Overview of the iMuSciCA project

Vassilis Katsouros
Institute for Language and Speech Processing
Athena Research and Innovation Center
iMuSciCA partners introduction

- Multi-Modal Interaction
  - Gesture Analysis
  - Human Behavior Analysis
  - Handwriting Recognition

- Human-Machine Interaction
  - Audio Processing
  - emotion recognition

- Virtual Reality
  - Modeling
  - Instrument Acoustics

- Online Education
  - Secondary Education
  - STEAM pedagogy
  - Teacher Communities

- Pedagogy
  - Learning Technologies
  - Learning evaluation

- Math and Science Pedagogy
  - Math and science software
  - Online Math Learning

- Pedagogical Research
  - Teacher Communities

- Learning Technologies
  - Pedagogy

- Learning evaluation
  - Teacher Communities

- Pedagogy
  - Learning Technologies

- Online Math Learning
  - Math and science software

- Computer Algebra System
  - Mathematic Expression Recognition
The educational movement of STEAM

- Cross-disciplinarily connected skills in the educational process to promote creativity, critical thinking, innovation, risk taking

- Alongside with knowledge and skills in Science, Technology, Engineering and Mathematics (STEM) fields

- Bring Arts (A) at the heart of the academic curriculum

STEM + A = STEAM
Inspired by trends, challenges and technologies

Source: New Media Consortium (NMC) Horizon Report 2015
iMuSciCA
interactive Music Science Collaborative Activities

- New pedagogical methodologies and innovative educational technology tools to support active, discovery-based, personalized, and more engaging learning

- Provide students and teachers with opportunities for collaboration, co-creation and collective knowledge building

- Design and implement a suite of software tools and services on top of new enabling technologies integrated on a platform that will deliver interactive music activities for teaching/learning STEM
iMuSciCA objectives

- Develop and explore **original and innovative enabling technologies** to facilitate open co-creation tools incorporated in music activities to support STEM learning

- Develop a **workbench of music activities** to give learners the opportunity to discover phenomena/laws of **physics, geometry, mathematics and technology**

- Encourage students to engage in innovative interactive music activities with **advanced multimodal interfaces** to discover new ways to look at science and technology to support **creative and artistic interventions**

- Enable teachers to design engaging **project/problem based STEAM learning activities**
iMuSciCA main outcomes

- **Workbench of Music Activities** containing methodological and advocacy tools of advanced enabling technologies to assist learners in developing co-creative processes for STEAM learning.

- **Cross-disciplinary lesson plans** for secondary education to teach physics, geometry, mathematics and technology combined with creative music activities.

- Professional development **material for teachers and educators** for adopting innovative STEAM teaching methodology.
iMuSciCA enabling technologies

Virtual 3D environments to design personalized musical instruments using geometric forms and tools
iMuSciCA enabling technologies

Computer generated sound produced by varying the design parameters of musical instruments with interpretations of the related physics and mathematics.
iMuSciCA enabling technologies

Gesture and pen-enabled multimodal interaction of the learners with the virtual 3D musical instrument for co-creation and music performance
iMuSciCA enabling technologies

Interactive STEM authoring and learning environments with advanced tools for the creation and presentation of lesson plans

Solve the following sum:

\[ P(x) = 1 + x + x^2 + x^3 \]

and write the resulting polynomial ordered by degree in decreasing order.

\[ 2x^2 + x + 1 \]
iMuSciCA enabling technologies

Deployment of 3D printing technology for realizing the physical musical instrument as a tangible physical object.
iMuSciCA main outcomes

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Use Case Scenario

Interactive Music Science Collaborative Activities

John & Beatrice
iMuSciCA students

Teachers design iMuSciCA class lessons for STEAM learning

Garry gives individual feedback to Beatrice

Alexandra is teaching geometry and waves

John and Beatrice incorporate new knowledge in their instrument design

They explain their 3D instrument to their classmates

3D printing of the instrument for the concert

Co-creative design, visualisation, and testing of 3D instruments that sound

Alexandra discusses the learning outcomes with John

At the end of the semester, a concert is taking place where students celebrate their deeper learning

Every year a new stage is organized. In each stage an instrument will be designed with the final goal of playing a concert. However, the three iterations differ in their level of deeper concepts to be taught.

1. Sound & tone generation, 3D instrument design
2. Timbre & harmonics, deeper mathematics & physics
3. Consonance & dissonance, solid knowledge and understanding in a variety of curriculum subjects (physics, mathematics, geometry, informatics, engineering, technology, music, design, and history of arts.)

Team Teaching for STEAM Education

Garry & Alexandra
iMuSciCA teachers

Teachers exchange knowledge from different subjects

Teachers committee measures the impact of iMuSciCA on deeper learning and refines lesson for next year

Logo Design & sketches by Andrin Hubacher
Evaluation of deeper learning with iMuSciCA

- How do we measure deeper learning?

- Formative evaluation
  - Pilots in Greece, Belgium and France (~30 students and ~6 teachers)

- Summative evaluation
  - Pilots in Greece, Belgium and France (~300 students and ~50 teachers)

- Qualitative and Quantitative methods and instruments
  - Surveys, questionnaires (teachers and learners)
  - Pre & post tests (learners)
  - Tracking learner’s activity (mouse clicks, response times, frequency of hints, etc.)
  - Tracking learner’s behaviour
Advanced monitoring tools for tracking learner’s behaviour

- Eye tracking
- Facial expressions analysis
- Galvanic Skin Response (GSR) sensors
- Electroencephalography (EEG)
Interaction between pedagogy and technology

- Enabling technologies
- Lesson Plans
- Pedagogy
- Workbench
Thank you!

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