dialogue can be ongoing rather than a one-way conversation. The second is the promotion of the idea of **professional wisdom**. At its heart, the CASE approach values the idea that teachers bring a wealth of often intuitive teaching and discipline knowledge and expertise; they cannot be viewed as "information deliverers". It is their professional wisdom that can make the STEM learning process creative and can engage children and young people in a meaningful way.

In the framework of the CASE project we are aiming to initiate an informed debate regarding collaboration between Art and STEM at curricular level in schools.

Today, the subjects continue to be perceived as intrinsically different and separate, both pedagogically and culturally. In CASE we will **combine Science with Arts** and test it through the proposed approach, which **pushes the boundaries of subject interconnection in primary schools**, while simultaneously providing a vehicle for creative STEM education, the acquisition of skills and



having fun while learning. In fact, there is an unparalleled level of connection between these two disciplines. As Wenham (1998, pg.61) states “there is and always has been significant common ground between art and science, encompassing not only issues of mutual concern but also modes of enquiry.” If we accept that artists and scientists (amongst others) are searching for understanding and meaning, then this is our first common bond between the two disciplines, and our starting point. Deckert (2001, pg.125) says science is “usually seen as rational and analytical and art often considered subjective and emotional.” With perceptions of art and science so diametrically opposed in our society, it is necessary to be clear about their commonalities and where opportunities for meaningful collaboration exist.

Prior to designing and developing such an experiment, we have identified five main categories of commonality between STEM and Art. This is essential to ensure authenticity in our approach and appropriate justification for implementing the project in schools. The five categories are: modes of inquiry; fields of study; experimentation; creativity and imagination; aesthetic experience and artistic attitude. The CASE approach is integrating all these characteristics in an integrated activity that is still seems a natural even to the young students.

2.THE CASE METHODOLOGY





2.1 Creative Inquiry Based Science Education

The CASE project attempts to combine the Inquiry Based Science Education framework with creative learning approaches and arts in order to succeed fruitful and effective learning in primary education. There is a current demand for instructional material and teaching methods in order to support the development of cognitive, meta-cognitive, social and emotional skills both for the classroom and for teacher training. Therefore, the target skills developed in schools and teacher-training courses need to be reassessed, as also the ways in which students are expected to learn and teachers' to be trained (Seroglou 2006). When teaching science, learners' motivation is always a challenge: How to motivate students, and in-service teachers, to develop active interest in abstract and complex "theoretical" issues.

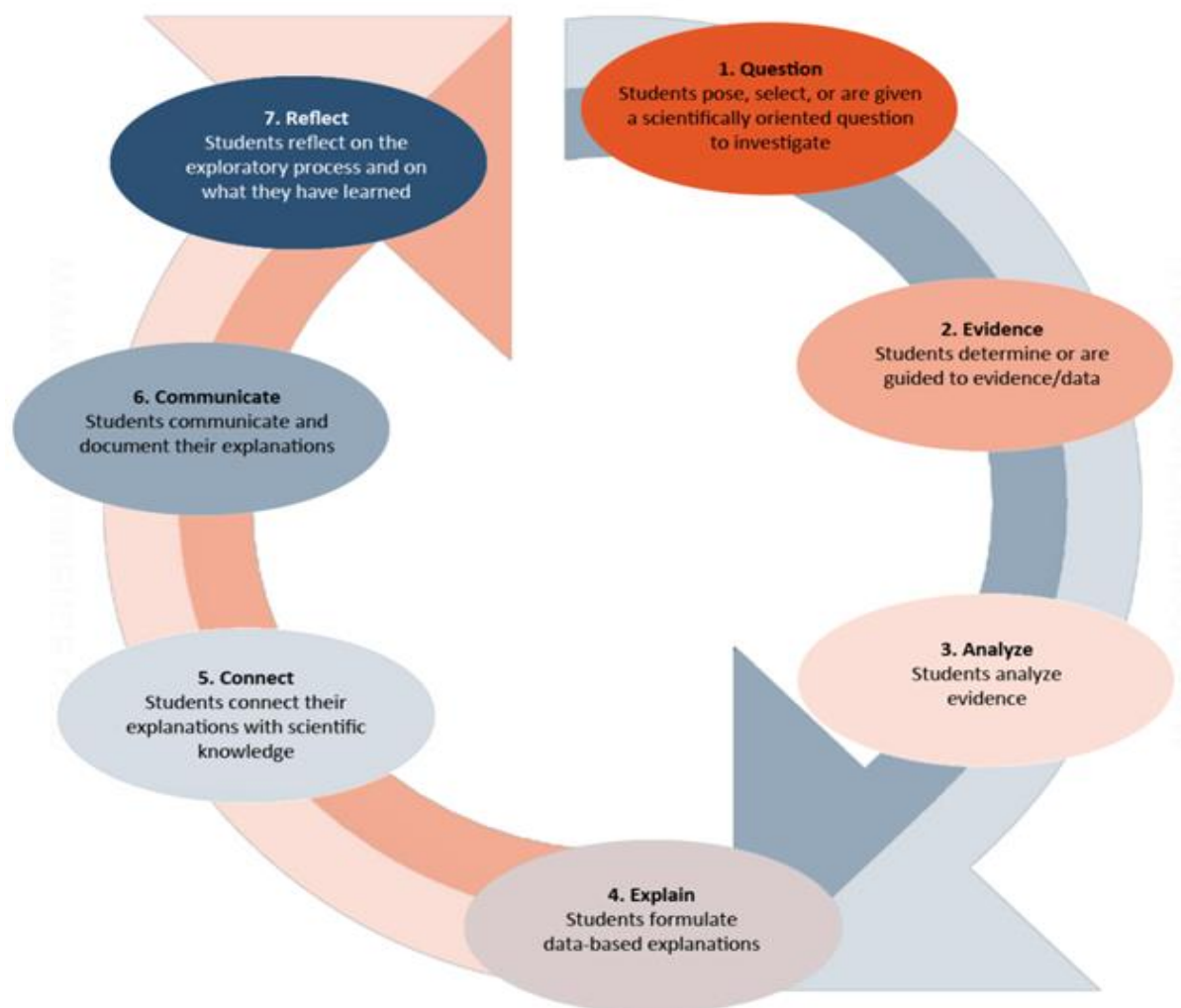


Figure 3: Inquiry Based Science Education Circle in CASE project

Students and teachers find the various science concepts presented in curricula “too difficult” and, in their eyes, “not at all interesting” (especially when compared with, e.g. ethics or aesthetics courses). Especially in the case of in-service teachers, although they teach science, they often present low self-esteem concerning their skills in describing, discussing and elaborating science concepts, theories and phenomena in the classroom (Guskey 1988, Allinder 1994, Connor 2007).

This is achieved through their active participation in activities that make sense to the students, chiefly due to the fact that they are largely initiated by those students themselves. Students understand in-depth the scientific concepts through their own perception of the world that surrounds them and through their own experiences and reflective processes.

2.2 The CASE Method

The CASE project elaborates a methodology that regards teachers as agents of change. It aims to empower their profession with skills and competencies that will enable them to widen their teaching capabilities by incorporating creativity and art in science education. For this, the consortium is realising a



specific master plan that, containing a series of training events supported by the CASE materials. The scope of this training scheme is to motivate teachers to become aware of specific weaknesses in their own practice and the need to make necessary improvements aligned to the guidelines of Europe for the future of science education. In general, this requires a deeper change in motivation that cannot be achieved through changing material incentives. Such changes come about when teachers have high expectations, a shared sense of purpose, and above all, a collective belief in their common ability to make a difference to the education of the children they serve. Individual teachers need to gain understanding of specific best practices. In general, this can only be achieved through training and demonstration of such practices in authentic settings.

The CASE project is implementing the Framework following a structure with:





- Preparing the needed material (Implementation Cases) and continuously improve them with feedback from the teachers and the implementation activities in each country.
- Organising specific Training activities – summer schools where the participants are trained on how they can implement the CASE Implementation Activities and they act as agents in their countries.



Figure 4: The timeframe of CASE project.

All categories of activities are presented in the timeframe above (figure 4) so to illustrate the schedule that should be followed in order to introduce such activities within primary schools. The main aim is that each year CASE will train at least 16 persons (teachers, artists working with students, in service teachers) in order to be ready to implement the activities in the next school year. This network could be expanding every year so to create a network of CASE ambassadors that will work in their countries with other teachers and schools.

2.3 Structuring the CASE Material

In CASE, science and art are intertwined, as shown in Table 1 below. The interaction between these fields within IBSE requires creative solutions on the part of both students and teachers and enables new ways of thinking about the science curriculum. In CASE, a core cycle of query, evidence collection, analysis, explanation, connection, communication and reflection is adopted and at the same time puppetry, theater, slowmation and digital storytelling in science education create a multi modal learning environment. Science understanding is based on the use of models, representations and other forms of visualization, in order to explain, clarify and demonstrate complex or abstract phenomena (Seroglou, 2006). We are using the steps of the Inquiry Based Science Education Circle (figure 3).



Table 1: CASE activities in the context of Inquiry Based Science Education

IBSE Steps	Learning Science Through Theater	Learning Science Through Puppetry
Question	Students face a scientifically oriented question and are asked to think of a story and characters about it	Hand-puppets ask students scientifically oriented question
Evidence	Students search for information and try to integrate them into a script	Students search for information in discussion with hand-puppets
Analyze	Students discuss, analyze science concepts while creating a theatrical script	Students play, discover and observe using their senses
Explain	Students explain science concepts while developing their theatrical performance. They communicate with researchers as well as artists in order to integrate the explanations into the performance.	Students collaborate and discuss decisions with hand-puppets

Learning Science Through Digital Narratives and Storytelling

Slowmation	Storytelling
Students face a scientifically oriented question and are asked to develop a narrative about it	Students face a scientifically oriented question and are asked to develop a story about it. Students will create storyboards and flipbook-style animations with paper and pencils
Students search for information and include them in the narrative that they develop	Students search for information and include them in their story. They will work with relevant scientists and engineers to learn about the specific topic
Students discuss, analyze science concepts while creating a scenario for slowmation	Students discuss, analyze science concepts while creating their digital storytelling using a specific platform (the STORIES platform)
Students explain science concepts while creating props (heroes and backgrounds)	Students will explore drawing, visual communication and image making to develop their ideas and concepts





IBSE Steps	Learning Science Through Theater	Learning Science Through Puppetry
Connect	Students explore the subject spherically and find interconnections during teamwork on music composition, scenography, lighting, costumes video production or editing etc.	Students discuss with hand-puppets in order to make connections of the new scientific knowledge
Communicate	Students use their bodies and voices to communicate scientific concepts in their theatrical performance. They perform in front of audience within their school or in any local and national initiative. Also, they disseminate their event in their local community	Students communicate science concepts using forms of art (living statue, painting, puppets)
Reflect	Students evaluate their work and receive feedback from artists and scientists	Students reflect on the learning process discussing with hand-puppets



Learning Science Through Digital Narratives and Storytelling

Slowmation	Storytelling
Students explore the subject spherically and find interconnections during teamwork on shooting and recording sounds and narration for slowmation	Student will follow their story. They will be able to compose music and prepare a video or a performance and film it. They will develop 3D printing models to use in their story and also a digital book, the digital storytelling, with all the components in it (music, theatre, visual objects).
Students use images and sounds to animate and communicate science concepts as they edit their slowmation videos	Their project will be uploaded in the STORIES platform and they will share it and communicated to the rest of the school. Also, they will organize an event to perform and demonstrate their result, open to the audience.
Students show the developed video, discuss and reflect with artists and scientists	Students evaluate their work and receive feedback from artists and scientists





Students and teachers, in their way to become scientifically literate citizens, use puppets, theater, slowmation and storytelling in order to learn science concepts and phenomena, representing them and their personal perspective about science in their activities. They develop a spirit of co-operation and teamwork, actively participating in the negotiation of scientific concepts and develop creative and critical thinking skills. Students and teachers handle knowledge from science in society, present attitudes and values that are expressed by science and affect their life in and out of the school (Seroglou, 2006, AAAS, 1993, Aduriz-Bravo, 2005).

Students and teachers recontextualize the facts and concepts of science creating new mediums of communication and interpretation of abstract science concepts (Hofstein & Rosenfeld 1996; Seroglou, 2006, Piliouras, et al., 2011; Seroglou & Aduriz- Bravo, 2007). Learning Science Through Theatre, Learning Science Through Puppetry and Learning Science Through Digital Narratives and Storytelling (Slowmation and Storytelling) contributes to further bridging school with society, allowing students to present their ideas, to improve their self-esteem, to take an active part, to use and develop educational material. A spread of information, collaboration, contribution, codependence and team spirit occurs, to achieve the knowledge and information transformation from single-dimensional and limited to multidimensional (Koulountzos & Seroglou 2007b).

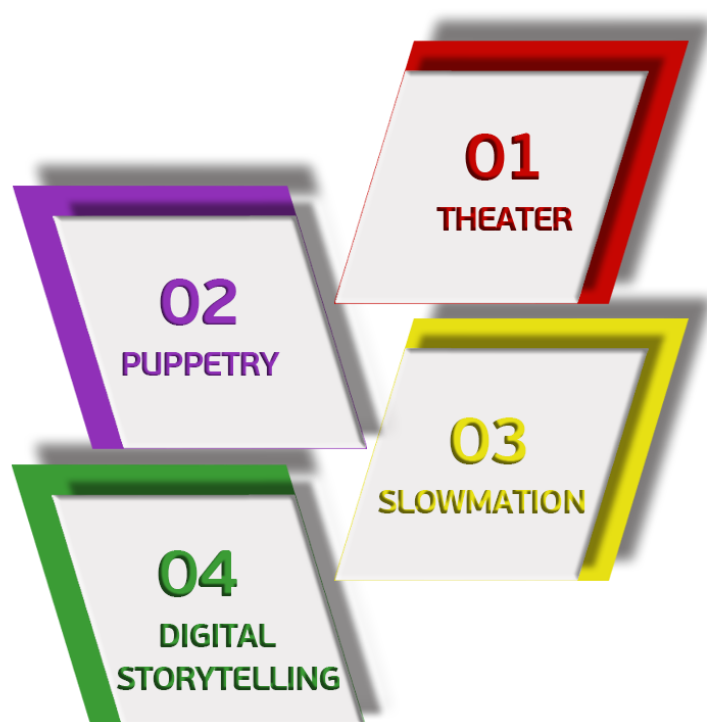
The CASE science activities that use art and narratives (puppetry, theater, slowmation, storytelling) seem to non-experts less complicated and friendlier than general descriptions of scientific theories and have the added bonus of being more “personal” and relatable. The CASE activities create the background to integrate knowledge, to set the scientific events in context and facilitate students and teachers to encounter science knowledge in a more holistic context as it is recommended in the EC’s recent report Science Education for responsible citizenship (2015).

During the CASE activities students learn in a pleasant, transformative and effective way using materials and situations they are familiar such as puppets, costumes, toys, photos, music, painting, 3D printing etc. to represent their constructions of science concepts, develop narratives to present their science knowledge, engage with science concepts in multiple and transformative ways (Kress et al., 2001; Hoban et al., 2007; Seroglou et al., 2008; Keast et al., 2010; Brown, 2011; Mezirow, 2000; Hoban & Nielsen, 2010).



3. THE CASES





3.1 “Learning Science Through Theater”





About the activity

Learning Science Through Theater (LSTT) brings together science and art inquiry. Students learn science in a creative way while implementing a theatrical performance related to scientific concepts.

In LSTT, students comprehend scientific concepts and phenomena, develop a spirit of cooperation and teamwork, actively participate in the negotiation of scientific concepts and develop creative and critical thinking skills. Furthermore, by participating in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance, they contribute to further bridging school with society and develop their own social and entrepreneurial skills.

Finally, one of the main aims of the activity is to motivate an increasing number of teachers and students to join an educational community that cooperates through exchanges of opinions, materials and best practices for science teaching and learning during and following the action's implementation.



Implementation phases

In the next pages, follows a description of the implementation phases of the LSTT activity.





KEY CHARACTERISTICS

Students pose, select, or are given a scientifically oriented question to investigate.



EDUCATORS' ACTIONS

The teacher chooses a chapter / module from the curriculum. S/he then begins a dialogue with the students, asking them questions. These questions will trigger a new round of questions, this time from the students themselves. The teacher should use these students' questions and come up with the subject that will eventually be explored and dramatized.

At this stage, the teacher can introduce physical warm-up exercises. These are great ice-breakers! They also help students get acquainted with the importance of the embodiment aspects of learning, while introducing basic theatrical techniques. Examples can be found in the Theatrical Team Exercise Guide (Link 1i).



STUDENTS ACTIONS

At this stage pupils decide upon a basic, scientifically oriented question which they wish to explore through the LSTT activity. This happens in dialogue with the teacher.



LINKS

Link 1i: Experiential Exercises

(http://scienceview.gr/wordpress/wp-content/uploads/LSTT/LSTT_WARM_UPS_BOOKLET_ENG.pdf)





KEY CHARACTERISTICS

At this stage, individual work *and* teamwork play important roles in finding and gathering necessary information about the main inquiry question that has been asked.



EDUCATORS' ACTIONS

The teacher ensures that all students have access to information on the exploratory question, whether via the internet or through printed material books. The teacher helps students search and collect the necessary information. For example, the teacher may provide basic search guidelines (e.g. suggested sub-queries to explore, providing keywords for search engines, etc.).



STUDENTS ACTIONS

Students search the web for information on the chosen question / topic. They sometimes work individually and sometimes collectively, exchanging key findings and information they have collected.





KEY CHARACTERISTICS

This phase includes the organization and analysis of data collected during the previous phase, as well as student dialogue aimed at categorizing that data.



EDUCATORS' ACTIONS

The teacher functions more as a facilitator, and coordinates discussions among students about the data collected. Also, s/he encourages the creation of organized information models, and search rules / standards for data organization (for example by providing students with a template according to which they may categorize their data). S/he then encourages and coordinates the students to improvise and create a first version of the theatrical performance.



STUDENTS ACTIONS

At this stage, students analyze and categorize the data they have collected while identifying different models of organizing information. Then they make a first attempt to capture the idea and create the scenario on which their theatrical performance will be based. Improvisation plays an essential role as students attempt to set up a basic skeleton of their performance spontaneously.





KEY CHARACTERISTICS

A key feature of this phase is the dialogue between students. That dialogue is needed in order to decide upon possible explanations and answers for the exploratory question raised earlier by the students.



EDUCATORS' ACTIONS

The teacher acts as facilitator and process coordinator while identifying and correcting possible misconceptions of students about the interpretation of data.



STUDENTS ACTIONS

Students collaborate and discuss decisions about the basic explanations they will adopt to answer the scientific question(s). They then proceed with the creation of their theatrical performance.



4

Explain



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



KEY CHARACTERISTICS

A key feature of this phase is inter-disciplinarity, as students study scientific concepts and knowledge while interconnecting scientific knowledge with various art forms.



EDUCATORS' ACTIONS

The teacher takes full advantage of the possibilities offered by the interdisciplinary approach of teaching, as it promotes the interconnection of various scientific themes with various forms of art (theater, music, painting). To achieve this, a communication and consultation with specialists in the field is pursued (specialist scientist in science education, specialized stage director, musician, etc.). In addition, the teacher coordinates the corresponding groups of students who have undertaken to create the script, music, costumes, etc.



STUDENTS ACTIONS

Students explore the subject spherically and find interconnections with other fields, such as the arts (theater, music, painting, etc.). They are divided into groups according to their interests, in order to design and implement a complete theatrical performance with scientific content related to the exploratory chosen question / theme. Thus, pupils are divided into groups of directing, music production, scenography and costumes, choreography, video production, sound and lighting, and promotional activities. Collaboration exists both between students belonging to the same group and pupils belonging to different groups, so that the results produced are consistent.





KEY CHARACTERISTICS

The main feature of this phase is the dimension of students' communication, both with their classmates and with specialized scientists and artists. In addition, communication also involves the expression of scientific concepts and findings by students through their theatrical performance.



EDUCATORS' ACTIONS

The teacher encourages students to communicate with scientists and artists so that they can express and communicate the findings of their exploratory process in the best possible way to the public through their theatrical performance. The teacher has previously taken care to arrange a special scientist's visit to the science and / or artistic session (stage director, musician, etc.) at the school in order to allow students to address their questions in each discipline. The teacher ensures a specific day for student rehearsals. Finally, the teacher is responsible for coordinating the final performance.



STUDENTS ACTIONS

Students in this phase communicate with both artists and scientists. They ask them questions about various ways of improving the theatrical performance. Both during the rehearsal



and the final theatrical performance, students use their bodies and voices to communicate scientific concepts through a variety of art forms, all of which may be included in the theatrical performance.





KEY CHARACTERISTICS

The main feature of this phase is student reflection and assessment of the exploratory process and learning.



EDUCATORS' ACTIONS

During this last stage, the teacher discusses with students about their reflections regarding the theatrical performance, and what may be improved in the future. The teacher evaluates whether all students have been involved in the creative exploratory process, and completes an observation form provided by the organizers of the action. This helps the description and assessment of the course of student exploratory learning and the extent to which scientific meanings were elaborated by students through embodied learning. This always relates to the school's curriculum.



STUDENTS ACTIONS

Students will fill in specific questionnaires in order to capture their motivation and interest in science fields after they realise the activity. These questionnaires are also filled in at the beginning of the activity. After the performance and receiving their awards and distinctions, they should discuss both with each other and with their teacher about the characteristics of the performance and the factors that contributed to the results of their final performance.





Find more information about the LSTT activity at: <http://lstt.eu/>



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

3.2 “Learning Science Through Puppetry”



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



About the activity



Children must be given the opportunity to play and develop, and we want them to enjoy themselves in the process. Puppetry inspires young children in creative approaches to achieving that goal, while building a bridge to the world as they experience it.

Science and technology are the ideal disciplines through which to stimulate the natural inquisitive behaviour of children. Puppet play leads the

children in fantasy adventures. The hand puppets excite children's curiosity because they have a question or need help, which instantly motivates children to go on to discover and create. Children learn from and with each other, and are allowed plenty of space to develop their talents in their own way. They love to share their experiences with the puppets. Often children with Special Needs also enjoy the combination of science and puppetry.

Implementation phases

In the next pages, follows a description of the implementation phases of the Science and Puppetry activities. Sometimes, the phases will overlap or can be combined.





KEY CHARACTERISTICS

Children are given a scientifically oriented question by the hand-puppet(s) to investigate.



EDUCATORS' ACTIONS

The teacher chooses a scientific subject from the curriculum or a scientific topic which fits with a theme the class is working on. It can also be a science experiment the teacher likes to introduce. She/he then starts with a puppet play in which the imaginary world of the puppet will connect science with the real world as young children experience it. One or two puppets are chosen for this. The teacher can play with the puppet standing in front of the children or sitting on a chair, no theatre is needed.

The puppets play a short story, introduce the topic by giving some information, asking questions and sometimes showing something. At the end of this phase the hand puppet will ask the children for help with solving a problem or the puppet has a scientific question the children can help discover.



STUDENTS ACTIONS

At this stage the children will observe, listen and if they like, ask the puppet questions. The children will be encouraged and their motivation to explore or learn more will be triggered.





EXAMPLE

'Making the wind sing'

Material you need for this activity:

- Hand-puppet of a Big Bear
- A bowl with water for every two children and
- For every couple a bigger stone, a middle-sized stone and a small stone (all fitting in this bowl) They can go outside to find these
- An example of a 'Bull Roar'

To make this you need:

- A yardstick
- Scissors
- A yard or twine
- A piece of cardboard which is quite thick, approximately 35 cm long and 10 cm wide
- A knife to cut this in the right shape
- Paint and brushes
- Making instructions:
 - Cut the cardboard in the right shape (search for examples on the internet using 'bullroarer', 'rhombus', 'turndun' or 'snorrepot'. Young kids might need help or pre-cut versions.)
 - Make a hole at the end of the shape.
 - Pull the yard through the hole.
 - Create your own design and paint it on both sides.

**If you like, you can make this from wood, pewter, clay or stone.*

- Playing instructions:
 - Go outside and find a safe place where nothing and no one is in your way.
 - Turn the bullroarer around and enjoy the sounds!





EXAMPLE



Phase 1: Big Bear is grumpy, he walks from one side to the other and you can tell he is not happy at all. "I don't like to hear all these sounds surrounding me, I cannot concentrate at all. I hear the sounds of cars, the sirens of ambulances and police cars, the terrible noise of the printing machine, the coffee machine, I cannot concentrate at all." He keeps walking and complaining (use the sounds which you can hear in your neighbourhood or in your school.)

Big Bear asks to the children about sounds he hears at this right moment: "You see? This high tone ... What is it? And

this beeping, do you know what that is?" (Try to make Big Bear focussing on sounds you can hear at this moment.)

"Children, do you recognize this? Are you sometimes annoyed with certain sounds as well?" Big Bear asks the children to give some examples.

Then he asks the children if they know how we can hear sounds. Maybe some children know, otherwise Big Bear explains (in Phase 2).

1

Question





KEY CHARACTERISTICS

At this stage, the teacher helps children find evidence by using the puppets to ask questions, show examples and give information.



EDUCATORS' ACTIONS

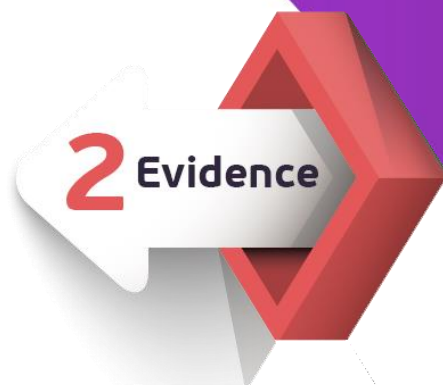
The teacher keeps playing with the puppet(s). In this phase, the puppet asks more questions, shows examples and gives some information to explain more about the scientific question. The teacher and puppet(s) help children search and collect information and materials. If there are (picture) books or useful internet sources available, these can be used. If there are specialists who can be visited or invited, this is another interesting way to explore evidence.

The teacher uses materials and adds playful activities in this phase. If there are things to see, touch, smell, hear, taste and do, this will encourage children more.



STUDENTS ACTIONS

The children decide upon the scientifically oriented question of the puppet(s) what they wish to explore. They ask questions and gather information about this question/topic. This happens in dialogue with the puppet(s) and the teacher. If they need to use materials, they can collect these now.





EXAMPLE

Big Bear asks the children to help him and put the bowl closer. "What do you think will happen when we drop a stone in this water? What would we see?" He asks children to come up with several answers (hypothesis).

Then he invites one child to take the stone and drop it. "What do you see? What happens? Was that what you expected? Were you surprised? Who was surprised as well? Why are there waves in the water?"

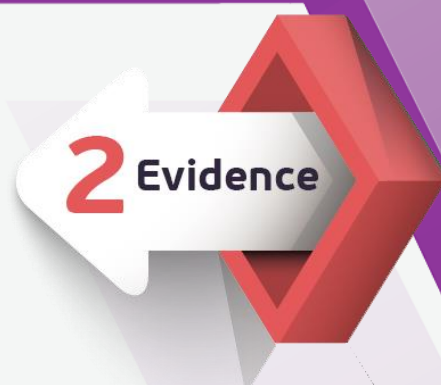
If you like, you can repeat this dropping of the stone several times. And if you think your children can go a step further, you could also vary with bigger stones and smaller stones to discover that the waves are different.

Then Big Bear starts explaining the connection between sound and what happens in the water:

"Imagine this water is the air surrounding us. The air between you and me, the air we breathe in and out and the air which makes the sounds travel to our ears so we are all able to hear." Big Bear sits next to the bowl and asks a child to put its ear at the other side of the bowl. "So, imagine, the bowl with water is the air between me Big Bear and ... (name of the child)." He drops a new stone at his side of the bowl and shows that the waves tremble and that the trembling water reaches the ear of the child. This is exactly how it works with sounds.

Sounds make the air tremble and your ears recognize this trembling of the air as sound.

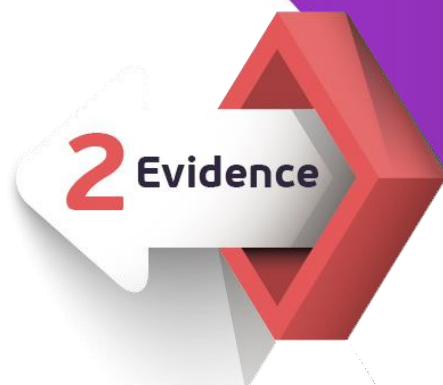
Then Big Bear listens to the current sounds again, says what he is hearing and suddenly realises that he could also decide to listen to the sounds as if it were music. He gives it a try, he shares the noise he hears, listens with all his attention and then starts humming a little bit with it.





EXAMPLE

This inspires Big Bear to think of making musical instruments which 'sing with the wind'. He asks the children to close their eyes or turn around and listen to what they hear. He sweeps the Bull Roar (see instruction in Phase 1) in the air and hides it after he did that. "What did you hear? What do you think made this sound?" Then he shows what he did. The children can make the same sound.





KEY CHARACTERISTICS

This phase will be an active and inter-disciplinarily part in which children will design, investigate, discover and at the same time analyse and categorize data in a playful way. The children might work part of this phase individually and at the same time will need to cooperate since teamwork plays important roles in finding and gathering necessary information about the main inquiry question that has been asked by the puppet.



EDUCATORS' ACTIONS

The teacher functions more as a facilitator, and coordinates discussions among children about the things they design and the outcomes they discover during playing. Again, the teacher can use the puppet(s) to ask questions and give suggestions to the children if this is needed. She/he encourages and coordinates the children to improvise, create, try, fail, make changes, improve, re-try and discover as much as they can.



STUDENTS ACTIONS

The children decide upon the scientifically oriented question of the puppet(s) what they wish to explore. They ask questions and gather information about this question/topic. This happens in dialogue with the puppet(s) and the teacher. If they need to use materials, they can collect these now.





EXAMPLE

In this phase, the children build their own bull roar or any other instrument which 'sing with the wind'. (The official name for this is 'Aero phone'.) They can try out bigger or smaller objects, turn the rope fast or slow and investigate the differences. Background: The bullroarers were used in ancient times in several cultures. For example, in North America by the Native Americans, in Australia by the Aboriginals and in the Netherlands by the Native Inhabitants (named 'Snorrepot').





KEY CHARACTERISTICS

A key feature of this phase is the dialogue between children. That dialogue is needed in order to discuss possible explanations, designs and answers for the scientific question. This phase is often combined with phase 5.



EDUCATORS' ACTIONS

The teacher acts as facilitator and process coordinator while identifying and correcting possible misconceptions of children about the interpretation of data. She/he uses the puppet(s) to interview the children or lead the conversations. This can be done in several ways, with pairs, smaller groups or the entire group at once. The teacher makes sure all children will be involved and have the chance to share something.



STUDENTS ACTIONS

Children collaborate and discuss decisions about the basic explanations to answer the scientific question(s) or solve the scientific problem. They can use their designs and materials to demonstrate and explain what they have discovered.

4

Explain





EXAMPLE

After the children had time to play and explore, Big Bear asks them to sit in a circle and he asks questions. "Who likes to show what he or she made?" "What did you discover?" "Did you hear differences in sounds? Which differences?" "What went well? Why?" "What was hard or went wrong? Why?" "What did this failure teach you?" (Getting used to fail and keep trying is very important.) "What was the best mistake you made? Why?" "Can you improve the sound? How?" What are the differences between the bigger versions and the smaller once?" "Is there a difference when you use a longer twine? Why?" "What would happen if ...?" Some questions can be answered by all children, they can for example talk with the one sitting next to them and then some of the children can share their answer with the group and Big Bear.



4

Explain



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



KEY CHARACTERISTICS

A key feature of this phase is connecting the process and outcomes with scientific knowledge.



EDUCATORS' ACTIONS

The teachers task in this phase is to use the puppet(s) to guide the conversation between children and ask the right questions in order to make children understand the scientific part.



STUDENTS ACTIONS

The children share more about the subject or experiment, in this phase focussed on the scientific part. They continue showing each other what they have explored, discovered and learned and answer questions of classmates, the teacher and the puppets.



EXAMPLE

Big Bear keeps asking questions, now more connected to the scientific part. "So, you did hear different sounds. How do you think this is possible, when was the sound louder and when was it softer? What was the difference? Which are the differences between the bigger versions and the smaller once?" "Is there a difference when you use a longer twine? Why?" "What would happen if ..."

He takes the bowl with water again and a bigger bullroarer and a smaller one. "Who can tell something about the connection between the big stone and one of these bullroarers?" If needed, Big Bear explains.





KEY CHARACTERISTICS

The main feature of this phase is the dimension of children's communication, both with their classmates and with the puppet(s) and teacher. In addition, communication also involves the expression of scientific concepts and findings by children through showing their answers, outcomes and designs.



EDUCATORS' ACTIONS

The teacher encourages children to connect the things they have learned and discovered. This can be done in several playful and creative ways. They can make a poster, write a diary, a poem, make a mindmap or wordweb, diagram, make a painting or drawing, an act or living statue, or use puppets to explain. If there is a specialist available, the teacher connects the children with this specialist again and they can share with the specialist. The puppet could also function as a specialist it selves.



STUDENTS ACTIONS

The children can reflect on what they have discovered in a creative way. They can use a variety of art forms mentioned above. Sometime the teacher might choose in which way, other times children can think of their own way and maybe choose a variety of ways for this phase, working in smaller groups.





EXAMPLE



Big Bear likes to make drawings or stick on pictures of different bullroarers on a poster to explain and remember differences and scientific content. (A bigger bullroarer makes lower sounds, turning faster make louder sounds, etc.) Which children like to help him? "How can we organise this so other people who see this will understand it as well?" Big Bear likes to make drawings or stick on pictures of different bullroarers on a poster to explain and remember differences and scientific content. (A bigger bullroarer makes lower sounds, turning faster make louder sounds, etc.) Which children like to help him? "How can we organise this so other people who see this will understand it as well?"

6 Communicate





KEY CHARACTERISTICS

The main feature of this phase is reflection on the process and learning.



EDUCATORS' ACTIONS

During this last stage, the teacher plays the puppet to discuss with the children about their reflections regarding what they experienced during the process and about the outcomes, products, solutions or designs. The questions can focus on both artistic and creative skills and scientific outcomes. The things that may be improved or further questions, next challenges or ideas and plans can also be discussed. At the end of the reflection, the puppet play finishes, so the teacher thinks of an end of the story and the puppet goes 'home' again or leaves the classroom.



STUDENTS ACTIONS

At this stage, children will evaluate different parts of the activity, chosen by themselves and/or the teacher.





EXAMPLE

Big Bear gives every child a post-it. On this post-it they draw an emoticon of their feeling of this activity. Children who write, can write some feedback. Or the teacher can help them. Big Bear can give the first part of a sentence. For example:

I was surprised that ... because ...

What I liked most was ... because ...

I found it hard to ... because ...

I discovered that ...

If I could change something I would change ... because ...

I am proud of ...

The mistake I learned most of was ...

Stick them all on one big paper and if you like, stick pictures of the children with their designs with it.

Big Bear loves listening to all the Bull Roars. He asks the children to go outside and all play at the same time. Now he isn't annoyed by the other noises anymore. He even starts humming again!

7 Reflect





Photo credits and more information about Science and Puppetry (Dutch language): www.lilaland.nl



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

3.3 “Learning Science Through Slowmation”





About the activity

In Learning Science Through Slowmation (LSTS), science understanding is based on the use of models, representations and other forms of visualization, in order to explain, clarify and demonstrate complex or abstract phenomena.

Teachers create digital narratives using the technique of slowmation (2 photographs per second) and “animate” science concepts and phenomena through inspired heroes and their adventures in scripts that they develop re-contextualizing science teaching and learning. Teachers through the slowmation process introduce to new ways of teaching science to pupils, representing still images, text, sounds, transforming them and connect them through this incorporation process.

Students use technology to represent their constructions of science concepts and design and construct narrated slowmation to present their science knowledge. Slowmation integrates features from digital storytelling, claymation, object and stop-motion animation. Slowmation engages students with science concepts in multiple and transformative ways creating links as a semiotic progression.

Students can make a narrated slowmation to explain a science concept and through the whole process they create a multimodal representation. They need only two pictures or frames per second (a slow animation called slowmation). Students can create 2-dimensional or 3-dimensional models in a model studio. The materials that students may use are play dough, cartons colored, pictures, drawings, existing game models, toys, natural and everyday materials, cutouts etc. Students use their own still photo camera or mobile phone camera with HD quality to take pictures. They create sounds and produce recordings with their phone recorder or their laptop recorder in order to enhance the explanation of a science concept by adding dialogues, music or natural sounds. Finally, they use their laptops or macs with moviemaker or i-movie software installed to edit the developed digital narrative.

Implementation phases

In the next pages, follows a description of the implementation phases of the LSTS activity.





KEY CHARACTERISTICS

Students face a scientifically oriented question and are asked to develop a narrative about it.



EDUCATORS' ACTIONS

The teacher and the students choose a chapter / module from the curriculum that has open questions concerning the understanding of certain science concepts. Questions are triggered by the teacher and the students, gradually the students taking over the initiative and finally leading to the subject that will eventually be explored through **slowmation** and **presented in an original digital narrative**.

At this stage, the teacher can introduce other developed examples of science concepts represented in existing slowmation videos. A short introduction in the making of slowmation is also carried out. Examples can be found on the **atlas movies channel** on YouTube.



STUDENTS ACTIONS

At this stage pupils decide upon a basic, scientifically oriented question which they wish to explore through the LSTS activity. This happens in dialogue with the teacher.



LINKS

YouTube: **atlas movies channel**

(<https://www.youtube.com/channel/UC84Bn5gQR73HKXxX-yIEK9Q>)





KEY CHARACTERISTICS

Students work in groups, search for information and include it in the initial storyboard for narrative that they develop.



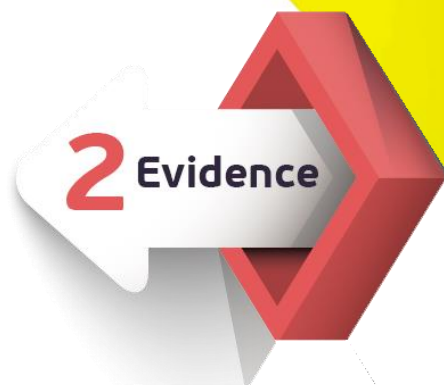
EDUCATORS' ACTIONS

The teacher ensures that all students have access to information on the exploratory question, whether via the internet or through printed material books. The teacher helps students search and collect the necessary information. This information is used in order to make a storyboard, that is, a comic version of the slowmotion to be developed. The teacher guides students to fold a piece of paper in half, then half again. When students open it, they have a four-frame comic. They add more paper as needed and make sure they number each frame in order of sequence. The drawing of a storyboard does not have to be artistic in any sense of the word, but each frame must be able to convey what is moving or what has changed.



STUDENTS ACTIONS

Students work in groups and search the web for information on the chosen question / topic. Students use their fantasy and creative thinking to embody this information in the initial storyboard for the digital narrative they are going to develop with the slowmotion technique.





KEY CHARACTERISTICS

This phase includes the organization and analysis of data collected during the previous phase, as well as student dialogue aimed at categorizing that data. Students discuss and analyze science concepts while creating a scenario for slowmation



EDUCATORS' ACTIONS

The teacher functions more as a facilitator, splitting the responsibility up between each group member so each student in the group has a task to do. Students work in groups and each group develops a version of the scenario for slowmation including the data collected. The teacher encourages students to express their ideas and facilitates the merging of the group scenarios into one main scenario for the slowmation to be developed.



STUDENTS ACTIONS

At this stage, students analyze and categorize the data they have collected. Students are going to like this part the most! Students get to re-create what is in each frame of their storyboard on paper or cardboard. They create versions of scenarios in groups and afterwards through discussion merge the various versions into one.





KEY CHARACTERISTICS

Students explain science concepts while creating props (heroes and backgrounds). During this process, they work on explanations of science phenomena related to the science concepts presented in the slowmation they develop.



EDUCATORS' ACTIONS

The teacher functions more as a facilitator, helping students to work in groups in order to prepare the props, the background and the heroes of their slowmation. At the same time coordinates students' discussions as all their unanswered questions are brought forward as they attempt this first visualization of the abstract science concepts.



STUDENTS ACTIONS

Students love this part of their work! They get to re-create what is in each frame of their storyboard using paper, cardboard, paints, play dough, clay or other 3D constructions. They may use 3D props such as dolls, action figures, toys (cars, trucks, human or animal figures), plants, seeds, soil, natural material etc. They put and adjust their props in mini studios created by empty paper boxes. The possibilities are endless! Before the students start making or collecting props, they should go through their storyboard and make a list of everything they need. Meanwhile, students discuss on basic explanations and procedures related to the science concepts presented in their slowmation and answer scientific questions that are provoked by the development of the scenery and the heroes of their narrative.

4 Explain





KEY CHARACTERISTICS

Students explore the subject spherically and find interconnections during teamwork on shooting and recording sounds and narration for slowmation.



EDUCATORS' ACTIONS

Then teacher explains that in order to create the slowmation video, students need to take 2 photos for every second of their digital narrative. The teacher asks them to work out how many photos are needed for a slowmation video that has 1 minute duration. It works out to be 120! The teacher gives tips on how to keep the camera or the smartphone steady in order to enhance the video quality. Here again the teacher plays the role of facilitator and coordinator guiding students to set up the camera on tripod and have all the props ready. The teacher guides the students as they take photos (how to set up the first scene in the viewfinder of the camera, how to use the tripod in the shoot, how to be careful of their own shadows, etc.). The teacher also helps students to record voices and sounds. Many sounds may imaginatively recreated by students under the teacher's instructions.



STUDENTS ACTIONS

Students do the shooting having in mind the final video quality. Students are encouraged to do their best on framing and focusing during the shooting and at the same time express their artistic expectations. Once the first scene is ready, the first photos are taken. It is crucial that students do not move the camera or the smartphone, the background and props that are not moving in the next shot. If a student bumps the background half a millimeter, then it can have a detrimental effect on the final product. A good way to avoid this is to glue or tape down anything that is not supposed to move.





STUDENTS ACTIONS

The heroes that move in the scene, are photographed in a series of photos each one presenting a tiny movement. Once the first scene is shot, students move or add the props according to the storyboard of the next scene. Students repeat the process until the end of the movie. Students can then quickly look through their photos in the viewfinder of the camera to see how the final product will turn out. Just by flicking through the photos, they can see if there are any mistakes that need to be corrected by taking some more photos. At the same time, students record voices and sounds trying to have the best possible sound quality. During this phase, the abstract science concepts acquire form and shape, sound and meaning by the students.

TIPS WHEN SHOOTING

- *Make sure to set cameras resolution to 1280 X 720 or higher.
- *Keep the camera as still as possible when shooting.
- *Do not touch or move props that are not moving in the next scene. The less movement of the camera and props gives us the better result.
- *Be conscious of shadows. Students usually get very excited when shooting as they can start to see their creation come to life. As a result they tend to crowd around the camera and props. If students are near a window or under a light, this can cause big shadows on the students work.
- *It is best for students to do all the shooting on the same day to have the same amount of light for each frame of their movie. If the animation shot over two or more days, then different weather can cause light conditions to change and effect how each day's photos turn out. They can also use their camera light or an external light to correct the shadows.
- *If possible, use a remote camera trigger to minimize camera shake and movement. If using an iPod or iPad, there are many apps; RemotoLite is a free app that does the trick.
- *Another option to reduce camera shake is to use the self-timer on the camera, set to a short delay.





STUDENTS ACTIONS

*Students might realize when shooting that they do not know specific details about the topic. This is a good thing! Let them go off and search for the correct answer, then come back and apply the new knowledge to their video.

*An alternative for tripod is the use of wooden building blocks or a pile of books to rest the device on.

TIPS WHEN RECORDING

*When the students are talking, they should speak with a loud, clear voice.

*Speak loud enough to push the level meter as far to the right without touching the last bar. This will ensure the student's voices are loud enough in the final product.

*Students can make their voice clearer and cancel out the background noise a little more by using audacity software.

*Isolate the students groups as possible from the rest of the class, in a quiet place to reduce the background noise in the video. Ask the class to be extra quiet while the students are recording their narration.

*If the background noise is an issue, you could also add a song to the background to try to cancel out some of the background noise.

*If using a laptop to record narratives, ask the students after they select record not to touch the computer, or the smart phone until recording is finished, unless they make a mistake. A usual problem when recording audio on a laptop is the noise of the student touching the computer or moving the angle of the screen records along with their voices.

*Have students write a script so they know what they want to say before they sit in front of the smart phone or the computer. They can watch the video a few times to work out how much they can say in the time they have. Having their script written down helps a lot because they usually have to redo the recording a few times until it is correct.





KEY CHARACTERISTICS

Students use images and sounds to animate and communicate science concepts as they edit their slowmotion videos. A key feature of this phase is to arrange photos and sounds on the computer, using software like i-movie or Windows Movie Maker.



EDUCATORS' ACTIONS

The teacher acts as facilitator and coordinator guiding students to use a movie maker software. The teacher helps students upload photos and sounds on the computer, facilitating further the students direct and develop their slowmotion. Teacher guide the students to use the audacity software on their computer and smart voice recorder app on their smart phones, facilitating further the students to go on with sound editing.



STUDENTS ACTIONS

Students communicate science concepts as they edit their slowmotion videos using images and sounds to animate. They discuss on their ideas presented in their slowmarion and on the image of science that will be reflected by their slowmotion when it is going to be released on the web (YouTube channel, CASE website). In this phase, students go through the following steps:

STEP 1 - Students collate each photo for their animation on the computer and they start creating their movie. If they use an IOS device, they can connect it to the computer using the cable to send the pictures.

STEP 2 – They open I-movie or Windows Movie Maker. They select the tab 'home'.





STUDENTS ACTIONS

STEP 3 – Students select and drag all photos at once, go and drop them to the storyboard pane of the moviemaker home window. This creates a slideshow with each picture on a separate slide.

STEP 4 – Students need to set the rhythm of the photos at 2 photos per second. In order to do that they change the duration of each photo to 0.5 seconds.

STEP 5 – Students add text in their slowmation in three ways: a) If they select 'Title', they may add text into a new blank background frame imported as an opening title. b) If they select 'Caption', they add text over a video or a photo imported on the storyboard pane. c) If they select 'Credits' they add at the end of the movie automatically the credits that are necessary. Whenever a clip with text is selected, a new menu emerges over the top: 'text tools' giving options to animate text and change fonts, sizes.

STEP 6 – Students elaborate recorded sounds, music and narration on the audacity software.

STEP 7 – Students add the final elaborated sound recordings to the Movie Maker software in their slowmation and combine image and sound editing.

STEP 8 – Students save their sloamation project in the form of a movie in MP4 file.





KEY CHARACTERISTICS

The main feature of this phase is student reflection and assessment of the LSTS learning approach. Students show the developed video, discuss and reflect with artists and scientists.



EDUCATORS' ACTIONS

The slowmotion movie produced by the students is presented to a big audience (students, teachers, parents, invited artists and scientists). A discussion follows with students and guests reflecting on the produced slowmotion and the way science is communicated. Later on, in the classroom the teacher discusses with students about their reflections on how this learning approach has helped students understand the meaning of science concepts and make proposals on how the school curriculum could be informed by their experience.



STUDENTS ACTIONS

Students present and share their slowmotion movie, discussing about their attempt to visualize abstract science concepts. They make comments to each other and receive feedback by their guests at the open screening (students, teachers, parents, invited artists and scientists). Students receive awards for their work, discuss further with artists and scientists on their realization of science phenomena. Later, in a meeting in the classroom with their teacher reflect on how this learning approach has helped their science understand.



3.4 “Learning Science Through Digital Storytelling”





About the activity

The main concept applied in this activity is the use of creativity as a mean to achieve innovative learning in STEM subjects, based on the use of storytelling and the example of a journey to Mars (*this could be any scientific issue that a teacher could use but, in this document, we have this example in order to demonstrate how this activity should be implemented*). When implementing the Digital Storytelling case to its full extent (at least 40 hours), a great variety of learning objectives can be achieved, such as:

- Students learn how to develop models and work with scales/analogies.
- Students represent the orbital paths of Earth and Mars through group demonstrations and make scale models of the planets and the Solar System.
- Students explore drawing, visual communication and image making to develop their ideas and concepts.
- Students learn how to make calculations and graphical representations. Students create storyboards and flipbook-style animations with paper and pencils that depict life in the first Martian community.
- Students learn how to solve complex problems.
- Students learn how to collaborate to solve a complex problem. Students learn how to collaborate over distance (for example while they are at home through the platform).
- Students work with scientists and engineers to learn about the Martian environment, and the challenges it would pose to the first inhabitants.
- Students explore the planet geology and identify good spots for establishing a human colony.
- Students understand the effects of the lower gravity in our body and identify solutions to handle these problems.
- Students work with 3D design software to create a community on Mars.
- Students propose solutions on how they will select the first settlers in terms of gender, age, profession etc.
- Students design and construct models of the spaceships, buildings on Mars, landers and rovers using 3D printers.
- Students plan and understand the challenges of a trip to Mars and its return to the earth by a spaceship.
- Students work with scientists, engineers, garden experts, artists and designers to provide food for the Martian community.
- Students perform experiments and tests to make sure that the Mars communities are going to last for extended periods on the planet.
- Students are developing their own models of spaceships and Martian infrastructure (rovers, landers) using 3D printer software.
- Students learn how to collaborate with external experts to provide guidance and support.

This list of learning objectives can be enriched or adapted to the needs of the teachers, students and curriculum, depending on the focus of the students' needs and curriculum demands of the respective grade.



Implementation phases

In the next pages, follows a description of the implementation phases of the Digital Storytelling activity.





KEY CHARACTERISTICS

Students pose, select, or are given a scientifically oriented question to investigate concerning the general theme of the activity, e.g. a journey to Mars.



EDUCATORS' ACTIONS

The teacher chooses a specific activity that the students should follow concerning the general theme of the Storytelling (e.g. journey to Mars). S/he then begins a dialogue with the students, asking them questions. These questions will trigger a new round of questions, this time from the students themselves. The teacher should use these students' questions and come up with the subject that will eventually be explored.

At this stage, the teacher can introduce physical warm-up exercises. These are great ice-breakers! They also help students get acquainted with the importance of the embodiment aspects of learning, while introducing basic art techniques.



STUDENTS ACTIONS

At this stage pupils decide upon a basic, scientifically oriented question which they wish to explore through the Storytelling activity. This happens in dialogue with the teacher.





KEY CHARACTERISTICS

At this stage, individual work **and** teamwork play important roles in finding and gathering necessary information about the main inquiry question that has been asked.



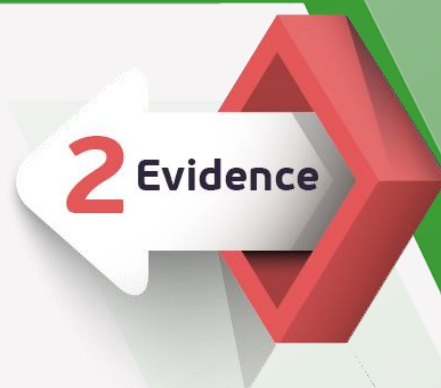
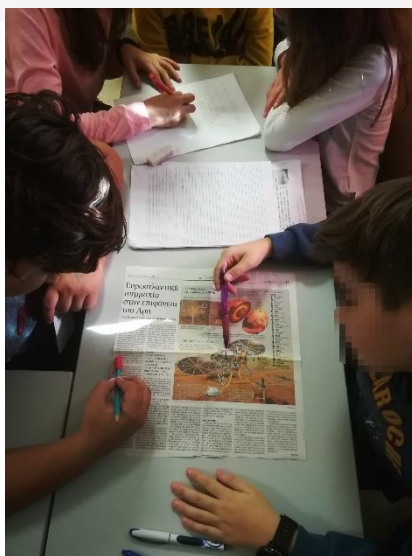
EDUCATORS' ACTIONS

The teacher ensures that all students have access to information on the exploratory question, whether via the internet or through printed material books. The teacher helps students search and collect the necessary information. For example, the teacher may provide basic search guidelines (e.g. suggested sub-queries to explore, providing keywords for search engines, etc.).



STUDENTS ACTIONS

Students search the web for information on the chosen question / topic. They sometimes work individually and sometimes collectively, exchanging key findings and information they have collected.





KEY CHARACTERISTICS

This phase includes the organization and analysis of data collected during the previous phase, as well as student dialogue aimed at categorizing that data.



EDUCATORS' ACTIONS

The teacher functions more as a facilitator, and coordinates discussions among students about the data collected. Also, s/he encourages the creation of organized information models, and search rules / standards for data organization (for example by providing students with a template according to which they may categorize their data).



STUDENTS ACTIONS

At this stage, students analyze and categorize the data they have collected while identifying different models of organizing information (e.g. according to the use of the information in order to compose music, develop a performance, use of 3D printing, develop a science movie). Then they make a first attempt to capture the idea and create the story on which their idea will be based. Improvisation plays an essential role as students attempt to set up a basic skeleton of their story.





KEY CHARACTERISTICS

A key feature of this phase is the dialogue between students. That dialogue is needed in order to decide upon possible explanations and answers for the exploratory question raised earlier by the students.



EDUCATORS' ACTIONS

The teacher acts as facilitator and process coordinator while identifying and correcting possible misconceptions of students about the interpretation of data.

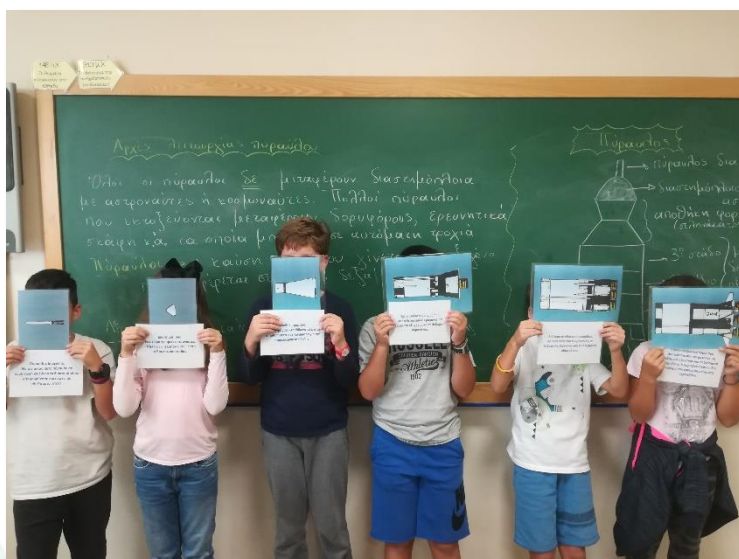


STUDENTS ACTIONS

Students collaborate and discuss decisions about the basic explanations they will adopt to answer the scientific question(s). They then proceed with the creation of their storytelling project.

4

Explain





KEY CHARACTERISTICS

A key feature of this phase is inter-disciplinarity, as students study scientific concepts and knowledge while interconnecting scientific knowledge with various art and science forms.



EDUCATORS' ACTIONS

The teacher takes full advantage of the possibilities offered by the interdisciplinary approach of teaching, as it promotes the interconnection of various scientific themes with various forms of art (theater, music, painting, 3D printing, filming). To achieve this, a communication and consultation with specialists in the field is pursued (specialist scientist in science education, specialized stage director, musician, etc.). In addition, the teacher coordinates the corresponding groups of students who have undertaken to create the story, music, 3D models, videos etc.



STUDENTS ACTIONS

In the following text there is an example of how students should work according to the storytelling methodology.

Phase A - Stories from Space & Mars

(Visual Arts and Music)

- Students will create storyboards and flipbook-style animations with paper and pencils that depict life in the first Martian community.
- They will work with scientists and engineers to learn about the Martian environment, and the challenges it would pose to the first inhabitants.
- They will have to explore the planet geology and identify good spots for establishing a human colony.





STUDENTS ACTIONS

- They will have to understand the effects of the lower gravity in our body and identify solutions to handle these problems.
- Students will explore drawing, visual communication and image making to develop their ideas and concepts.
- Students can add Martian music and sound effects to help tell their stories.
- Their videos are uploaded on the STORIES Storytelling Platform.

Phase B - Planning a mission to Mars - Preparation

(Visual Arts, 3D Worlds and 3D Visualizations)

- Students will work with 3D design software to create a community on Mars.
- Students will have to think on how they will select the first settlers in terms of gender, age, profession etc.
- Students will team up to create their designs using commonly found materials, such as cardboard and paper cups.
- The students will take their community plans to the next level by recreating it with 3D design software commonly used by architects. The 3D design software as well as the resulting 3D world will be integrated in the authoring and delivery environment of the STORIES Storytelling Platform

Phase C - The trip to Mars

(Performing Arts, Science Theatre, Science Movie)

- Students imagine how they will travel to Mars and return to the earth by this spaceship. They play in a blue screen set, and digitally synthesized with their drawing and virtual scenery. To make a movie, children have to use different types of talent, for example, painting, acting, writing a script, coordinating roles, and building spaceships and Martian buildings with





STUDENTS ACTIONS

simple materials. Art, Math, Science, Literature, and learning to communicate are very important in this kind of activity. Their videos will be uploaded on the STORIES platform.

Phase D - Explore and Monitor Mars

(Arts and Architectural Design)

- Students will brainstorm on what we need for a successful and sustainable community on Mars keeping in mind the Martian environment, the needs of the settlers, and the materials available.
- Students create different artefacts (paintings, dioramas, biospheres, and constructions with simple means). All students' constructions will become part of a Martian landscape which can be completed with craters and lava tubes.
- They will have to think of innovative solutions to produce a self-sustained environment capable of hosting humans on an alien planet. They will have to explore the consequences of the thin atmosphere on the attempts to grow plants and how to retrieve water.

Phase E - Sustainable Community on Mars

(Arts and Architectural Design, 3D Printing)

- Students will design and construct models of the spaceships, buildings on Mars, landers and rovers using 3D printers. In this way they will develop further their dioramas and create step by step more realistic representations of their stories (as part of the activities presented in the previous stages).
- The completed model can be exhibited at the end of the project during a school event. As the project evolves, students will have collaborated on site planning to figure out which building should go together and how they would be connected.





STUDENTS ACTIONS

Phase F - Living Community on Mars

(Arts and Architectural Design, 3D Printing, Augmented Reality)

- Students will work with scientists, engineers, garden experts, artists and designers. They will work on common projects developing e.g. Martian gardens that serve two purposes - they are beautiful, hold a variety of plants from all over Earth, and provide food for the Martian community.
- Students will take their stories to the next level by using the advanced interfaces of the platform. Students' models that will be created by the 3D functionality of the authoring tool and models that will be created through the 3D printer will be integrated in the same story and they will come to life through the use of Augmented Reality interface of the STORIES Storytelling Platform.



LINKS

The STORIES Platform

<http://www.storiesoftomorrow.eu/content/stories-storytelling-platform>





KEY CHARACTERISTICS

The main feature of this phase is the dimension of students' communication, both with their classmates and with specialized scientists and artists as well as audience if it is possible. In addition, communication also involves the expression of scientific concepts and findings by students through their storytelling projects.



EDUCATORS' ACTIONS

The teacher encourages students to communicate with scientists and artists so that they can express and communicate the findings of their exploratory process in the best possible way to the public through their storytelling projects. The teacher has previously taken care to arrange a special scientist's visit to the science and / or artistic session (stage director, musician, etc.) at the school in order to allow students to address their questions in each discipline. The teacher ensures a specific day for student to present their work to the rest of the school as well as general audience (e.g. open day in school). Also, they can participate in a public event and have the opportunity to present their work in the general public e.g. a Science Festival, a Conference.



STUDENTS ACTIONS

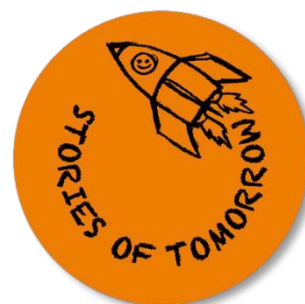
Students in this phase communicate their storytelling projects with scientists, artists, parents as well as the public. This depends on the organization setting that they will decide to present their work in collaboration with the teacher. All the projects produced during this period are uploaded to the STORIES platform.



STUDENTS ACTIONS

The STORIES Platform

<http://www.storiesoftomorrow.eu/content/stories-storytelling-platform>





KEY CHARACTERISTICS

The main feature of this phase is student reflection and assessment of the exploratory process and learning.



EDUCATORS' ACTIONS

During this last stage, the teacher discusses with students about their reflections regarding the activity, and what may be improved in the future. The teacher evaluates whether all students have been involved in the creative exploratory process, and completes an observation form provided by the organizers of the action. This helps the description and assessment of the course of student exploratory learning and the extent to which scientific meanings were elaborated by students through storytelling.

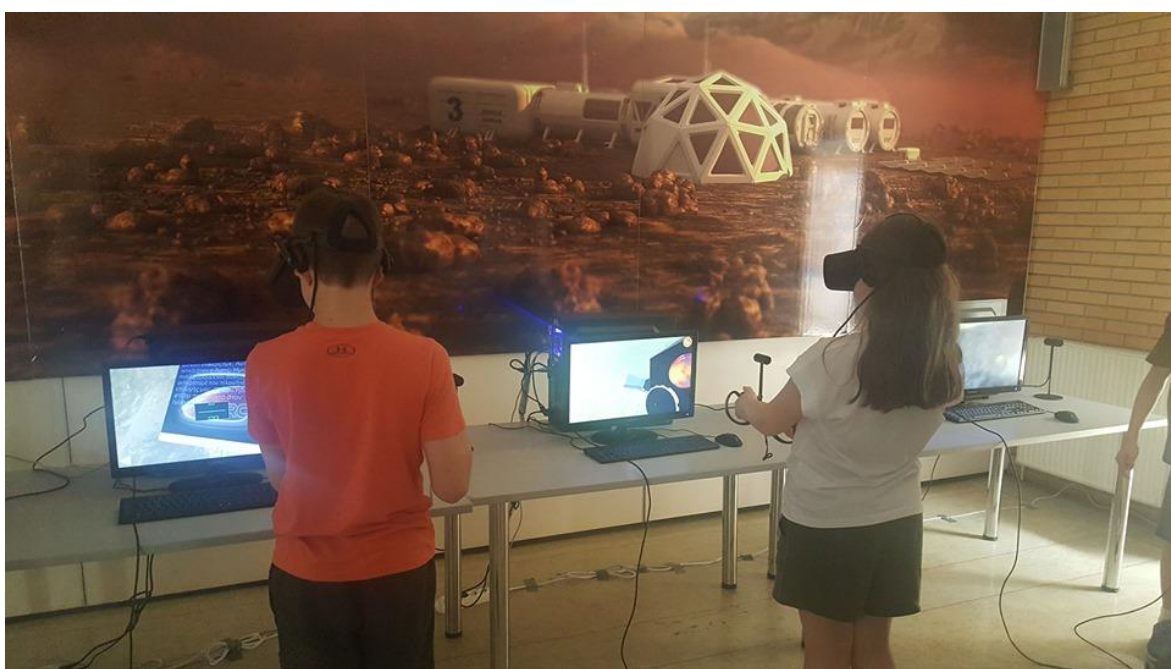


STUDENTS ACTIONS

Students use forms to evaluate the activity.

Also, it has to be noted that students need to fill in questionnaires in order to measure their motivation and interest and if these were raised. They should fill in one questionnaire before the activity start and one just after the end of the activity.





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

4. REFERENCES

Aduriz-Bravo, A. (2005). An introduction to the nature of science. Buenos Aires (in spanish): Fondo de Cultura Economica.

Alexopoulos, I., Sotiriou, S., Smyrniou, Z., Sotiriou, M., Bogner, F. (2016). CREATIONS: Developing an Engaging Science Classroom, HiSTEM

Allinder, R. M. (1994). The Relationship between Efficacy Consultants, Teacher Education and Special Education, 17, 86-95.

American Association for the Advancement of Science (AAAS) (1993). Benchmarks for Science Literacy: Draft, AAAS, Washington, DC.

Brown, J. (2011). The impact of student created slowmation on the teaching and learning of primary science. Post-graduate Thesis. School of Education Edith Cowan University, Perth, Western Australia.

Connor, R. (2007). The Effect on the Self-efficacy for Science Teaching and Knowledge in Practicing Elementary Teacher through Participation in a Professional Development Program Promoting Nature of Science Understanding. Paper presented at the Ninth International History, Philosophy & Science Teaching Conference, June 24-28, 2007, Calgary, Canada.

Chappell, K., Craft, A., Rolfe, L. & Jobbins, V. (2012). Humanising Creativity: valuing our journeys of becoming. International Journal of Education and the Arts.13:8, 1-35.
<http://www.ijea.org/v13n8/>[Retrieved Jan 2013]

Chappell, K. (2008) Towards Humanising Creativity. UNESCO Observatory E-Journal Special Issue on Creativity, policy and practice discourses: productive tensions in the new millennium, 1:3, Available from <http://www.abp.unimelb.edu.au/unesco/ejournal/vol-one-issue-three.html> [Retrieved September 2014]

Craft A., O. Ben Horin, M. Sotiriou, P. Stergiopoulos, S. Sotiriou, S. Hennessy, K. Chappell, Ch. Slade, M. Greenwood, A. Black, E. Lale Dobrivoje, Đ. Timotijević, A. Drecun, A. Brajović, C. Belmontecinzia, G. Conforto, "CREAT-IT: Implementing Creative Strategies into Science Teaching", New Developments in Science and Technology Education, Springer, Innovations in Science Education and Technology Vol. 23, 1, 2016, pp. 163-179, doi 10.1007/978-3-319-22933-

Craft, A., Gardner, H. & Claxton, G. (2008) Creativity, Trusteeship, and Wisdom. Thousand Oaks: Sage.
Jennifer A. Strauss, Richard M. Allen; (2016) Benefits and Costs of Earthquake Early Warning. Seismological Research Letters ; 87 (3): 765-772. doi: <https://doi.org/10.1785/0220150149>

Craft, A. (2011). Creativity and Education Futures. Changing Childhood and Youth in a Digital Age.

Deckert, Diana (2001) Science and Art: Lessons from Leonardo da Vinci in Burnaford, G.





European Commission, Directorate-General for Research and Innovation Science with and for Society (2015), Report to the European Commission of the Expert Group on Science Education (SEEG), *Science Education for responsible citizenship*. Retrieved from:

http://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf

Guskey, T. R. (1988). Teacher Efficacy, Self-concept and Attitudes toward the Implementation of Instructional Innovation, *Teaching and Teacher Education*, 4, 63-69.

Hoban, G. & Nielsen, W. (2010). The 5 Rs: A new teaching approach to encourage slowmations (student generated animations) of science concepts, *Teaching Science*, 56 (3) (2010), pp. 33-38

Hoban, G., Ferry, B., Konza, D. & Vialle W. (2007). Slowmation: exploring a new teaching approach in primary school classrooms. *Proceedings of the 2007 Australian Teacher Education Association Conference*.

Hofstein, A. & Rosenfeld, S. (1996). Bridging the gap between formal and informal science learning. The Wizeman Institute of Science, Israel.

Keast S., Cooper R., Berry A., Loughran J. & Hoban G. (2010). Slowmation as a pedagogical scaffold for improving science teaching and learning. *Brunei International Journal of Science & Mathematic Education*, 2(1), 01-15

Koulountzos, V. & Seroglou, F. (2007a). 'Designing a Web-based Learning Environment: The Case of ATLAS'. Paper presented at IMICT 2007 Conference "Informatics, Mathematics and ICT: a golden triangle", 27-29, June 2007, Boston.

Koulountzos, V. & Seroglou, F. (2007b). 'Web-based Learning Environments and Teacher Training in Science Literacy'. Paper to be presented at ITET 2007 and ETLL 2007 Joint Working Conference "Information Technology for Education and Training", 26-28 September 2007, Prague.

Kress, G., Jewitt, C., Ogborn, J. & Tsatsarelis, C. (2001). *Multimodal Teaching and Learning: Rhetoric of the science classroom* (London, Continuum).

Leci, A., Vourlias, K., & Seroglou, F., (2013). "Six activities to change pupils' science world": Science in the courtyard. *Πρακτικό συνεδρίου ESERA*, 2013.

Martina S. J. van Uum, Roald P. Verhoeff & Marieke Peeters (2016) Inquiry-based science education: towards a pedagogical framework for primary school teachers, *International Journal of Science Education*, 38:3, 450-469, DOI: 10.1080/09500693.2016.1147660

Gentzi, E. (2014). Teaching science through narratives in a science club. Thesis. School of Primary Education, Faculty of Education, Aristotle University of Thessaloniki (in Greek).

Piliouras, P., Siakas, S., & Seroglou, F., (2011). Pupils Produce Their Own Narratives Inspired by the History of Science: Animation Movies Concerning the Geocentric-Heliocentric Debate. *Science and Education*, 20(7-8), 761-795.

Seroglou, F., & Aduriz-Bravo, A. (2007). Designing and evaluating nature-of-science activities for teacher education. Paper presented at the 9th international history, philosophy and science teaching conference, June 24–28, 2007. Calgary, Canada.

Seroglou, F., Koulountzos, V., Papadopoulos, P. & Knavas, O. (2008). Restructuring science stories in films & role-playing: Teaching science concepts in their social and cultural context. Invited paper presented at the second international conference in science teaching, July 14–18, 2008. Munich, Germany: Deutsches Museum.

Seroglou, F. (2006). *Science for citizenship*. Epikentro publications. Thessaloniki. (in Greek)

Smyrniou, Z., Sotiriou, M., Sotiriou, S. & Georgakopoulou, E.. (2017). Multi- Semiotic systems in STEMS: Embodied Learning and Analogical Reasoning through a Grounded- Theory approach in theatrical performances, *Journal of Research in STEM Education*.

Smyrniou Z., Georgakopoulou E., Sotiriou M., Sotiriou S. (2017). The Learning Science Through Theatre initiative in the context of Responsible Research and Innovation, *Proceedings of The 10th International Multi-Conference on Society, Cybernetics and Informatics: IMSCI 2017*.

Suduc A-M., Bizoi, M., & Gorghiu, G. (2015). Inquiry Based Science Learning in Primary Education, *Procedia - Social and Behavioral Sciences*, 205, 474 – 479.

Wenham, Martin (1998) Art and Science in Education: The Common Ground. *Journal of Art and Design Education* Volume 17, Issue 1



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

5. ANNEX

Template for the Cases

In CASE, primary teachers are agents of change.

Dear teacher,

This document is a template which the CASE project places at your disposal in order to encourage you to plan, document and communicate creative teaching sequences. In CASE, science and the arts are intertwined. Based on pre-existing creative CASE materials, we would like to invite you to take the exciting journey of developing your own ideas for how your classroom may feel.

It is based on the structure of our training materials for Learning Science Through Theater, Learning Science Through Puppetry and Learning Science Through Digital Narrative and Storytelling.

The aim of the template is to support teachers' development, description and documentation of their own CASE-inspired teaching activities by providing a strong theoretical and pedagogical background. In this chapter, a brief description is provided as a guide to the teachers' working with the template. The description follows the template's structure.

CASE aims to empower teachers' profession with skills and competencies which will enable them to widen their teaching capabilities by strengthening creativity in the classroom. Our approach to creativity lies at the intersection of science and art in education.

Inquiry Based Science Education (IBSE) is a method of teaching and learning that focuses on use of questions, problems, and educational scenarios used to engage students in concepts of science and support their acquisition of scientific knowledge and skills. This is achieved through their **active participation** in activities that make sense to the students, chiefly due to the fact that they are largely initiated by those students. Students understand in-depth the scientific concepts through their own perception of the world that surrounds them and through their own experiences and reflective processes.

In CASE, science and the arts are intertwined. The interaction between these fields within IBSE requires creative solutions on the part of both students and teachers, and enables new ways of thinking about the science curriculum, as shown below. Various approaches have been developed for IBSE implementation. In CASE, a core cycle of query, evidence collection, analysis, explanation, connection, communication and reflection (see Figure 1) is adopted, based on previous initiatives in the field (e.g. the CREATIONS project¹).

¹ www.creations-project.eu / H2020-EU Project reference: 665917





Name of your activity

Choosing a name for the art-science activity is a fun and important part of your process. We recommend involving your students in this choice. This allows students to experience ownership towards the activity and its content.

There is no “correct” way to name your activity. Including an element of science and an element of arts in the activity’s name is a good way to indicate to those involved what the nature of the activity is. Some suggestions may be “the Drama of Jupiter” or “Animation for the Seasons”.

About the activity

A general description of the activity should be included in this section. Some important issues to address are how you plan to bring together elements of science and art education; why you consider this to be a creative activity; an explanation of what you expect the students to learn; and added values for the students beyond the curriculum (e.g. how they may interact socially during the activity, potential to support critical thinking skills, etc.).

Implementation phases – General overview



Implementation of CASE activities follows an inquiry-based art and science approach in seven phases:

1) Question. 2) Evidence. 3) Analysis. 4) Explain. 5) Connect. 6) Communication. 7) Reflect.

For each of these phases, the CASE template accommodates detailing the key characteristics, the educators’ actions, and the students’ actions. When developing your own template, it is especially exciting to add new insights and ideas during the various phases, which you have not tried before.



KEY CHARACTERISTICS

Finding a scientifically oriented question for the students to investigate.



EDUCATORS' ACTIONS

Describe the chapter/module/theme from the classes' science curriculum which provides the focus for the CASE activity. Document the dialogue with the students, and the questions they ask.



STUDENTS ACTIONS

Describe your expectations of the students during the "question" phase. What is required of them? Students may play an important role in choosing the overall question from a pool of options provided by the teacher and drawn from the curriculum.



LINKS

Please provide relevant links (e.g. websites, social media) here.





KEY CHARACTERISTICS

Describing the details of how the students will gather evidence relating to their specific question.



EDUCATORS' ACTIONS

The teacher's role in this phase is to support the students' evidence gathering. Describe what you will need for this specific activity (e.g. specific books, laboratory equipment, internet access etc.).



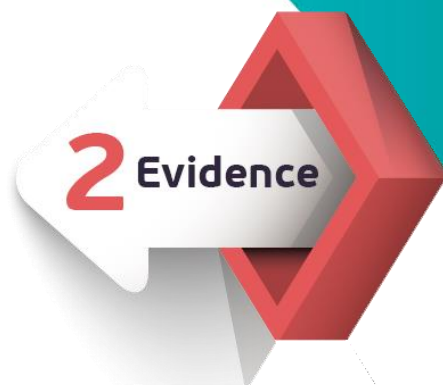
STUDENTS ACTIONS

Describe the details of how students will gather evidence in this activity. Mention specific challenges that may arise, and how they may be dealt with.



LINKS

Please provide relevant links (e.g. websites, social media) here.





KEY CHARACTERISTICS

Describing the organization and analysis of data collected during the previous phase.



EDUCATORS' ACTIONS

Describe how to coordinate the discussions among students about the scientific data. Provide details about strategies which you may use to support the students' organization of their data. Then, provide details for how the students will be invited to begin their arts activity, inspired by their analysis. We encourage you to be creative here! There may not be a "one size fits all" way to make this transition from the scientific analysis to the artistic part of the activity.



STUDENTS ACTIONS

Students analyze and categorize the data. They make a first attempt to create a scenario on which their arts-education activity will be based. They may work in groups to generate ideas for how to achieve this.



LINKS

Please provide relevant links (e.g. websites, social media) here.

3 Analyze



KEY CHARACTERISTICS

Here students engage in dialogue in order to contemplate possible explanations and answers for the question raised earlier.



EDUCATORS' ACTIONS

The teacher supports students' making connections between their question and the gathered data.



STUDENTS ACTIONS

Students collaborate and discuss decisions about the basic explanations they will adopt to answer the scientific question(s). This discussion should provide content for the arts-education activity's process and product.



LINKS

Please provide relevant links (e.g. websites, social media) here.





KEY CHARACTERISTICS

Inter-disciplinarity: as students connect scientific concepts with areas of knowledge drawn from arts and art forms.



EDUCATORS' ACTIONS

Describe specific ways in which the teacher will guide the students' exploration of science connection to specific, concrete areas of knowledge in the arts. Note: there are many ways to do this, and we encourage you to discover your own new ones. It is important to remember that inter-disciplinary projects have the deepest meaning and added value when all disciplines are involved with equal levels and treated with equal value and importance. Specific, concrete measures may include finding materials from the science class (leaves, rocks, liquids, etc.) to be used in the arts education activities.



STUDENTS ACTIONS

Describe the inquiry process you wish the students to undergo. What kind of understandings would you like them to gain at the intersection of science and art? What kind of questions do they need to ask in order to reach this? Note: be specific and use concrete, tangible examples from both science and art in your description of this phase.



LINKS

Please provide relevant links (e.g. websites, social media) here.





KEY CHARACTERISTICS

Describing the methods, tools, and activities the students will use to communicate their new knowledge and the process they have undergone.



EDUCATORS' ACTIONS

Describe the way in which the teacher(s) in your activity will guide students' reaching out to various target audience. These may be the general public, families, local community, professional artists, scientists, etc.



STUDENTS ACTIONS

In this part of the template, describe the students' communication actions and ideas. Include links to websites (e.g. local radio station) which may inspire students to reach out to others. Also, include ideas which were raised by the classroom, but which were not realized due to limitations of time, resources, etc. These may come in handy for future implementations of your activity!



LINKS

Please provide relevant links (e.g. websites, social media) here.





KEY CHARACTERISTICS

Describing the approach to student reflection and assessment of the activity.



EDUCATORS' ACTIONS

Describe how the teacher(s) intend to lead the students' reflection process. It is important to note that there many different elements and perspectives to reflect on in the CASE approach. Students may reflect on the scientific inquiry process, on the arts inquiry process, on the way in which the arts impacted their sensation and experience, on the challenges they met during the process, and more. Note: Typically, students will surprise you during reflections about the CASE activity! Make sure you are prepared for this by being open and accepting that the discussion may wander into "unchartered waters". This is acceptable and even recommended. Let it happen. See where it takes you.



STUDENTS ACTIONS

Use this part of the template to plan for, and especially document, students' reflections upon their experience here. They may produce interesting reflections, and this is a crucial part of their inquiry process. For many of them, the CASE activity will have been a completely new experience. It will have challenged them in new ways which are surprising. Their physical class structure has probably been different than what they are used to. Their daily schedule may have changed. The goals of learning, as they perceive them, have been altered. They are in new territory. Many of your students will, during reflection, provide insight into their creative process. This helps the other pupils (and the educators) understand and put words to what they have experienced.





LINKS

Please provide relevant links (e.g. websites, social media) here.

Note: CASE activities may be new, challenging, and exciting. But not all students find CASE to be easy. Some pupils depend very much on a rigid structure for the daily process in the classroom. For these students, CASE may be strange, and they may intuitively search for their familiar situation. Do encourage them to be open about this. You will most certainly gain new insights about how to adapt CASE to additional personalities of students in the future.



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

PARTNERS



Western Norway
University of
Applied Sciences



ARISTOTLE
UNIVERSITY
OF THESSALONIKI



ELLINOGERMANIKI AGOGI



KLAIPĖDA
UNIVERSITY



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



ISBN: 978-618-84415-0-7