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An Application for the Study of Art Movements

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Abstract

This work presents a general architecture for creating an application called the Art Movement Learning App (AMLA), whereby students can familiarize themselves with key characteristics of a given art movement (such as Surrealism), using technology, and appropriate the experience through their own artistic creation in a mixed reality environment. The architecture consists of two modules. The first is an apprentice art-and-technology familiarization module, wherein a specific art movement is introduced through a cumulative sequence of six phases, using a digital surface: (1) observation, where students analyze images portraying key characteristics of the chosen movement; (2) combination, including a set of tools that enables the combination of 2D images and 3D models, in light of these characteristics; (3) association, where key elements abstracted from a given artwork are matched with their location in the original artwork; (4) grouping, where students determine the characteristics shared by a given set of artworks; (5) discernment, where students choose from a pair of images, one of which belongs to the art movement that the AMLA was configured to introduce; and finally (6) evaluation by peers, where the artworks created in Phase 2 are evaluated by other students, using a preset scale. The major features of the art movement to be used as stimuli are selected in advance, after which the AMLA configures the respective phases. The second AMLA module is an Augmented Reality module, enabling students to create artworks displayed in mixed reality scenarios. This module consists of two phases: one wherein a student creates an artwork in a specific real-world environment, which is associated, by GPS coordinates or location-based services (LBS), with a physical object; and a second phase, wherein artworks are displayed as part of the app, so that anyone downloading the application can view the students' work, and evaluate it using an affective-response scale. User registration is necessary in order to access the first module; thus, if the application is downloaded without registration, only the final phase, of the second module, will be shown (i.e., artworks are displayed with augmented reality using GPS coordinates or LBS). The objective of the AMLA is to present an interactive process, through various stages, involving a set of actions enabling students to learn more about the characteristics of art movements, while enhancing both their creative skills and their art-perception experience.

Peer-review under responsibility of organizing committee of the 2015 International Conference on Virtual and Augmented Reality in Education (VARE 2015)

Keywords: Art Movement Learning App (AMLA); Gradual Immersion Method (GIM); augmented reality (AR); application development.

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1. Introduction

The increasing adoption of Augmented Reality (AR) by digital artists is not surprising, given the medium's interactivity and the potential use of the world as a canvas. Defined as a system that supplements reality by incorporating virtual elements that coexist in the same space, AR allows interaction in real time with 3D images and graphics, though it may also be applied to the broader senses (e.g., in the form of audio or tactile feedback) [1]. Museums and multidisciplinary laboratories around the world continue to explore potential implementations of AR through innovative exhibitions which seek to draw audiences into interactive tridimensional scenarios, as demonstrated by the seven-year joint study at the Louvre-DNP museum laboratory in Tokyo [2][3]. However, art education presents its own outreach challenges, beyond the artistic motivation and desire to entertain an audience, since pedagogical methods must often be suited to appropriate technologies in order to provide evidence of learning and/or visitor impact [4]. The application of AR as a means for creative skills development in educational contexts has proven to be a useful tool, with significant promise of further learning enhancement [5].

As the access of institutions and individuals to technologies increases, so does the need to provide software tools that support institutional curricula, and can leverage both non-formal[1] and informal learning[2] (for instance, after visiting a museum), given the increased recognition gained by both types of learning with regard to educational and training policy [6]. In addition, software tools should be designed with consideration of the current devices available, in order to improve the user experience; and different combinations of devices, simultaneously or alternately employed, should be considered, in order to exploit students' potential to accomplish learning tasks individually and/or collectively (e.g., tablets and mobiles, PCs and tablets, etc.) [7].

Art exhibitions have for some time incorporated multimedia elements, and now audiences are witnessing the potential of AR to generate a physical-digital mixed reality world. Within the broader notion of mixed reality, itself part of the "reality-virtuality continuum" [8] (Fig. 1), AR typically involves a predominance of the physical world with a few digital elements, in contrast to Augmented Virtuality (AV) where the virtual world predominates over the physical. The present study can be clearly located in the AR band of the continuum, given the software's implementation in an open real-world environment.

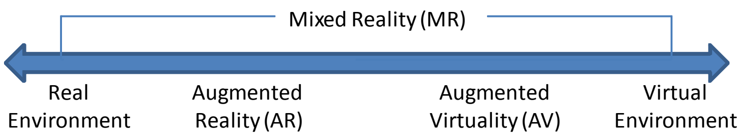

Fig. 1. Reality-virtuality continuum. [8]

The basic hardware required to implement an AR system includes a video camera and a user interface, to combine real-world and digital elements, with optional technologies (such as GPS technology or image recognition software) used to enhance the experience [9]. In the diagram below (Fig. 2), three types of AR display are depicted in relation to the physical environment and the user: head-attached, hand-held, and spatial [10]. Given the increasing use of portable devices, the hand-held display system has found increasing usage with AR apps, and this system was employed in the present study.

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[1] Learning acquired alternatively to school (formal learning), but more flexible, which may lead to qualifications and other recognitions by means such as validation and accreditation processes. [5]

[2] *"Learning that occurs in daily life, in the family, in the workplace, in communities and through interests and activities of individuals. Through the recognition, validation and accreditation process, competences gained in informal learning can be made visible, and can contribute to qualifications and other recognitions. In some cases, the term experiential learning is used to refer to informal learning that focuses on learning from experience."*[5]

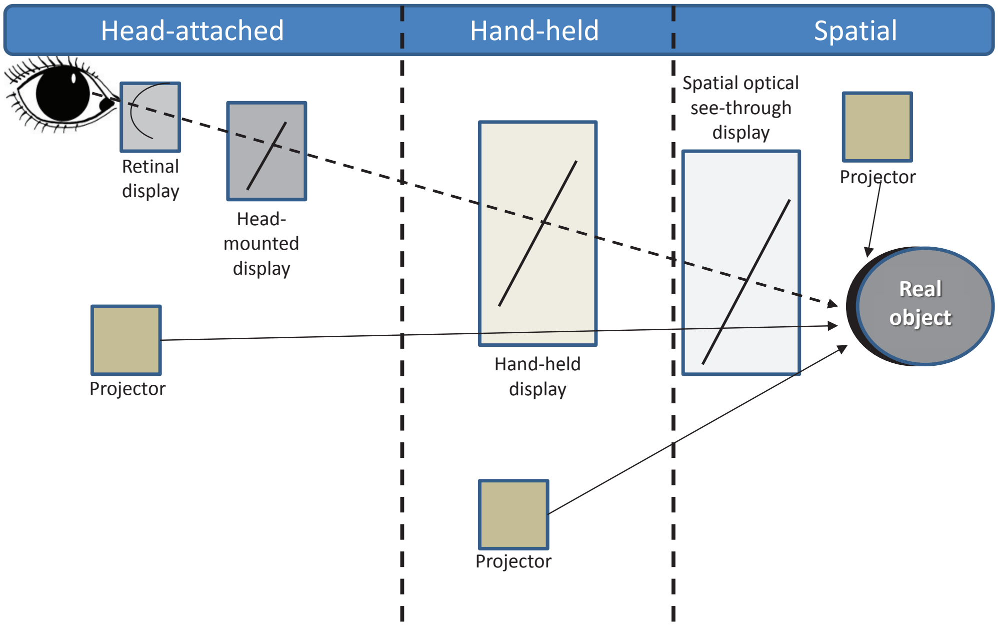

Fig. 2. AR visual display techniques and positioning. [10]

In light of the foregoing, this study proposed and tested a software tool, supported by digital surfaces (i.e., interactive white boards) and an AR system, with the objective of enhancing both creative skills and the study of art movements. Ultimately, the proposed application aims to provide supplementary support for the creative study of art movements introduced in school or in museums.

2. Art Movement Learning App (AMLA)

The Art Movement Learning App (AMLA) was conceived to support an art-and-technology research project focused on enhancing creative skills. The AMLA's goal is to familiarize students with key characteristics of a given art movement (such as Surrealism), while appropriating the desired technological experience through their own artistic creation in a mixed reality environment. The project was developed based on the Gradual Immersion Method (GIM) [11], an approach that facilitates student familiarization with a learning objective (content) and relevant technologies, by performing intuitive tasks. As aforementioned, the AMLA's architecture consists of two modules: (1) an apprentice art-and-technology familiarization module, and (2) an AR art creation module.

2.1. Apprentice art-and-technology familiarization module

In the first module, groups of students learn about the essential characteristics of a given art movement, understanding and responding to key characteristics of the movement, and finally evaluating related work done by their peers from this acquired point of view. A specific art movement is introduced through a cumulative sequence of six phases (Fig. 3), using a digital surface: (1) observation, where students analyze images portraying key characteristics of the chosen movement; (2) combination, including a set of tools that enables the combination of 2D images and 3D models, in light of these characteristics; (3) association, where key elements abstracted from a given artwork are matched with their location in the original artwork; (4) grouping, where students determine the characteristics shared by a given set of artworks; (5) discernment, where students choose from a pair of images, one of which belongs to the art movement that the AMLA was configured to introduce; and finally (6) evaluation by peers, where the artworks created in Phase 2 are evaluated by other students, using a preset scale. The major features of the art movement to be used as stimuli are selected in advance, after which the AMLA configures the respective phases.

Fig. 3. Phases of AMLA Module 1.

The AMLA was developed using the Unity3d Engine [12], a 2D and 3D development platform for creating interactive experiences. The architecture of the AMLA considers four concepts that Unity incorporates to create any application: (1) assets, content files (e.g., images, audio files, 3D models) required to make an app; (2) 'GameObjects', containers which users program and design to execute an action (e.g., an image viewer within a Graphical User Interface (GUI)); (3) scenes, where GameObjects are kept (e.g., in a level-based game each scene can be a level); and (4) scripts, the necessary codes for creating events to provide the expected interactive experience (e.g., to validate the input from a user).

The global architecture of the AMLA, based on this developmental structure, is shown in Fig. 4, including all implemented components. The AMLA uses Unity as its engine to create the phases, processes, and behaviors, as a mirror match of the Unity structure, where assets are translated as contents such as graphic work, 3D objects, codes, and particularly artwork stimuli carefully selected by experts in the targeted art movement (e.g., Surrealism, Cubism). The scene configurations are constructed using the provided assets, to determine the target behavior for each phase, which in turn requires the programming of different processes in order to achieve such behavior.

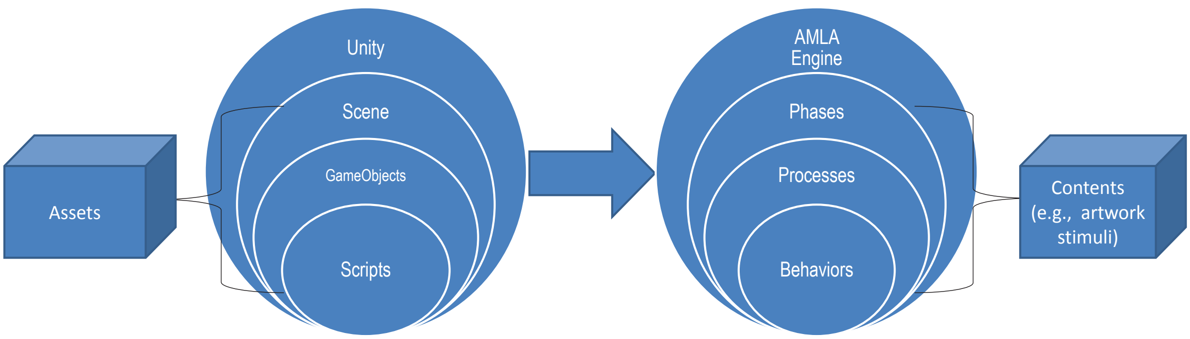

Fig. 4. Global proposal architecture matching AMLA to Unity structure.

Regarding the contents of each phase, there are three types of components: customized (C), required (R), and optional (O) (Fig. 5). The customized component in the AMLA, referred to as the 'avatar', is an icon chosen by each group of students as part of a previous registration process, and includes three characteristics: (1) group team name, (2) an image to identify the group, and (3) each student's ID number. The required components, referred to as the 'instruction panel', 'goal phase', and 'user interface', describe the topic that identifies each phase: the instruction panel provides directions about the task to be performed by the students in each phase; the goal phase is the main component, containing the necessary processes for the student to achieve the phase objective; and the user interface integrates the typical navigation events in a given phase (e.g., command buttons). Finally, the optional component, referred to as the 'criteria panel', allows students to individually input text, as required by the instructions at the beginning of the task.

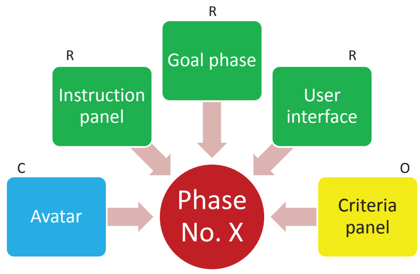

Fig. 5. AMLA phase components.

The processes involved in achieving each goal phase of the AMLA are shown below (Fig. 6). Each phase integrates a number of processes, either performed by the users or automatically executed by the app, which are implemented to achieve the particular goal phase. For instance, in the 'observation' phase, where students are instructed to analyze images portraying key characteristics of a chosen movement, three processes are required: 'browse within the reel', 'load images', and 'display images in a horizontal reel'. The processes involved are translated into scripting behavior[1] so they can be compiled by the Unity engine.

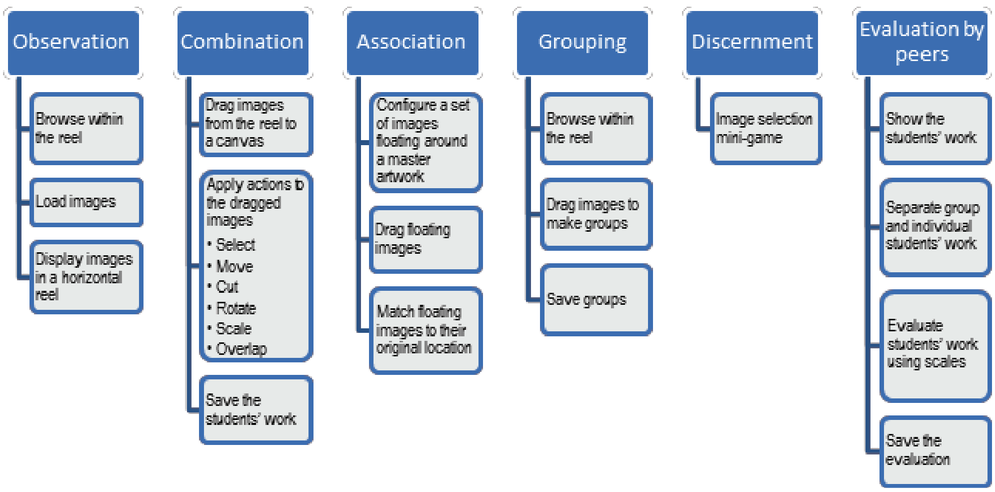

Fig. 6. Processes to achieve goal phases of AMLA Module 1.

2.2. Augmented reality module

This module, used to create artworks displayed in mixed reality scenarios, consists of two phases: field mounting, and work exhibition (Fig. 7).

[1] Scripting was programmed using C# language.

In the first phase, field mounting, each student creates an artwork in a specific real-world environment, by combining a physical and a digital object. The GIM for 3D digital creation involves a sequence of 3D capture in the field, 3D capture in the lab, 3D-model mounting in the lab, and field mounting of the final artwork. However, only the last stage of the GIM is performed by the AMLA; that is, the resulting 3D digital object is associated, either by GPS coordinates or location-based services (LBS), with the physical object.

In the second phase, work exhibition, students' final 3D artworks, already associated with GPS or LBS coordinates, are displayed as part of the app, such that anyone downloading the application can view the students' work in the physical environment, and can evaluate their work using an affective-response scale.

Fig. 7. Phases of AMLA Module 2.

Fig. 8 shows the processes necessary for completing the augmented reality module. User registration is necessary in order to access the first module; thus, if the application is downloaded without registration, only the final phase, of the second module, will be shown (i.e., artworks are displayed with augmented reality using GPS coordinates or LBS). The objective of the AMLA is to present an interactive process, through various stages, involving a set of actions enabling students to learn more about the characteristics of art movements, while enhancing both their creative skills and their art-perception experience.

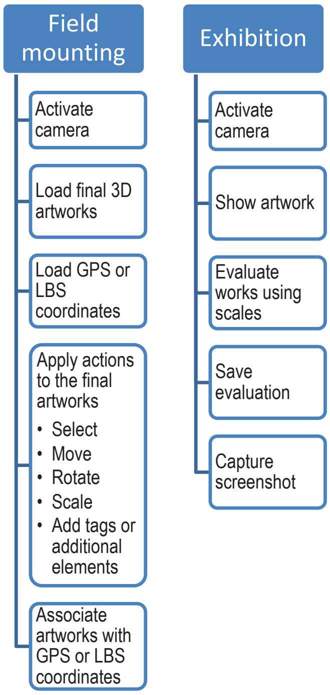

Fig. 8. Processes to achieve goal phases of AMLA Module 2.

2.3. AMLA app prototype

After determining which processes are necessary for each of the AMLA Modules 1 and 2, an app prototype was developed. Fig. 9 shows a screenshot of AMLA Phase 1 (‘observation’) of Module 1, with the relevant components and processes involved.

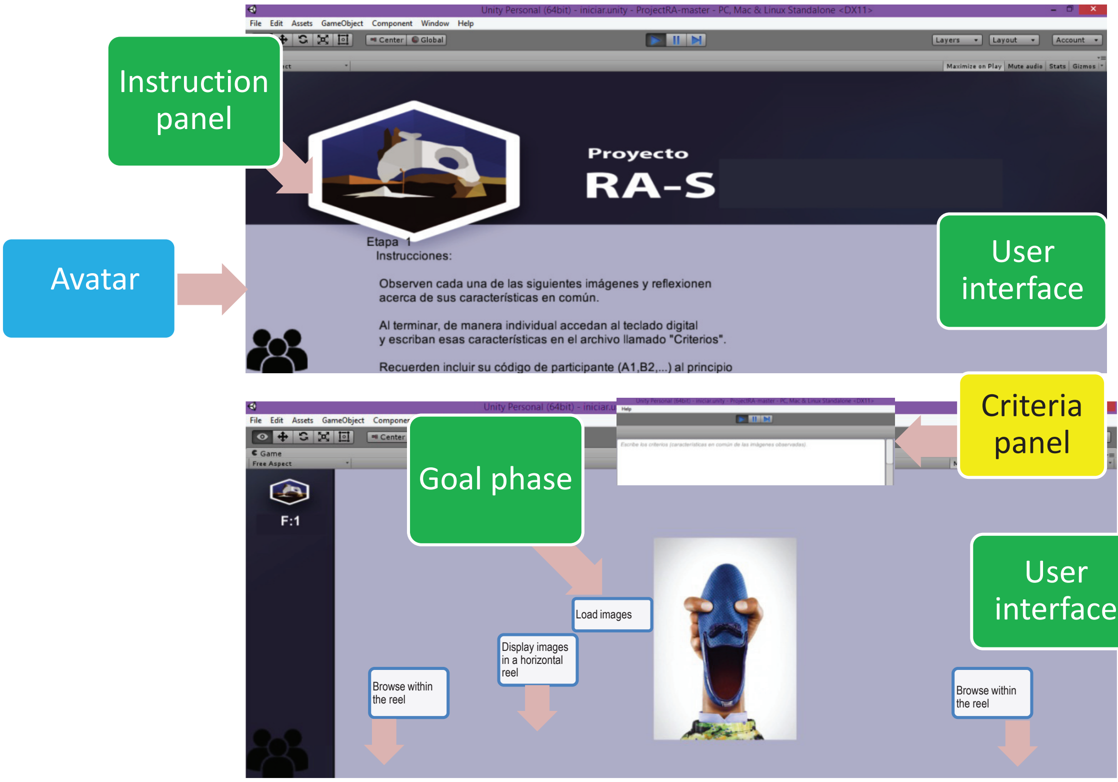

Fig. 9. Processes and components of AMLA Module 1-Phase 1.[1]

Fig. 10 Screenshot of AMLA Phase 1 (‘field mounting’) of Module 2 using AR, with the relevant components and processes.

[1] The text in the interface reads: “Project RA-S; Phase 1; Instructions: Observe the following images and reflect on their common characteristics. When you are done, individually enter the digital keyboard and type these characteristics in the file named ‘Criteria’. Remember to include your participant ID (A1, B2, etc.) at the beginning of each contribution; Back, forward (command buttons)”. Main picture by MAX shoes ©.

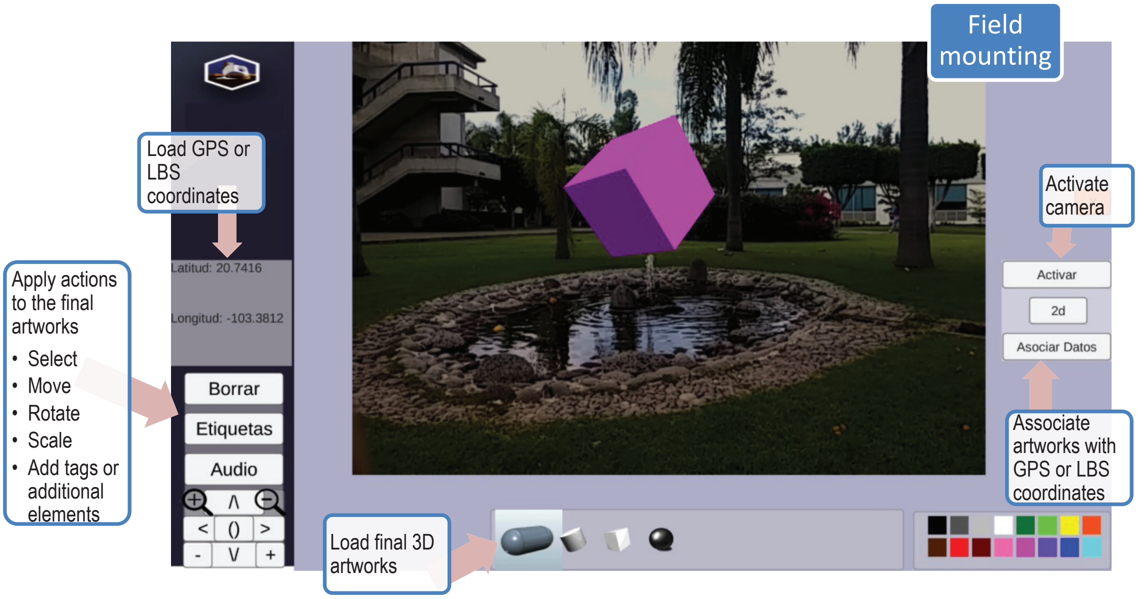

Fig. 10. Processes and components of AMLA Module 2-Phase 1.[1]

3. Conclusions

The AMLA's global architecture software can be easily adapted to a wide range of configuration possibilities, to suit the given pedagogical context; for example, by varying the content in the 'goal phase' component (adjusting the input assets to reflect different art-movement educational objectives, based on a given institution's curricula). The interface, both for the digital surface and for the portable devices, properly introduces the intended objectives of the respective modular phases. The software was initially configured to incorporate the chosen art movement (Surrealism) in all the structural phases, but will be further augmented, with the participation of high school students, in the near future. The second module, which employs AR as a creative tool, integrates key AR characteristics from the mutually beneficial perspectives of the art creator, using the app for artwork field mounting, and the audience, using the app for observation of the created artwork. The AMLA app prototype will be updated and enhanced through future implementations with students.

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[1] The text in the interface reads: In the left column from top down, "latitude; longitude; erase, labels, audio"; in the right column, "activate, 2D, associate data".

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