A PEDAGOGICAL ARCHITECTURE FOR DESIGNING DIGITAL MUSICAL INSTRUMENTS

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EDUCATIONAL CONTEXT

Motivation to learn

Engagement

Enjoyment

Cognitive aspects

Socio-Affective aspects

Science
Mathematics
Physics
INFORMATION AND COMMUNICATION TECHNOLOGY IN EDUCATION

impacts on people’s lives mainly on adolescents
commitment to school
way they interact
thoughts
relationship with work
way of life
HOW TO PROMOTE SOCIO-AFFECTIVE ASPECTS BESIDES COGNITIVE ONES

For now, I would like to play games ‘cause I really enjoy them!

What I want to learn?

Cognitive

Social?

Affective?
SOCIO-AFFECTIVE ASPECTS

Social Aspects

• Collaboration/ cooperation (PIAGET, 1973).
• Teamwork.

Affective Aspects

• Affectivity (emotions, states of mind, motivation, interest, enjoyment, etc) (SCHERER, 2005; LONGHI, 2011).
• Engagement
PISA 2015 RESULTS

http://www.oecd.org/pisa/
MOTIVATION TO LEARN SCIENCE

- Enjoyment of science declines from elementary to high school.
  (Archer et al., 2010 apud OECD/PISA RESULTS Vol. I, 2015, p.121)

- Why?

- Students interest changes and become specialized.
  (OECD/ PISA RESULTS Vol. I, 2015, p.121)
PISA 2015 RESULTS

Interest in science and its importance to the students' world

Extracurricular activities:
- Science competitions;
- Clubs;
- Sports;
- Music;
- Arts

Participating in science activities

Disadvantage schools – lack of student engagement
STUDENTS’ SOCIO-AFFECTIVE DIMENSION DURING THE LEARNING PROCESS

Cognitive

Socio-
Affective
development

Promotes knowledge

Stimulates social and emotional competencies

Contributes to reach goals, to establish relationships and make decisions

(CASEL, 2015; PISA, 2015)
How to promote socio-affective aspects besides cognitive ones in the teaching and learning process?

One possibility is…

Designing, constructing and use DMIs with students
DIGITAL MUSICAL INSTRUMENTS (DMIs)

- Digital device control by computers or by other digital supports
- Electronic sensors that present
- Virtual or physical interface or both.

Artiphon
(Butera and Jenkins, 2014)
http://artiphon.com/

ReacTable
(Jordà, 2005)
http://www.reactable.com/products/experience

(MORREALE et al. 2014)
ADVANTAGES DESIGNING DIGITAL MUSICAL INSTRUMENTS WITH STUDENTS

• Promotes STEM competencies.
• Aligns with the school curriculum.
• Integrates robotics activities with computing language and music.
• Can link theory with practice.
• Students can become engaged and motivated during the teaching-learning process.

(Blikstein, 2010; Sawyer et. al, 2013; Harriman, 2015)
Designing and developing DMIs with/by students

Computer Science

Music

Physics

Electronic
TEACHING PRACTICES AND MOTIVATION PROMOTING

• Intrinsic motivation – students may learn science because they enjoy it.
• Instrumental motivation – students recognize learning science is important to their future plans.
• Motivation – driving force behind engagement.
• Teaching practices - students’ natural motivation to learn science.

(PISA, 2015)
LEARN SCIENCE AND LEARN DESIGNING AND BUILDING DMIs

Learn science

Learn designing and building DMIs

- Develop problem-solving skills.
- Awareness about technology.
- Develop ideas.
- Fix problems in electronic objects.
HOW TO TEACH DESIGNING AND BUILDING DMIs IN SCHOOLS?

• New approaches must be tested among students to develop pedagogical projects (Harriman, 2015).
• What software and hardware toolkits should be used in teaching DMI designing? (Harriman, 2015).
• What concepts of programming, electronics, interaction design, music and more can be taught through DMI design? (Harriman, 2015).
• Is it possible to create tools to design DMIs that can be easily understood and used by students and teachers that are interested in them? (Harriman, 2015).
• How can the designing, construction and use of DMIs in the classes promote learning, involving the socio-affective aspects besides the cognitive ones? (Rosas; Behar; Palma).
Developing Pedagogical Architectures for Designing Digital Musical Instruments with and by Students.
PEDAGOGICAL ARCHITECTURE (PA)

- One or more theories

- Solid background

- Teacher pedagogical model

(KNUPPEL & ECKSTEIN, 2013; BERNARDI, 2011; BEHAR, 2009)

- Multidimensional structure based on a pedagogical model that elucidates and directs how to affect the curriculum.

(BEHAR, 2009, p.24)
ASPECTS OF A PEDAGOGICAL ARCHITECTURE

- Management of the Distance Learning course
- **Pedagogical planning**
- Students and teachers profile
- Objectives and Purpose

- Selection and evaluation of learning objects (LO)

- Didactic
- Forms of interaction
- Evaluation tools

- Computer resources
- Virtual Learning Environment (VLE)

Aspects of a Pedagogical Architecture adapted by authors
Source: (BERNARDI, 2011, p.57)
PEDAGOGICAL ARCHITECTURE (PA) FOR DESIGNING DIGITAL MUSICAL INSTRUMENTS

ORGANIZATIONAL ASPECTS
- 'WHO', 'FOR WHAT'
  - Audience definition.
  - Goals definition.
  - Purpose of the workshop or course.
  - Formation of the interdisciplinary team building.
  - Creation of a DMI prototype.

CONTENT ASPECTS
- 'WHAT'
  - Construction of a prototype of DMI: PentaTRONIX.
  - Development of the LO DMIE with:
    - Module 1: Digital Musical Instruments (DMIs).
    - Module 2: Scratch Programming and Scratch for Arduino (S4A).
    - Module 3: Stages of the building and design of a DMI.
    - Module 4: Pedagogical Strategies (only for teachers).

METHODOLOGICAL ASPECTS
- 'HOW'
  - Didactic sequence.
  - Selection of techniques, procedures and computing resources according to the proposed objectives and the target audience.
  - Creation of challenges and themes to address content.
  - Choice of types and evaluation tools: posts of tasks in Virtual Learning Environment (VLE).
  - Interactions carried out in VLE.

TECHNOLOGICAL ASPECTS
- 'WHAT TECHNOLOGIES'
  - Selection of the ROODA VLE and its features.
  - Choice of the physical classroom space.
  - Choice of technologies to be used such as computers with internet, speakers, projector, sound box, software.

Source: The authors
ORGANIZATIONAL ASPECTS

'WHO', 'FOR WHAT'
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Source: The authors
ASPECTS OF THE CONTENT

CONTENT ASPECTS

'WHAT'

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Source: The authors
ASPECTS OF THE CONTENT: CONSTRUCTION OF A DIGITAL MUSICAL INSTRUMENT PROTOTYPE

PentaTRONIx prototype

Source: The authors
METHODOLOGICAL ASPECTS

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RESULTS

COGNITIVE

• Logical reasoning and the ability to solve problems.

SOCIAL

• Activities and challenges in groups or pairs to develop Skills to work collaboratively.

AFFECTIVE

• Interaction with music and opportunities to create new objects (physical and/or virtual).
• Positive states of mind, motivation and engagement.
APPLICATION OF THE PEDAGOGICAL ARCHITECTURE FOR DESIGNING DMIs IN A CASE STUDY

- Where: public school
- Audience - 14 to 17 years.
- 20-hour classes.
CASE STUDY

Pedagogical Architecture (PA)

Designing DMIs

DMI prototype

Workshop

LO

Socio-Affective aspects
CASE STUDY RESULTS

• How did you feel while participating in this workshop? Check the option that best represent your feeling:

- Predominance of the positive states of mind from students.
FINAL CONSIDERATIONS

• It broadens perspectives for the development of other pedagogical architectures for designing DMIs following the same aspects of this to be used as support for technology-mediated interdisciplinary projects to attend adolescents students dimensions (cognitive, social and affective).
Thank you for your attention!

QUESTIONS?

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