E-ARTinED Background Report on Using New Media Arts to Teach Curricular Subjects

Author: Nektarios Moumoutzis (TUC/MUSIC), July 29, 2016

Introduction

New media arts employ new media technologies including digital art, computer graphics, computer animation, virtual art, Internet art, interactive art, video games, computer robotics, 3D printing, cyborg art and art as biotechnology ("New media arts", 2016). Consequently, learning in new media arts involves digital technologies and cross-disciplinary art forms related to the creation, distribution and interaction with various types of artworks including those that are presented through digital means (audio, screen-based), printed or hybrid ones. A modern trend is to include materials that use embedded devices with Internet connection capabilities as well. Such constructions are usually described with the term "Internet of Things" and are closely related to the "maker movement" and trends in education that focus on construction of materials that integrate digital logic, sensors and actuators (Justice, 2015)

The role of new media arts in education is to enable students to understand, analyse and actively participate in the modern media culture from multiple viewpoints, develop skills to work in a plethora of forms and styles, reflect on their own role as consumers and producers of new media artworks and evaluate such artworks and related cultures. The ultimate aim is to enable students express themselves and communicate through their new media artworks managing their inherent complexity and gradually developing their aesthetic understanding.

Learning in new media arts and constructionism

Peppler (2010) stresses that learning in new media arts is closely related to:

1. Active engagement in the learning process.
2. Students' personal connection to their work, which inspires a general love of learning and builds upon their prior experiences.
3. The creation of projects that are of value to a larger community.

Consequently, understanding media art creation requires an elaborate learning theory and corresponding pedagogy to support it. A theory and a pedagogy that acknowledge the interplay between the learner, the media artwork, and the social context within which the learning process unfolds. A pedagogy with these characteristics, Peppler (2010) argues, can be found in constructionism, which places learners in designer roles and ties together the importance of designing artifacts that are of relevance to a larger community. In constructionism, learning is achieved when constructing new things that are meaningful for the learning. Consequently, constructionism places the students in the role of producers of artifacts beyond their traditional passive role of "consumers" of information. This distinction between students' role as producers versus consumers is very important for understanding learning in new media arts.

Students as consumers and producers of new media artworks

Students as producers use digital technologies to create new media artworks and share them with others. The creation of new media artworks incorporates many alternative design approaches,

depending on the media forms employed, and exploits appropriate devices and software tools. Consumption of new media artworks is related to skills that enable students to find, evaluate, explore, understand, analyze them and participate in media culture.

In both consumption and production there are certain key concepts, story principles and elements of media that can be broadly classified as technical and symbolic (Australian Curriculum, 2016).

- Key concepts refer to the media languages employed, the essential digital technologies, institutions that engage in media production and use, the audiences targeted, and the constructed representations of the world.
- The technical and symbolic elements include composition, space, time, movement, sound visual appearance etc. These elements are carriers of meaning in various contexts serving alternative aims.
- Story principles are usually framed under genre conventions (such as film, documentary, advertisements, digital games and their combinations) and refer to dramatic structure (plot), intent, characters, settings, viewpoints.

The new media creation process

The creation of new media artworks follows a process with three distinct stages: Preparatory actions (**pre-production**), subsequent development (**production**) of the main materials of the artwork, and final assembly (**post-production**). In some cases two more stages are distinguished: (a) One is distinguished from pre-production and is related to the development of the general concept or idea that will guide the development of the media artwork. For example, in film making, this initial stage could refer to scriptwriting. (b) One more is distinguished from post-production and refers to the distribution or sharing of the media artwork. For example, a digital story that is developed in the form a digital video, could be distributed via youtube or other appropriate video sharing web portal.

There are cases where the above stages are titled in different ways or organized in slightly different set-up depending on the form of new media artwork. For example, in the case of digital games it is usual to have the following stages (Moumoutzis et al., 2014): Idea and Conception, Design, Development, Testing, Distribution.

Independent of the exact term used, the pre-production stage includes some form of storyboarding and or sketching, design, planning and research to identify the important properties of all elements that will be used in the synthesis of the artwork. The production stage employs capturing devices and techniques (audio recording, video recording) as well as coding the interactive behavior of the media artwork (e.g. in case of digital games or interactive animations). Finally, the post-production may include editing and mixing as well as testing in case of media artworks that have a complex (interactive) behavior such as video games.

Knowledge and skills promoted by new media arts

Learning in new media is about developing the conceptual knowledge on how media works are constructed and developing the skills on how new media can be used to communicate and tell stories. The first level of engagement with new media refers to the role of student as a consumer: Consuming new media involves analyzing them in order to become active and ethical participants

in the contemporary media culture. Knowing about how media works includes, ideally, social media as well. Important issues and practices refer to copyright, the creative commons sharing framework, and the ethics of sharing, in general, media works and personal information on-line.

When students engage in new media arts production, several learning opportunities arise:

- Students use many different media types such as images, sounds, videos and text. They learn how to search for resources and how they can remix them or develop their own ones using tools and technologies related to image processing, video editing, audio processing and text processing.
- When students participate as actors in media production they use equipment, props, costumes and sets taking into account the suitability of these elements in respect with the form of the media artwork and the intention of the creators.
- The creation of new media artworks is in many cases the result of collaborative work that is organized in several distinct and closely interconnected tasks. By engaging in such complex joint activities, students learn to collaborate in creative teams. Furthermore they exercise analytical and interaction/communication skills. Finally, they learn and practice creative techniques and methodologies for many alternative media forms as those that have been or being formalized within the related communities of practice as “media conventions”.
- An important aspect of learning in media arts is the effective development of the so called “digital citizenship”. This refers to knowledge regarding intellectual property rights and respect for intellectual property, responsibilities and protocols in the media artwork creation.

Learning in new media arts should not be considered as an alternative to learning in traditional arts. As noted in Peppler (2010), media artists Tyler Adams stresses that:

> *It shouldn’t be an issue of traditional versus media art—it should be both. There are distinct lessons to learn about drawing by hand and drawing in the computer. We encounter many concepts in media art, for example, gravity or easing, that do not translate when working with traditional materials... Media art has the aesthetic history of traditional art, but technical topics specific to the medium.*

Along this view, Peppler (2010) underlines that apart from reshaping artistic practices, new media arts is closely related to computer programming and, thus, learning in media arts has a significant contribution to enabling students become capable of innovating with computers:

> *Media arts introduce new tools and reshape some of the fundamentals of artistic practices. Computer programming, in this context, is another tool that has entered the palette for artists. In the context of media arts, learning to write computer programs is often an important component of becoming “software literate” or having the ability to create novel user interfaces with the computer.*

Computer programming can be used indeed as a creative tool and learning to code contributes in the overarching aim of enabling students develop their computational thinking skills and abilities (Knochel and Patton, 2015).

New Literacies

According to Peppler (2010) learning in media arts is fundamentally connected to the development of new literacies, i.e. any type of communicative interaction involving speaking, reading, listening, drawing, and writing with text in print and non-print forms.

The terms “literacy” and “text” were traditionally linked to reading and writing, i.e. the ability to understand, exchange, and create meaning through text, speech, and other forms of language. With the advent of digital technologies the notion of literacy is redefined. The term “text” now means many things beyond sequences of alphabetic characters: social arrangements, tagging, type of dress, singing, drawing, and dancing.

Arts play a crucial role in this new context while students’ media art projects can be seen as complex forms of multi-modal communication combining visual, audio, animated movement, written, and kinesthetic/interactive modes of communication. By engaging in media arts students acquire a number of literate practices related to new media literacy, technology fluency, and artistic expression. These practices go beyond scripted reading and writing curricula , traditional computer courses (organized around skills like typing and using office applications), or media education (structured around critical reading of media texts and not the creation of such texts. In summary, through media art making, students become more fluent at communicating ideas.

The term “media literacy” is used to frame is an effort to extend the domain of traditional literacy in order to assimilate in its overarching language-oriented framework diverse forms of media, from images and music to film, television, and advertising. The emphasis remains on text and the term is extended to account for the new forms of symbolic expressions. The aim is to understand the intended and unintended messages and meanings in media (critical dimension) and be able to craft one’s own media to communicate and express oneself (fluency dimension). This kind of literacy, as Zimmerman (2009) argues, it is not sufficient for one to be fully literate in our world today. It fails to address effectively new kinds of literacy that are emerging, mainly due to the wide spread use of computers and communication networks.

Zimmerman (2009) goes on to identify an emerging set of skills and competencies, new ideas and practices that are going to be part of what it means to be literate in the 21st century. Game design is a paradigm for understanding what these new literacy needs are and how they might be addressed. This goes beyond the notion of media literacy that was offered until recently as an answer to address the new literacy needs (Zimmerman, 2009).

Gaming literacy is the ability to understand and create specific kinds of meanings and it has three dimensions: systems, play and design. Game design is the overarching concept that includes and extends systems and play. Indeed, many researchers have documented that game development offers a powerful learning environment promoting effective learning and learner autonomy (Kafai 2006; Kafai 2001). It is a rich creative activity that offers opportunities to exercise a wide spectrum of skills to embody creative ideas in a complex cultural artifact.

The crafting of digital games is facilitated by many end-user development platforms that are currently available. Many youngsters find in them learning engagement as well as a space for personal expression and social recognition (Burke & Kafai, 2014). Consequently, gaming literacy can be considered as an inclusive framework for addressing all major needs of learning in new

media arts. However, learning approaches that follow media literacy directions or ad hoc learning scenarios that focus on distinct aspects of media production (e.g. image or audio processing) are possible as well depending on the learning needs of certain groups. As an alternative to gaming literacy based frameworks, digital storytelling approaches can be followed based on a media creation process incorporating pre-production, production and post-production stages (Moumoutzis et al., 2016).

Examples of Practices

Six examples of practices follow that refer to the use of new media arts to teach curricular subjects from Mathematics, Science, Literature, Foreign Language, History, and Geography.

New Media Arts and Mathematics

Title: Moving with numbers

Age: 11-12 years

Aim: The aim of this activity is to make mathematics meaningful through coding in Scratch. In particular, the mathematics concepts that are covered are: positive numbers, negative numbers and 2D coordinates. The students experiment with coordinates and use them to animate sprites.

Process:

1. The teacher presents to the students the Scratch platform and invites them to explore the movement code blocks for sprites.
2. The students form groups of 2-3 and use their computers to explore the movement blocks under the facilitation of their teacher trying to understand how the movement is achieved.
3. The teacher invites the students to put a background image that show the coordinate system of Scratch and explains how coordinates can be used to move a sprite up and down, left or right.
4. Under the facilitation of the teacher, the students explore movement using absolute coordinates vs movement using the sprites current position and orientation. Only horizontal and vertical orientations are used. The students try to guess the new absolute position of a sprite after the execution of a “move <number> steps” command using sprite position and direction.
5. The teachers triggers a discussion about positive and negative numbers and invites the students to test negative number of steps while moving a sprite.
6. Under the facilitation of the teacher, the students explore movement using negative numbers and try to guess the new absolute position of a sprite after the execution of a “move <number> steps” command using negative <number>.

Materials required: Computers with Internet connection

Teacher's skills: Adequate knowledge of using the Scratch platform (https://scratch.mit.edu)

Suggested duration: 45 min can be extended to several sessions of 45 to 90 minutes each.

Expected outcomes: After successful completion of this activity, students will understand the practical difference between positive and negative numbers in terms of movement in 2D coordinate systems. The will also understand how 2D coordinates are used to identify the position of an object in the plane and how they could be used to change the position of an object.

New Media Arts and Sciences

Title: In the forest

Age: 10-12 years

Aim: The aim of this activity is to help students understand the relations between the creatures living in a habitat and use this knowledge to develop an animation that can be extended to a game.

Process:

1. The teacher presents to the Scratch platform and puts a background and sprites showing animals and plants inside a forest (bear, beetle, butterfly, fox, frog, mouse, trees, flowers…) and informs the students that they will create an animation simulating the life in a forest.
2. The students form groups of 2-4 members each. Each group will work on a computer.
3. The teacher presents how sprites can be animated in Scratch, how background can be changed, and invites students to animate the animals and plants of the forest.
4. The students make their animations trying to simulate the usual behavior of the forest creatures (e.g. butterflies fly, foxes run, trees grow…).
5. The teacher discusses with the students the relationships between the animals and plants in a forest and invites them to visualize these relationships in their animations.
6. Students extend their animations to visualize relationships (e.g. foxes chase mice, butterflies rest on flowers and trees…).
7. If further time is available, the teacher presents how sprites can be controlled using the keyboard or the computer mouse and invites the students the extend their animation to a game. A forest animal is the protagonist controlled by the user. The user earns points when the animal eats another animal or plant that is possible to be eaten and loses points when another animal eats the protagonist or if the protagonist eats a poisonous plant.

Materials required: Computers with Internet connection

Teacher's skills: Adequate knowledge of using the Scratch platform (https://scratch.mit.edu)

Suggested duration: 45 min can be extended to several sessions of 45 to 90 minutes each.

Expected outcomes: After successful completion of this activity, students will be able to interpret the relations of organisms in a habitat to playful interactions of representations of those organisms in a digital game. Furthermore, they will be able to create simple yet powerful animations by employing a programming language in Scratch and evolve these animations to simple digital games.

New Media Arts and Literature

Title: A Magic Book

Age: 9-11 years

Aim: The aim of this activity is to enable students understand in depth a selected story and transform it into an interesting computer animation or a series of animations and/or digital mini-games that can be triggered through “tangible interfaces” using a special electronic board that can transform any material that is an electrical conductor to an input device.

Process:

1. The teacher has already selected and presented to the students a small book with illustrations asking them to read it at home before coming to the class.
2. Having read the book, the students discuss about the book (teacher coordinated).
3. The teacher asks them to form groups.
4. Each group select a distinct illustration of the book and finds an animation or a video or any other suitable digital resource from the web that explains or complements the illustration.
5. The teacher presents the makey makey board, shows them how it can be connected to a computer and asks them to create special wiring with a copy of the selected book so that each illustration can be transformed into a tangible button that can trigger the presentation of the resource found for the illustration.
6. The students, under the supervision of their teacher, wire the book and present the resources that they have found when flipping the book and selecting one illustration after the other.

Materials required: Computers with Internet connection, makey makey (http://www.makeymakey.com/). A computer for each group.

Teacher's skills: Basic ICT skills required by the teacher and the students. The teacher should already know how to use and wire the makey makey board.

Suggested duration: 45 min that can be extended to several 45-90 min sessions if the length of the selected book and the number of illustrations are big. Furthermore, instead of finding digital resources to link to book illustrations, the students may animate the illustrations after scanning them and using suitable software like Scratch (https://scratch.mit.edu/). The could also evolve their animations to interesting mini-games.

Expected outcomes: After successful completion of this activity, students will be able to interpret a printed story to a dynamic animation environment presenting in a more interesting way the elements of the story. Furthermore, they will be able to search and select or develop interesting animations and assemble them into a coherent whole that can be controlled through tangible interfaces.

New Media Arts and Foreign Languages

Title: Animating a dialogue

Age: 9-11 years

Aim: This activity aims to enable the students understand a dialogue presented in a foreign language and develop their own animated version. The initial dialogue can be in printed form or a film or even an orally presented tale or narrative. The students analyze the dialogue to identify its theme, characters, plot etc. and then develop an animated version based on certain digital tool selected by their teacher.

Process:

1. The teacher presents a dialogue in the foreign language. Before the lesson, he/she has already found or prepared the necessary sprites and/or background to animate it using the Scratch platform (or any other similar software of his/her choice).
2. The students identify the characters participating in the story and organize it into a small number of distinct scenes.
3. The teacher presents the selected software to be used for animating the dialogue. If Scratch is selected, the teacher invites the students to use it with the interface elements translated in the foreign language of the lesson to enable better practicing for the students.
4. The students are organized in groups. Each group animates one of scene of the dialogue.
5. After completion of the distinct scenes, the final animated dialogue is assembled (by the teacher, if no further time is available for the students, or by the students themselves, if time is available) and uploaded on the web.

Materials required: Computers with Internet connection.

Teacher's skills: Adequate knowledge of using the Scratch platform (https://scratch.mit.edu) or any other appropriate software to develop the animated version of the story or dialogue.

Suggested duration: 45 min that can be extended to 2-3 45-90 min sessions depending on the length and complexity of the selected dialogue.

Expected outcomes: After successful completion of this activity, students will be able analyse dialogues in the foreign language, organize them in coherent parts, and animate them using special software.

New Media Arts and History

Title: A

Age: 9-11 years

Aim: The aim of this activity is to create an interactive in-class museum using an AR application such as Aurasma (https://www.aurasma.com/). This is an adapted version of the scenario presented at http://www.educade.org/lesson_plans/create-an-interactive-in-class-museum-with-aurasma.

Process:

1. The student selects a specific historical period and invites the students to search and find information about items found during that period along with pictures of these items as they are exhibited in real museums.
2. The students select the pictures that will be the exhibits of their in-class museum, print them and put them in specific places in their classroom.
3. The teacher presents Aurasma, or any other appropriate software, and guides students on how they could create overlay content (pictures, video, recordings) for each picture placed in the classroom.
4. The students work in groups to develop the overlays.
5. To facilitate the peer evaluation that will follow, the teacher distributes an evaluation rubric.
6. Each group present the overlays it has developed. The other students, evaluate them using the rubric provided by the teacher.
7. The teacher collects the filled rubrics and presents the evaluation results.

Materials required: Tablets running Aurasma or any other appropriate software to create the virtual museum exhibits. Color Printer.

Teacher's skills: Basic ICT skills. Knowledge of Aurasma or any other alternative software to create a series of augmenter reality virtual museum exhibits.

Suggested duration: 3 sessions of 45 min each. During the first session, the students select and printout the pictures that will be used as the in classroom exhibits. During the second session they develop their overlays in groups. They present them and evaluate their peers' work during the third session.

Expected outcomes: After successful completion of this activity, students will be able to deconstruct a theme into a sequence of artifacts/pictures, to curate and share an augmented reality museum experience and to evaluate their peers’ virtual exhibits.

New Media Arts and Geography

Title: Musical instruments of the world

Age: 9-11 years

Aim: The aim of this activity is to work collaboratively to develop an interesting multimedia presentation of musical instruments from different countries so that the cultural similarities and difference between them can be better understood and presented.

Process:

1. Children are asked before the activity to bring in class an musical instrument from a foreign country. If the do not have such an instrument, they are asked to bring a photo or a painting of such an instrument and a sound recording with this instrument playing.
2. In the class the teacher invite the students to take photos of the instruments (or the images that they brought), the record the instruments (or digitize the recordings that they brought.
3. The teacher presents the software (preferably a slide presentation tool or a creative programming platform such as Scratch) that will be used for creating the multimedia presentation and asks the students to decide on the sequence of the materials to be presented.
4. The students use the digital images of the instruments and the recording to create a multimedia presentation.
5. The teacher uploads the final presentation into an appropriate web site (e.g. if the presentation has been developed as a slide presentation, it could be uploaded to Slideshare).

Materials required: Computers with Internet connection. Digital cameras and recorders. Alternatively, devices that have cameras and microphones such as mobile phones or tablets can be used. The multimedia presentation can be developed using slide presentation software or any other appropriate software that the teacher selects and is able to present to the students.

Teacher's skills: Basic ICT skills including basic knowledge of digital photography and audio recording.

Suggested duration: 45 min can be extended to multiple sessions during one or two weeks of the school year depending on the length and complexity of the multimedia presentation to be developed.

Expected outcomes: After successful completion of this activity, students will be understand cultural similarities and differences between different national contexts focusing on music. They will be also able to develop simple multimedia presentation in the form of successive pages (slides) and organizing the digital material in an interesting way.

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