Creativity, Arts and Science in Primary Education

Training Material

Learning Science Through Digital Storytelling

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Science View

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Content

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The CASE Project and Inquiry based science education

In CASE, primary teachers are agents of change.

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 project[1]).

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

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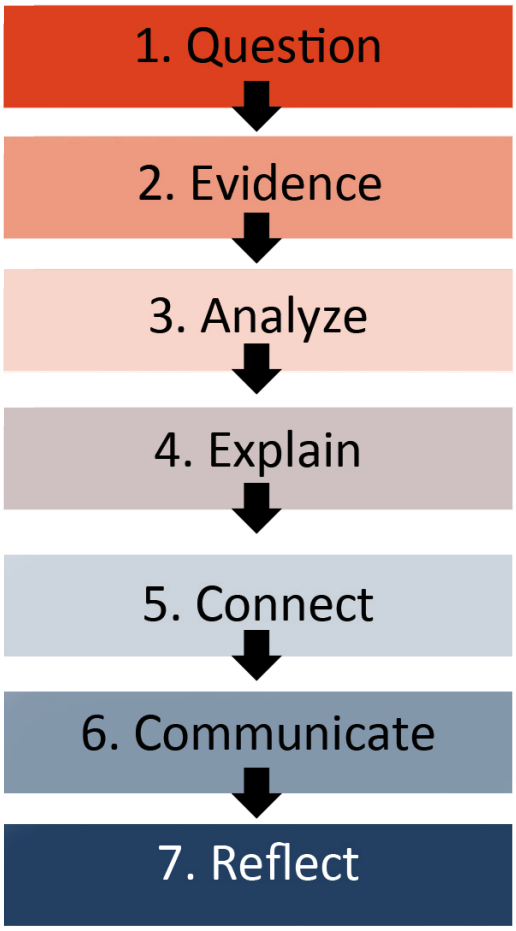

Figure 1: Phases of IBSE

This cycle emphasizes the need for students to engage in creative processes, through which they will act as young scientists and communicate science.
In Figure 2, actions that students perform in each IBSE phase are briefly shown.

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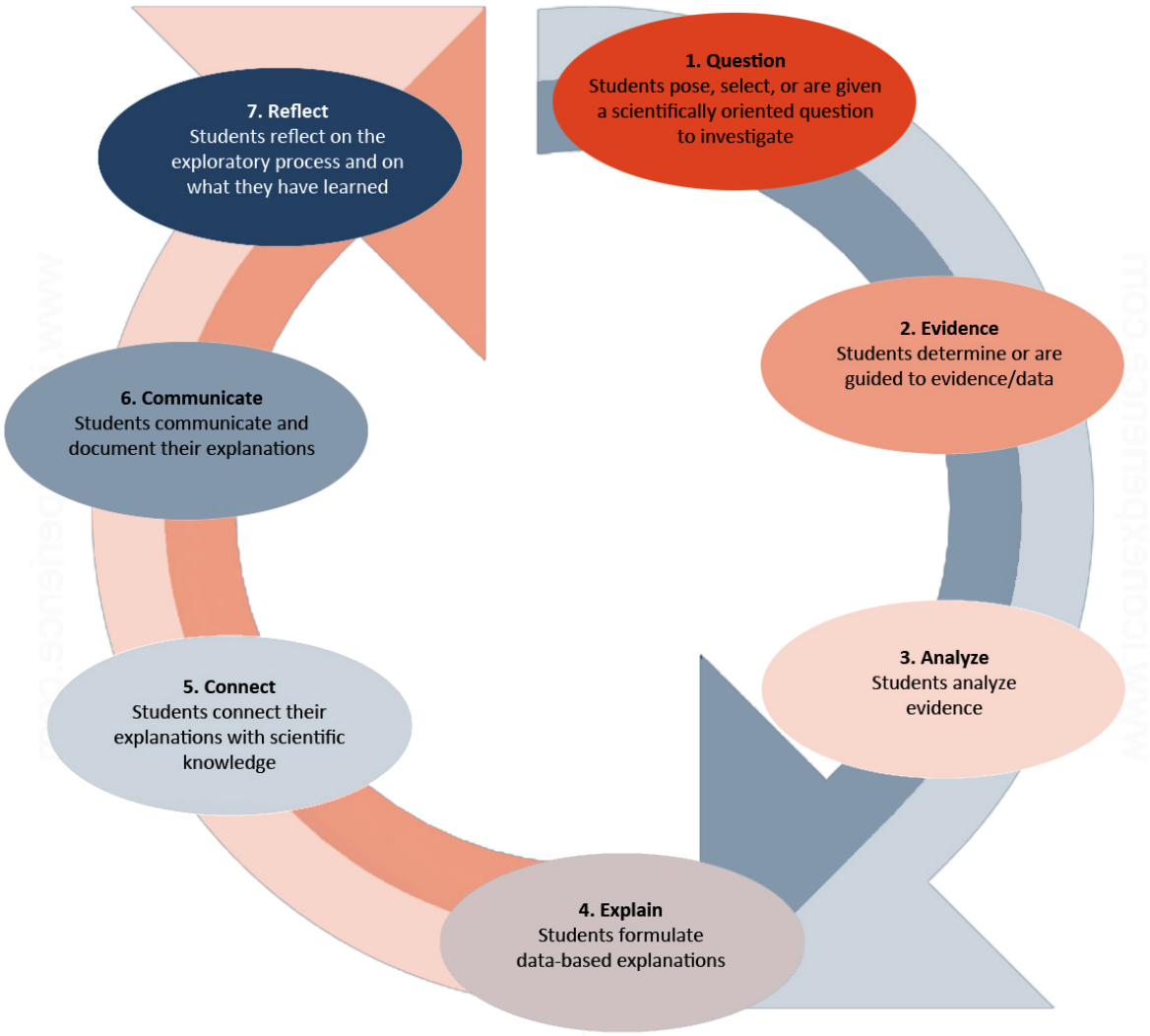

Figure 2: Student actions at each stage of IBSE

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"Digital Storytelling"
(Learning Science Through Digital Narrative and Storytelling)

Some words 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.

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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

Below you may find a description of the implementation phases of the Digital Storytelling activity.

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PHASE 1. QUESTION

KEY CHARACTERISTICS

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

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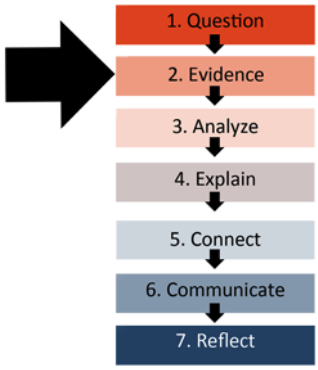
PHASE 2. EVIDENCE



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.

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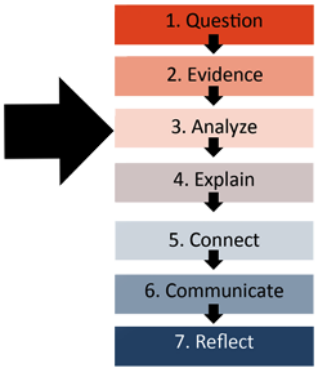
PHASE 3. ANALYSIS



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.

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PHASE 4. EXPLAIN

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.

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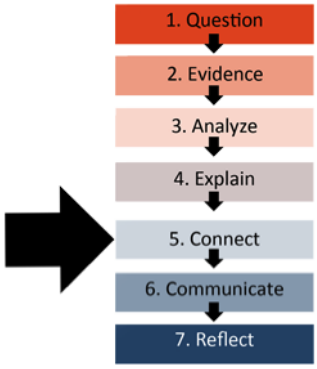
PHASE 5. CONNECT



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.
- 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.

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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 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 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.

Phase F - Living Community on Mars
(Arts and Architectural Design, 3D Printing, Augmented Reality)

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- 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

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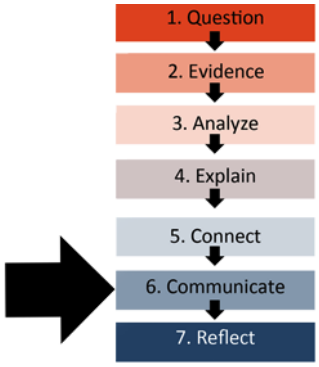

PHASE 6. COMMUNICATION

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 and 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 depend 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.

LINKS

The STORIES Platform
http://www.storiesoftomorrow.eu/content/stories-storytelling-platform

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PHASE 7. REFLECT

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.

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