NEXT STEP O2

NEXT STEP SCENARIO

Advanced Educational Scenario

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Project Reference:		**Author(s):**	Petros Stergiopoulos
Output and Deliverable Code:		**Contributors:**	
		Approved by:	
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Short Description:

This scenario is focused on the preparation of a short concert arranged by the students using a combination of virtual and physical musical instruments. The scenario introduces the steps for experimenting virtual instruments that produce parts of a certain chord that will be defined by the teacher. Students experiment with a virtual platform resembling the acoustic properties of certain physical instruments, mainly the monochord. They search for the appropriate instrument characteristics that will perform the notes needed to accompany a certain part of a renowned melody. A short concert is finally arranged as a result of the teachers' collaboration with the school and local communities.

This scenario enhances the students' collaborative and inquire skills and it is ideally implemented through collaborative teaching (involving ICT, Science and Music teachers). Students do not need to have music skills necessarily although some musical skills are encouraged.

An evaluation test here can be used before and after the implementation of the scenario.

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1. Introduction

Main aim

The NEXT STEP project is proposing a whole school approach to science learning. Building on previous successful European open schooling and STE(Arts)M initiatives, the project will bring about the NEXT STEP in education by providing a roadmap for the transformation of school classrooms into open and creative learning spaces. NEXT STEP methodological approach exceeds the state of the art regarding existing creative approaches and STEAM initiatives. In this framework the NEXT STEP project will design and set in operation the STEAM IDEAS' Square, an innovative learning environment which will be the nucleus of the school's activities. NEXT STEP will demonstrate how these environments a) can offer opportunities for deeper learning of STEAM, b) can improve the innovation and creative capacities of learners, c) can support the new role of teacher as a coach of the learning process, d) can facilitate effective cooperation with external stakeholders and e) can inspire policy-makers, school heads and school staff to imagine the schools of tomorrow.

Vision of the Project

The NEXT STEP vision for a creative and innovative school is the development of the creative and innovative classroom of tomorrow, the STEAM IDEAS' Square, in which education relies on an interdisciplinary, arts-based methodology within an entrepreneurship and design thinking framework.

STEAM IDEAS' Square - **(SIS)** which will be the main core of the school's creative and innovative activities will have two substances: digital and physical. In its premises and via its digital tools in-school interaction between STEM and other disciplines schoolteachers and among all the relative stakeholders (students, educators, parents, artists, scientists, local community authorities, industrial stakeholders, and policy makers) will be established with purpose to run complex and exciting real-life educational world projects. Teams of students (from the same or different classes) can also work and cooperate under SIS umbrella.

By connecting curious minds and specialists and lead them to think "out of the box" will help to speed up the flow of ideas to **transform the school and its classrooms to** a unique creative space for educational innovation and STEAM education.

Through collaboration and the appropriate pedagogies will be established prototyping, pedagogical innovation, creativity (along with distance learning opportunities) and well-being at school.

In addition, the capacity to work with external organizations so as to explore how such partnerships and networks can be built through a long-term strategy-based on trust and common objectives they contribute to key competence development.

A way to implement and use the ideas of NEXT STEP project is through developing a series of scenarios of use that are in line with the proposed approach and involve schools in a series of creative and innovative activities for the improvement of the local cities, settlements, and communities' physical and built-up environments, while engaging key stakeholders (experts, researchers, local communities, businesses etc.) in the process. Different scenarios about different school typologies will be created and these with the help of the right Strategies will help schools to evolve

One of these scenarios that is suitable for a STARTER school (according to our typology) is the one presented later in this document.

2. Essential Features of the STEAM IDEAS' Square

The development of key competences is further facilitated by the provision of context from other disciplines and can:

a. offer opportunities for deeper learning of STEAM,

b. improve the innovation and creative capacities of learners,

c. support the new role as a coach of the learning process,

d. facilitate the effective cooperation with external stakeholders and

e. inspire policy makers, school heads and school staff to imagine the schools of tomorrow.

All the above in total in the context of a functional NEXT STEP STEAM IDEAS' square will drive to overcome the organizational and technical barriers and to integration of creative and innovative culture in every day school practices and to aggregate and create projects and activities customized to the specific needs of schools.

Deeper Learning Competences, as **defined in the Recommendation of the European Parliament and of the Council of 18 December 2006 on Key Competences for Lifelong Learning (2006/962/EC)** as described by the Hewlett Foundation model (Pellegrino & Hilton, 2013) can be adopted in order to define the exact indicators needed to measure the efficiency of the project's objectives. A selection of certain deeper learning competences that correspond to a range of ages wider than the high school students (which is the main target group of the deeper-learning competences model) can be classified in the following three groups (Frans & Andreotti, 2018):

Group A: Cognitive competencies
(1) Mastering rigorous academic content - A1
(2) Thinking critically - A2
Group B: Interpersonal competencies
(3) Working collaboratively - B3
(4) Communicating effectively - B4
Group C: Intrapersonal competencies
(5) Learning to learn (C5)
(6) Developing academic mindsets - C6

As defined in the Recommendation of the European Parliament and of the Council of 18 December 2006 on Key Competences for Lifelong Learning (2006/962/EC):
F1) Literacy competence (GA1)
F2) Multilingual competence
F3) F3M.Mathematical competence and F3S. competence in science, F3T. technology and F3E.engineering, F3MS, F3ST, (STEM=F3)
F4) Digital competence - F4
F5) F5P.Personal, F5S.social and F5L.learning to learn competence (C5)
F6) Civic competence
F7) Entrepreneurship competence
F8) F8C. Cultural awareness and F8E.expression competence
We use the Competences as Features taxonomy from the European Parliament and the Council's recommendation in our scenario.

3. NEXT STEP Scenario Identification

(Playing with virtual instruments)

3.1. Scenario of Use in a upper secondary General education School.

This scenario enhances the students' collaborative and inquire skills and it is ideally implemented through collaborative teaching (involving ICT, Science and Music teachers). Students do not need to have music skills necessarily although some musical skills are encouraged.

An evaluation test here can be used before and after the implementation of the scenario.

3.2 Scenario Identification Card

Category	Description
Title	***Playing with virtual instruments***
Teaching theme/problem	***(Description of the main theme or the problem that our scenario deals with***
Keywords	*Voice, Frequency, Harmonics, Geometrical proportions*
Language	*English (Support material currently in Greek)*
Thematic classification	**STEAM oriented Education**
Learning/Teaching main objectives:	***Arts (Music)***
Suggested age group	*15-18 years old*
Estimated level of difficulty	*Medium - advanced*
Material and technical infrastructure needed	*Online tool. Fast Internet connection uninterrupted.*
School - Stakeholders Synergies	***Local musicians, Local authorities as gusts at the final event***
Typical intervention time	*May vary (23-27hr)*
Teaching level	***Gymnasium and Lyceum or Junior High School or High School***
Level of interactivity	*high*
Type of interactivity	***Physical, Digital, Educational field trips, and Sosial Events***
Authors, Publisher name	***Petros Stergiopoulos***
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3.3 Scenario Identification Image

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Before you start fill in the following tables, please read what it is expected to include in its one of the 4 steps:

The **FEEL**-phase addresses real-world challenges, and invites students (and teachers) to actively engage towards building their own future. This is done by encouraging students to take and share control in the collective creative process, where they understand the rules and make decisions in consideration of them. The safe, small-world society of the classroom, is a good place for students to become being active agents in their own learning. This may in turn inspire an engagement in the larger-world society. In both cases, the engagement is based on empathy towards others, both people and planet (and all those who reside here).

Both teachers and students *can* and *will* influence the process and the final output. No matter what the main scientific topic is, the aim is to adapt it to todays´ challenges, encouraging students to explore good solutions.

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Imagination is a powerful tool! It may seem to be an under-estimated talent in the school-system. But where would we be, if we didn´t imagine the impossible? There would be no inventions! No innovation! And little exploration. The **IMAGINE**-phase is about exploring possibilities, celebrating them.

This is the phase where students engage each other with new ideas through collective brainstorming-sessions, with ideas building upon ideas, gradually moving from a quantity of ideas to a quality idea through a collective process. It is about the willingness to take risks in finding the best solution (in a safe environment), immersing themselves into the unpredictable process of creativity. Instead of taking and sharing control, this phase is about a willingness to loose part of the control in the name of progression in the creative process. It can be rather scary to enter the chaos that creativity is closely related to. Being open to new ideas that emerge can be a challenge both for students and teachers, especially if the sense of ownership to one idea is strong. Which is why the emphasis on a circular, collective process of developing ideas is so important: By breaking down the creative process of writing a story into smaller parts (or composing a piece of music, or creating steps in a choreography), and circling it from group to group, lots of ideas are shared. Each group has influence and can share ideas in each of the stories. This way, when one story is chosen at the end, there are no losers, and everyone is a winner, because everyone has contributed to all of the stories!

In this phase, **CREATE**, students will need to develop and to apply their solutions, what they have imagine in the previous phase. The ideas can vary widely depending on the type of activity and the solutions they seek and the level of the problem students are trying to solve. They have to implement their ideas, interact with external stakeholders to ask for support and guidance and also be creative to find solution while they are implementing. It is very important to note that the proposed solutions have to be based on scientific evidences and research results (coming as input from the Feel Phase). Students have to be engaged in experimentations and data analysis to provide optimum solutions. Close cooperation with the local communities in necessary.

Young people have to be interested in societal challenges and find creative solutions. According to the Open Schools to Open Societies project results (https://www.openschools.eu/) nowadays schools work as ecosystems (Sotiriou et al. 2017), which not only produce knowledge but also link this knowledge to real world and real needs. Moreover,

collaboration between formal, nonformal and informal educational providers, enterprises, industries and civil society should be enhanced to ensure relevant and meaningful engagement of all societal actors with science.

At this step, students should develop the needed approach in order to communicate their results into the local, national or international community. Students, facilitated from their teachers, should communicate with the rest of the schools but also outside the school. They should inform the community for their results and how these could contribute to any possible issue that the community is facing.

3.4 Title of Project

(Playing with virtual instruments)

Feel Step

Act 1	Description of activities, strategies, methods, means, resources and synergies			Learning goals Learning outcomes - Features	STEAM Disciplines Place and Estimated Duration
A1	*Music* Teacher	**Actions -** ***The diatonic scale is played by the teacher and the Grades of pitches is explained.***	**Educational Method** ***Teacher performs and gets feedback***	***This activity introduces the idea of music appreciation and its fundamental concept.***	S, A
		Tools – Support material here.			
	Students	**Actions –** ***Students feel the concept of the octave in the musical scale.***		***B3, B4***	***1 school hour***
		Tools – ***musical instruments of diatonic scale***			
A2	*Music* Teacher	Actions - ***Students familiarize themselves with the platform's Recording Sampling***	Educational Method *Teacher performs and gets feedback*	*They record with the help of the respective tool and edit the recording so that it acquires rhythmic and melodic meaning.*	**S, A, T**
		Tools – *(second environment at https://workbench.imuscica.eu/).*			
	Students	**Actions –** ***In collaboration with the Music teacher, students understand the concept of sequencer.***		***B3, b4***	***2 school hours***
STEAM Ideas' Square (SIS) Operation - School Community	**Schoolteachers (musicians, artists, scientists) collaborate on creating the lesson plan and worksheets.**				***Time: 1-2 hs***

Synergies		
School-Stakeholders Synergies	**A teacher can start preparing with the school representatives the venue for the final event.**	***T* Time: 1 hs**

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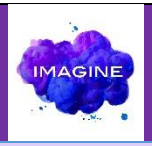
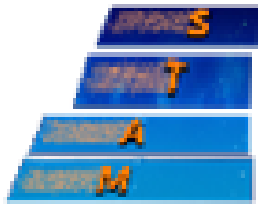
Imagine Step



Act 2	Description of activities, strategies, methods, means, resources and synergies			Learning goals Learning outcomes - Features	STEAM Disciplines Place and Estimated Duration
A1	Science Teacher Music Teacher	**Actions** – Teachers show the geometric proportions 1/2, 2/3, and 3/4 with the corresponding intervals of 1st, 5th, 4th and the corresponding degrees: I, V, IV.	**Educational Method** . ***Inquiry method***	• **Show the connections between the octave, the fifth and the fourth and help students imagine the relations with geometrical proportions**	S, A, T, M 
		Tools - *(3D Instrument design environment at https://workbench.imuscica.eu/).*			
	Students	**Actions** - ***Experiment with the tool and observe the connections between geometrical proportions and sound.***		***Students must* be capable to connect the notions of proportions with the string-length of a monochord.** ***B3, B4, C5***	**1 School hour**
		Tools – *(3D Instrument design environment at https://workbench.imuscica.eu/. The use of real instruments is encouraged using the microphone and graphic analysis tools)*			
(SIS) - School Community Synergies	**Teachers have a draft of a 3D printed "aulos" tube for display. Music teacher presents the connections between the monophonic tone of the aulos tube in relation to real instrument. Science teacher analyzes the reflection of tone using sound analysis tools on the iMuSciCA workbench**				**At SIS, Time: 1 hr**
School-Stakeholders Synergies	**Physical visit to a Science Center that has exhibits related to Sound Acoustics.**				**At SIS, Time: 1h, field trip: approx. 4hs**

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Create Step

Act 3	Description of activities, strategies, methods, means, resources and synergies			Learning goals Learning outcomes - Features	STEAM Disciplines Place and Estimated Duration
A1	Science Teacher Music Teacher	Actions - Teachers explain the phenomenon of consonance using the Cochlea analyzer and the computer mic. Consonance frequencies are added as layers in the cochlea graph. The use of voice or instruments is ideal.	Educational Method *Guided Discovery and Experimentation*	• To understand the idea of consonance using two separate sounds.	*S,T,E*
		Tools - *(third environment of the platform https://workbench.imuscica.eu/) And the Cochlea analyzer (snail)*			
	Students	Actions – *Consonance* *Students create frequencies and graphs in the "Sound Composer" tool (third environment of the platform https://workbench.imuscica.eu/). They explore the timbre so that, with the help of the Music teacher, they can combine the appropriate frequencies. The objective is to produce an audio structure that contains a wide range of harmonic frequencies within the audible compass. Supporting material here.*		*Students must* be capable of understanding the notion of consonance . A1, A2, C5	2 school hs
		Tools – *The online platform (third environment of the platform https://workbench.imuscica.eu/).*			

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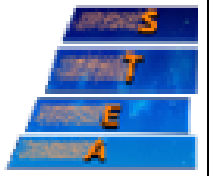
<table>
<tr><td rowspan="3">A2</td><td rowspan="2">Science Teacher
Music Teacher</td><td>Actions -

Teacher helps students understand the idea of chords using the learning outcomes from the previous activity.</td><td>Educational Method

Design and Experimentation</td><td rowspan="2">• To understand the idea of consonance using three separate sounds.</td><td rowspan="2">S, T, E, A
  </td></tr>
<tr><td colspan="2">Tools - (fifth and fourth environment of the platform <u>https://workbench.imuscica.eu/</u>) And the Cochlea analyzer (snail)</td></tr>
<tr><td>Students</td><td colspan="2">Actions –
Management and interpretation of virtual instruments.
Students familiarize with the manipulation of virtual instruments that produce harmonic resonances. As a result of the "Elements of Musical Practice" from Act 1 they create sketches of chords using virtual instruments combined with physical instruments if available.</td><td>Students must be capable of understanding the notion of consonance with three tones
A1, A2, C5</td><td>2 school hs</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="2">(SIS) - School Community Synergies</td><td colspan="3">The Music Teacher chooses a simple renowned melody and defines one chord that accompanies it in certain beats. The teacher also arranges the score to present it in the final event.</td><td>At SIS, Time: 2 hs</td></tr>
<tr><td colspan="2">School-Stakeholders Synergies</td><td colspan="3">The performance of the melody can be undertaken by local musicians. Music teacher can collaborate with local musician who will perform the chosen melody. With the help of their music teacher, students familiarize with the arrangement.</td><td>At SIS, Time: 2h</td></tr>
</table>

Share Step

Act 4	Description of activities, strategies, methods, means, resources and synergies			Learning goals Learning outcomes- Features	STEAM Disciplines Place and Estimated Duration
Ax	ICT Teacher And Music Teacher	Actions - Performance. The music teacher introduces the melody and the arrangement for the chord. ICT teacher supervise the virtual instrument performance using Leap motion sensor.	Educational Method *Inquiry Method*	• To perform their creation in public • To collaborate and coordinate a final performance with their teacher or professional musician	A
		Tools - *(fifth environment of the platform https://workbench.imuscica.eu/) and (fourth environment of the platform https://workbench.imuscica.eu/). Interaction with Virtual Instrument design and performance. Leap motion sensor.*			
	Students	Actions - *Musical sympraxis. In collaboration with the Music teacher, the students prepare the performance of the chordusing their own virtual constructions from the Virtual Instrument 3D design environments.* *The chord itself played by their instruments is a result of their research.*		*Students must* be prepared to understand their role within a group. Their own virtual instrument are tuned to play along a certain melody B3, B4, C6	2 hs
		Tools – *(fourth environment of the platform https://workbench.imuscica.eu/). Interaction with Virtual Instrument design and performance. Leap motion sensor.*			

(SIS) - School Community Synergies	**Teacher in collaboration with the rest of the faculty can arrange the final event and the venue. A team of students can also assist in the preparation of the event and in facilitating the venue and guests.**	**At SIS, Time: 2 hs**
School-Stakeholders Synergies	**Teacher in collaboration with the rest of the school faculty can invite local authorities at the event. In collaboration with parents, the event can be published in the school website or in social media.**	**At SIS, Time: 1 hs**

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4. References

P. Stergiopoulos. Music and STEM. Multiple sides of the same coin. International Conference | STE(A)M educators & education. Conference proceedings STEAM on EDU 2021, p.202-220. ISBN: 978-618-5497-24-8. (chapter link here).

5. Abbreviations, short terms, apps used in Scenario of Use

- SIS: STEAM IDEAS' Square
- Stakeholders: Parents, special scientists, external Educators, authorities, entrepreneurs,
- IWBS: Interactive White Board System, Video Projector and interactive whiteboard.
- Leap motion sensor: https://en.wikipedia.org/wiki/Leap_Motion

Competences

- F1. Literacy competence
- F2. Multilingual competence
- F3. F3M.Mathematical competence and F3S. competence in science, F3T. technology and F3E.engineering //or/ F3MS, F3ST , (STEM=F3)
- F4. Digital competence
- F5. F5P.Personal, F5S.social and F5L.learning to learn competence
- F6. Civic competence
- F7. Entrepreneurship competence
- F8. F8C. Cultural awareness and F8E.expression competence

NEXT STEP Partnership

Western Norway University of Applied Sciences

SCIENCE VIEW

ELLINOGERMANIKI AGOGI

NUCLIO
Núcleo Interactivo de Astronomia

DUNDALK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA DHÚN DEALGAN

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