A Reference Framework to Establish and Sustain Onlife Communities and Its Use

Rich Learning Experiences in History with ViSTPro

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Abstract. This paper employs the overarching concept of communities to express the social contexts within which human creativity is exercised and learning happens. With the advent of digital technologies, these social contexts, the communities we engage in, change radically. The new landscape brought about by digital technologies is characterized by new qualities, new opportunities for action, new community affordances. The term onlife is adopted from the Onlife Manifesto and used to distinguish the new kind of communities brought about by the modern digital technologies, the *Onlife Communities*. Design principles are presented to foster such communities and support their members. To showcase the use of these design principles, the paper presents a concrete system addressing creativity and learning in the field of cultural heritage (history teaching and learning): ViSTPro. ViSTPro enables the visualization of spatiotemporal processes, thus facilitating active learning of historical events. To demonstrate the flexibility of the ViSTPro and its capability to provide insightful visualizations, a pilot application has been elaborated on the Battle of Marathon, 490 BC.

Keywords: Onlife communities, spatiotemporal processes, google maps, visualization.

1 Introduction

The goal of the work reported in this paper is to provide a comprehensive approach for supporting Onlife Communities by employing digital technologies within an overarching framework that is informed by current trends in re-conceptualizing and rethinking about our societies facing the so called "hyperconnected era" (Ganascia, 2015). This is reflected in the term "onlife", which has been employed in The Onlife Manifesto (Ganascia, 2015). This term stresses the fact that the deployment of information and communication technologies and their uptake by society radically affect the human condition, modifying our relationships to ourselves, to others and to the

world. In particular, this new reality that is brought about by digital technologies and their ever-increasing pervasiveness shakes established reference frameworks through four important transformations (Onlife Initiative, 2015):

- the blurring of the distinction between reality and virtuality;
- the blurring of the distinctions between human, machine and nature;
- the reversal from information scarcity to information abundance; and
- the shift from the primacy of entities to the primacy of interactions.

To elaborate a framework for the establishment and support of onlife communities, we build on our own experience in designing creativity and learning systems initially conceptualized following the, so called, engineering mythology (Cabitza, & Simone, 2015) that is based on a set of certain assumptions. In particular, the term myth is used to signify a certain stance, a legitimate and reasonable assumption or principle that is accepted without further analysis or justification. The myths of the engineering mythology, as described by Cabitza & Simone (2015), is that digital systems consist of parts that interact according to certain patterns that are defined and understood at design time. Designers seek to discover these patterns or even invent them targeting a certain harmony in the operation of the final system. On the other hand, users are expected to interact with the final system in certain ways following certain rules that are effectively imposed by the internal logic of the system.

Following the engineering mythology in technological projects there are cases when the emergence of certain patterns in end-user usage of the systems or desirable features that go beyond initial assumptions during design. To address these emergent patterns, an alternative mythology has been proposed that goes beyond the legitimacy of design as a process done by IT experts with the participation of representative of end-users in order to guide the development of digital systems. This alternative mythology points to the fact that digital systems can be realized by the composition of elementary components with limited initial design and be put to work by end users, eventually facilitated by IT engineers that play the role of catalysts of change and evolution of those systems towards directions that could not be initially foreseen (Cabitza, & Simone, 2015).

Elaborating on this alternative design approach, this paper proposes a framework to establish and sustain of onlife communities, *i.e.* communities of creators using digital tools in a certain domain, emphasizing creativity and learning. This framework is presented in section 2. Section 3 presents ViSTPro, a platform that enables the authoring and playback of scenarios that describe spatiotemporal processes such as complex historical events. Section 4 presents ViSTPro as an example of how the framework presented in section 2 is applied and how it could be used to interpret how users understand and use the tool. Section 5 presents experimental evaluation results on the usage of ViSTPro in the domain of learning communities (learning history). Section 6 concludes and presents directions for future work.

2 PerFECt: A Performative Framework to Establish and Sustain Onlife Communities

As exposed in Cabitza et al. (2014), end users are increasingly more required to act as active contributors at use time, thus becoming "producers" of contents and functionalities. The term *expert user* is suggested here to signify a person that is always an expert in a particular domain with main goal to develop the capabilities available than just software code. An expert user subsumes all those roles denoting people in charge of carrying out creative/authoring activities (frequently described as End User Development activities) without being a professional software developer. Usually the role of *end user* and that of an expert user are played by different people that may also belong to different communities. Furthermore, Cabitza et al. (2014) suggest the role of *meta-designer* to describe professionals who create the socio-technical conditions for empowering end users to engage in continuous system development. They create open systems at design time that can evolve by their users acting as co-designers. Yet another important role is that of *maieuta-designer* who is in charge of designing the End User Development environment by which expert users can build and adapt the artifacts to be used by end users. The role of the maieuta-designer is mainly oriented at social conditions, rather than technical ones, for supporting the meta-task of the expert users: Creating the socio-technical preconditions for facilitating expert users appropriate the design culture and technical notions necessary for the meta-task of artifact development and involving as many end users as possible in the process of continuous refinement of the artifact, by improving participation. The word "maieuta" is used to signify an analogy with the Socratic method of getting people acquire notions, motivations and self-confidence to undertake challenging tasks.

The above four roles (end user, expert user, meta-designer and maieuta-designer) interact with each other and with the digital artifact and End User Development tools and each contributes to a co-evolution phenomenon. The meta-designer is focused on designing and providing the most effective tools that may sustain the co-evolution between end users and expert users. The maieuta-designer facilitates the migration from the role of end user to the role of expert user to empower end users to appropriate and contribute to their IT artifacts. In cases when an end user is not interested or fails to evolve into the role of expert user, the maieuta-designer may facilitate participation in system evolution by systematizing the reporting of shortcomings and system faults as identified by the end user and proposing solutions that are handled by expert users.

The above four roles give rise to two co-evolution processes: The first one refers to the use of software devoted to the end user where there is continuous (cyclical) interaction between the end user and the system. This is depicted in **Fig. 1** (left) with three homocentric cycles of arrows that represent the action-interpretation cycle at the lower level, the task-object cycle at the middle level and community-technology cycle at the upper level. In an analogous way, there is a second cyclical process depicted in **Fig. 1** (right) that refers to the use of the End User Development environment and/or software components as building blocks of the system in continuous evolution. This

process corresponds to yet another three homocentric cycles of the same nature: action-interpretation, task-object, and community-technology layers.

The inner interaction cycle in each co-evolution process refers to actions (triggered by the corresponding user or software) that are interpreted by the other party (software or user respectively). The task-object cycle in the middle refers to the co-evolution of the user task and the corresponding artifact within the boundaries of the System. Finally, an outer community-technology cycle captures the idea that the overall environment within which a user is working (community), co-evolves with the technology that supports the operation of this environment.

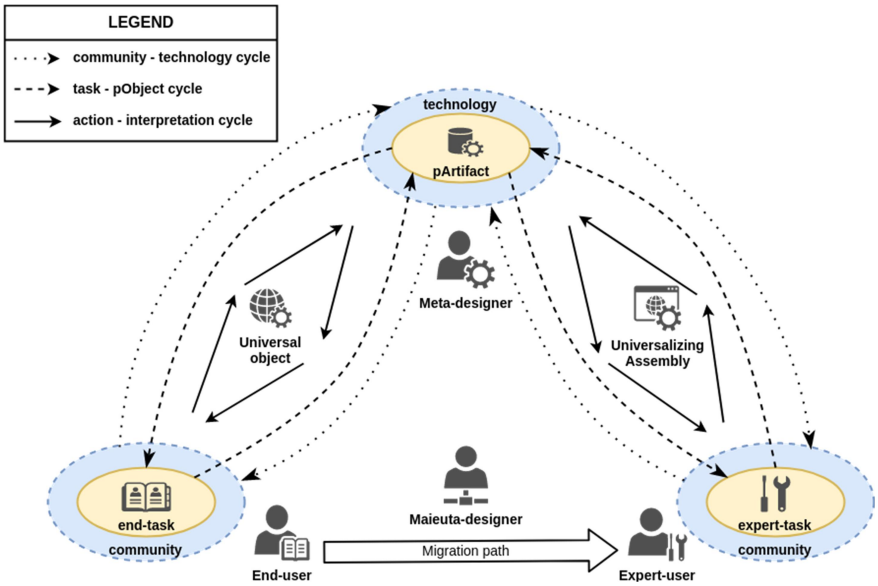

Fig. 1. The main components of PerFECt framework

Finally, we employ the term *Onlife Community* to signify all user roles of the proposed framework: end user, expert user, maieuta-designer and meta-designer along with the artifacts, tools and even underlying physical objects to account for situations where technologies are embedded into physical objects or, in a more modern setting, are also connected on the so called Internet of Things. In other words, we emphasize the fact that all these user roles, through their interactions within the two co-evolution processes, create a bigger aggregation of humans that engage with other humans as well as with machines and natural entities in mindful interactions, thus creating what we call onlife communities.

Note also that the framework presented above employs the notion of *universality* to refer to blends of machines and physical objects that generalize the notion of software or tool. Universality addresses the issue of *causality* in digital representations, as Brenda Laurel puts it in her seminal book “Computers as Theatre”:

> "*The fact that people seek to understand causality in representational worlds provides the basis for Aristotle's definition of universality. In the colloquial view, an action is universal if everybody can understand it, regardless of cultural and other differences among individuals. This would seem to limit the set of universal actions to things that everyone on the planet does: eat, sleep, love, etc. Aristotle posits that any action can be "universalized" simply by revealing its cause; that is, understanding the cause is sufficient for understanding the action, even if it is something alien to one's culture, back-ground, or personal 'reality'.*" (Laurel, 2013, p. 94)

Consequently, within the framework presented above, the meta-task of expert users is to enable this universalization of physical objects by exploiting the available tools in the form of performative artifacts (pArtifacts) to account for the incorporation of the idea of performativity in digital technologies. Performativity underlines the relationship between humans and the artifacts they create that is triggered by social interaction and continuously recreates the bonds that keep the society as a whole. Niedderer (2007) offers an interesting term to capture this idea and link to purposeful and mindful use of physical objects: the category of performative object. She claims that the performative object is a special type of design objects that are designed to facilitate mindful awareness of the physical and symbolic social actions and their consequences within which they are used. Considering that performative objects are design objects, the framework presented here uses the term *performative artifacts* in a broader sense: all artifacts involve a certain level of performativity that is usually captured by their affordances *i.e.* clues about how an object should be used, typically provided by the object itself or its context. However, this latter term, does not explicitly refer to mindfulness as a target during the design process. In this respect, the term performative artifact, is used here to capture the idea of intentional design for social interaction, to create and sustain social bonds and call for symbolic social actions that recreate the social contexts within which we live in.

3 ViSTPro

As a concrete case study of how the framework presented in the previous section can be put in action to enable the deep understanding of how modern digital technologies can foster social interaction and promote creativity and learning, this section presents ViSTPro and how it enables the formation of onlife communities within the domain of cultural heritage and, in particular, in learning about important historical events.

ViSTPro employs the concept of *scenario* as a core one for modeling complex spatiotemporal processes (Sifakis et al, 2016). This concept suggests the visual representation of the evolution of spatiotemporal processes. Explanations and semantic maps play an important role in this representation. ViSTPro distinguishes scenario author-

ing from scenario playback. During scenario authoring ViSTPro helps and guides the scenario author throughout the process of creating a scenario. The scenario author initially selects a name and describes the new scenario. At the same time, active components of the scenario are determined (**Fig. 2**).

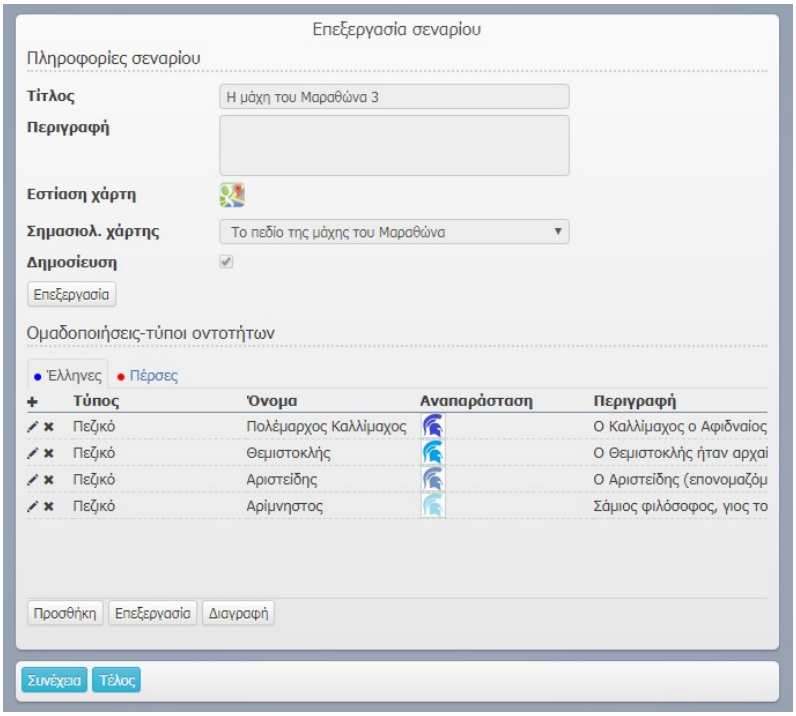

Fig. 2. Initiating the creation of a scenario. The form to create a scenario includes information about the scenario (title, description), selection of semantic map, creation of groupings and selection of types of entities per grouping.

A scenario contains groupings, types of entities and specific entities. If we consider the example of the Battle of Marathon, a grouping may represent Greek or Persian troops, types of entities may relate to the infantry or cavalry and certain types of entities leading figures such as Miltiades. The user selects the characteristic color of each troop and the representation of each entity type and also can import its own icons. Specific types of entities are represented with a larger size in order to differentiate from other types of entities. In addition, the representation of the different states of the types of entities providing multiple views for each of them (*e.g.* killed, on-fire, *etc.*) can be supported, while the user can create custom states. These elements are contained in optional map legends to facilitate the explanatory power of the presentation.

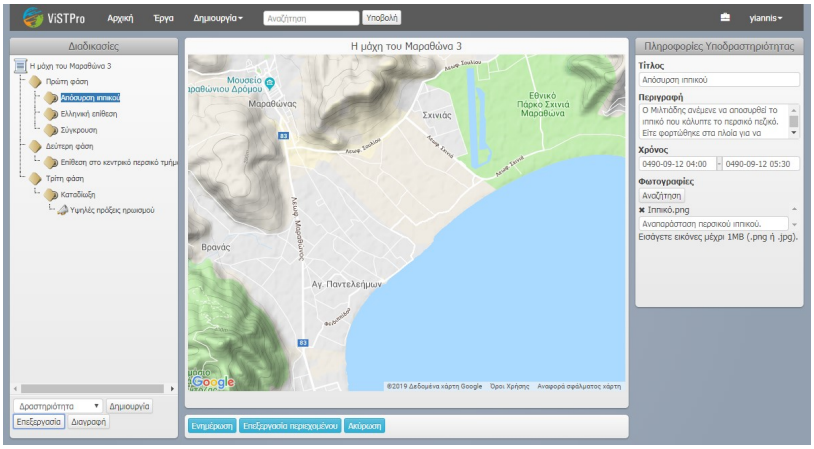

Fig. 3. The structure of a spatiotemporal process and the visualization panes for the process nodes: On the left, the hierarchical structure of a process is shown and the user is able to manage this structure by adding/modifying activities, sub-activities and events. On the center the process nodes are shown on Google maps. On the right, explanations are shown.

The second phase of the authoring process is the structuring of the scenario. The structural elements of a scenario include activities, sub-activities and events. Activities correspond to main units of action (**Fig. 3**). Each activity is connected with a title, a description, and may include other activities or elementary unities of action (sub-activities) where the action unfolds and the movements, actions and interactions of the active components are visually described. For each sub-activity several properties are available such as its name, description, start- and end-time, photos, recorded narration and related activities and other sub-activities of the scenario. Sub-activities may include events that represent a milestone or a particular incident. An event is identified by its title, description, timestamp and possibly its correlation with some type of entities, its state and a semantic object. Each scenario is thus modeled as a hierarchical structure of activities, sub-activities and events.

Another important scenario element is the set of formations that will be visualized. A formation is a set of entities handled as a whole. ViSTPro offers the necessary tools for the design of formations through predefined shapes (square, rectangle, circle, polygon, *etc.*) varying sizes, orientations, *etc.* After formation definition, entity types can be specified along with their size, location and density, in order to be included in the corresponding formations. Furthermore, the existence and position of one or more specific types of entities can be indicated.

The handling of a specific formation is possible through sub-activities. When a sub-activity is created, the scenario author chooses which formations will appear, defines the initial and final position and specifies the path that will be followed during scenario playback. Furthermore, there is a set of actions available for each formation. These actions are related to their behavior and interaction during playback.

The representation of actions is displayed by means of suitable graphical elements, such as icons and arrows. A formation may change its state as it moves or performs an action or interacts with other formations during scenario playback. For this reason, during scenario authoring, it is possible to redefine the state of a formation by defining its size, shape and density of varying types of entities, while their state can be modified. State changes of formations are managed via interpolation.

Another important modeling primitive is graphics. A set of graphical elements are available such as lines, arrows, and other predefined shapes, which are placed on the Google Maps during scenario authoring and they play a crucial role in the playback of a scenario. Semantic content is provided via title and description, and can also determine characteristics such as color, size and orientation. During scenario playback the graphics can remain stationary or move. They can also change their shape in a manner similar to the state change of formations.

Process visualization addresses important elements such as human-made objects and significant locations of the surroundings. The presentation and provision of relevant information regarding these objects is done through semantic maps. Semantic maps are collections of important locations and objects of a region, which are represented on a map. The creation of a semantic map gives the possibility to create semantic objects each one described by its name, description, and one or more images. Thus, during scenario playback, it is possible to interact with the objects of a semantic map and examine their semantic content. Semantic maps are customizable by selecting certain objects and creating a new semantic map containing them. The new semantic map can be saved with a new name for future use. An original or customized semantic map can be used in one or more scenarios in the way described above.

During scenario playback individual learning needs are addressed through the provision of explanations for better understanding the evolution of the processes represented in each scenario. ViSTPro handles the movement of formations, involved in each sub-activity from an initial to a final position and provides an intuitive representation of state changes by changing the size, shape and density and status of the types of entities employing appropriate interpolations. Furthermore, during scenario playback each sub-activity title and description is presented possibly enriched with sound recorded narration. The playback can be paused to give time for examination of photos, related information that may have been registered in the sub-activity or even the physical surroundings. Events are depicted through entitled panels on the map, with location and time properly indicated. If an event is associated with a specific type of entities and/or a specific semantic object, those entities and/or objects are shown emphasized. Event-related additional information and pictures can be examined if scenario playback is paused.

Fig. 4. Scenario playback in ViSTPro.

During the playback of a scenario its hierarchical structure is displayed (left panel depicted in **Fig. 4**). Through this structure one can switch to another scenario that describes in more detail the currently presented sub-activity. Finally, it is possible to speed up or slow down playback in order to adjust the speed to learner needs.

Fig. 5 presents the conceptual model of ViSTPro in the form of a UML class diagram. The classes of this diagram represent all important elements of the model such as Scenarios, Activities, Sub-activities, Events, Formations, Grouping, Actions, Semantic Maps, Semantic Objects, Animations, 2-D and 3-D representations of Entity Types as well as their relationships in the form of UML associations. This conceptual model is the basis of the underlying database of ViSTPro on top of which all user interfaces presented in this section are built.

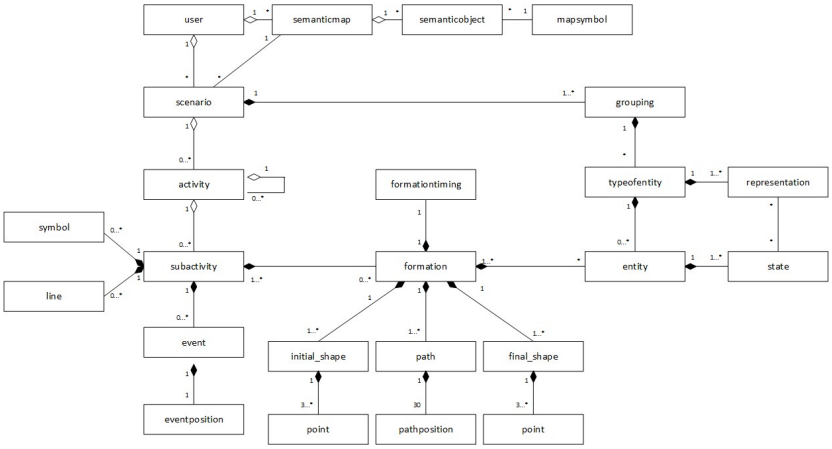

Fig. 5. The UML class diagram depicting the conceptual model of ViSTPro.

4 Using ViSTPro to Establish and Sustain Onlife Communities for History Teaching and Learning

Employing the concepts and user roles of the PerFECt framework presented in section 2, the use of tools such as ViSTPro can be put within a wider context that accounts for the rich social interactions that could be promoted towards the establishment of onlife communities. In particular, ViSTPro can be considered as a representative tool on how a learning community can be established (in the field of cultural heritage) that brings together:

- software developers supporting the software and providing further enhancements to address the needs of the users,
- teachers that prepare animations of historical events, *i.e.* scenarios representing the corresponding spatio-temporal processes in ViSTPro along with semantic maps and digital materials explaining the details of the animated events, and
- students that use the scenarios prepared by teachers to learn about the animated historical events in a personalized manner.

Employing the user roles described by the PerFECt framework, the above categories of participants in a ViSTPro-based learning community can be presented as follows:

- Software developers that support ViSTPro and implement further enhancements to address the needs of teachers and students are the meta-designers of the PerFECt framework. As meta-designers, they are expected to offer an open system that can evolve by its users as co-designers. To enable this, ViSTPro offers several capabilities to use various media types, thus offering the capability to integrate digital materials coming from a diverse range of sources. Furthermore, it offers a flexible authoring environment as a means to support expert users that wish to develop new scenarios, thus animating new historical events. Finally, ViSTPro is also open with respect to creating semantic maps, *i.e.* providing semantic information about human-made objects and physical formations on top of Google maps. Semantic maps can be used within scenario playback to provide important semantic information that allow for deeper understanding of the animated events.
- Scenario authors (*e.g.* teachers, but also historians or even students that wish to engage in activities to apply their historical knowledge in developing ViSTPro scenarios) that create scenarios in ViSTPro are what the PerFECt framework describes as expert users that address the needs of end users using the open system capabilities offered by meta-designers to develop new components in the form of *universalizing assemblies* of digital objects that can then be used by end users in their tasks. This is indeed what teachers are expected to do with ViSTPro: Using its features to develop scenarios for spatio-temporal processes that represent important historical events. These scenarios capture knowledge about the corresponding historical events along with pedagogical content knowledge so that effective scaffolding can take place that will enable students develop their historical knowledge within a

rich learning environment supporting social interactions and use of digital tools to make complex historical events more understandable.

- Students that use ViSTPro to see the animations of the scenarios (using its playback features) are what the PerFECt framework calls end users. They essentially use the creations of expert users in the form of *universal objects* (*i.e.* digital artifacts that represent and present causality within and across historical events to make the historical knowledge more understandable and justifiable).

Apart from the above mentioned roles, which are directly related to ViSTPro as a tool supporting authoring and playback of spatio-temporal processes, the PerFECt framework introduces yet another (fourth) user role: maieuta-designers. This is an important role that has a critical contribution in framing and supporting an onlife community. In particular, maieuta-designers are addressing the social conditions for supporting the meta-task of expert users and the transition from the end user role to the role of expert user. This transition and support of expert users' tasks are essentially a learning process that takes place within a social context (*i.e.* the community of users). In the case of ViSTPro, as it will be described in the next section presenting the evaluation of the platform, the need for maieuta-designers emerges very naturally from the use of the tool in actual learning situations when students express their desire to develop their own scenarios (*i.e.* go beyond the end user role toward the expert user role) and thus learn deeper about the historical events they study. These enhanced learning results are documented by the actual evaluation following a controlled experiment approach in actual school settings (Sifakis, 2019) presented in the next section.

Furthermore, teachers also express their belief that students can better learn when they are engaged in expert user role tasks, thus creating their own portfolio of digital artifacts that can help them express their creativity and offer insights and motivation to find more information about the studied historical events using digital resources. Consequently, this approach is directly related to inquiry-based learning approaches and, more importantly, to constructivism: the learning theory that claims that learners learn better when they construct things (Kafai, 2006).

5 Evaluation

To demonstrate the flexibility of the ViSTPro and its capability to provide insightful visualizations, a pilot application is elaborated focusing on the Battle of Marathon, pertaining to the corresponding chapter in the History course of the first grade of Greek Gymnasium (grade K-7). The scenario contains groupings, types of entities and specific entities. In particular, specific grouping represent Greek and Persian troops, types of entities that relate to the infantry or cavalry and certain types of entities leading figures such as Miltiades. In addition, the representation of the different states of the types of entities providing multiple views for each of them (*e.g.* killed, wounded, *etc.*). These elements are contained in map legends to facilitate the explanatory power of the presentation.

After studying the Battle of Marathon as end users (via the ViSTPro playback environment), the students were invited to develop their own scenarios of the battle using the authoring environment of the platform. This is what the PerFECt framework describes as transition from end user role to expert user role. This transition is facilitated by the maieuta-designer role. Students were thus engaged in more deep study of the subject and discussions with the maieuta-designer on the way the various elements offered by ViSTPro are used to represent real world entities and their interactions.

The detailed results of this process (Sifakis, 2019) show a clear improvement in performance of the students, especially after they have followed the authoring session, *i.e.* after following the expert user role. Furthermore, the students were very enthusiastic about the use of the tool and reported that it was much more interesting and engaging for them to create their own version of the scenario to study the Battle of Marathon instead of just watching the playback of a readymade scenario.

Following this positive evaluation, the students that participated in its experimental evaluation presented ViSTPro during the 2019 Student Festival of Digital Creativity, a local cultural event organized annually by local educational authorities. During this event, many students were able to see the Battle of Marathon animated in ViSTPro. Several sessions with the visiting students were organized and after each session, the students were asked to fill in the User Experience Questionnaire - UEQ (Laugwitz et al., 2008). UEQ is a fast and reliable questionnaire to measure the User Experience of interactive products. It is available in more than 20 languages including Greek.

The UEQ contains 6 scales with 26 items:

- Attractiveness: It measures the overall impression of the system measuring how much users like or dislike the system.
- Perspicuity: This scale measures how easy to get familiar with the system (*i.e.* if it is easy to learn how to use it).
- Efficiency: This measures if it is possible for users to solve their tasks without unnecessary effort.
- Dependability: It measures how much users feel in control of the interaction.
- Stimulation: It measures how exciting and motivating it is to use the system.
- Novelty: It measures the innovative and creative character of the system.

UEQ can be used in two ways: Either to compare a product with its previous version/main competitors or compare against a benchmark (Schrepp et al., 2014) that classifies a product into 5 categories (per scale):

- Excellent: In the range of the 10% best results.
- Good: 10% of the results in the benchmark data set are better and 75% of the results are worse.
- Above average: 25% of the results in the benchmark are better than the result for the evaluated product, 50% of the results are worse.
- Below average: 50% of the results in the benchmark are better than the result for the evaluated product, 25% of the results are worse.
- Bad: In the range of the 25% worst results.

The benchmark graph that was computed for ViSTPro after the analysis of the questionnaires filled during the sessions with the schools is given next. 45 questionnaires were filled in total.

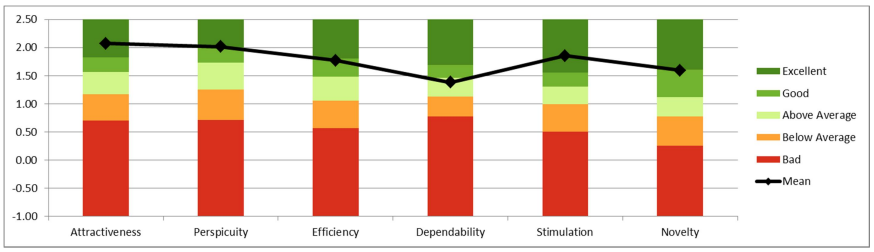

Fig. 6. Benchmark graph from the use of the User Experience Questionnaire for evaluating ViSTPro against the UEQ benchmark.

The results show that in four out of the six scales, namely attractiveness, perspicuity, stimulation and novelty, ViSTPro has 'excellent' rating (in the range of the 10% best results of the benchmark). In the efficiency scale, it is characterized as good (10% of results better, 75% of results worse) and in the dependability scale, it is characterized as 'above average' (25% of results better, 50% of results worse).

The following table presents the numeric results (mean value for each scale) in more detail.

Table 1. Numeric results from the use of the User Experience Questionnaire for evaluating ViSTPro against the UEQ benchmark.

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	2.07	**Excellent**	In the range of the 10% best results
Perspicuity	2.02	**Excellent**	In the range of the 10% best results
Efficiency	1.77	**Good**	10% of results better, 75% of results worse
Dependability	1.38	**Above Average**	25% of results better, 50% of results worse
Stimulation	1.86	**Excellent**	In the range of the 10% best results
Novelty	1.59	**Excellent**	10% of results better, 75% of results worse

6 Conclusions and Future Work

The PerFECt framework, presented in this paper, addresses issues related to the establishment and support of onlife communities as rich socio-technical contexts where learning can be promoted and engaging learning experiences can take place. This framework can be used to inform the design and use of educational digital platforms and tools. As a concrete example of such a tool and its use, this paper presents ViSTPro, a digital platform that enables the specification of scenarios used to animate spatio-temporal processes. The experimental evaluation of ViSTPro clearly shows that ViSTPro can be used in many ways during the learning process: It may simply host learning materials prepared by educators in the field of history teaching and

learning, but it can also be used by the learners in more active ways. In the first case the educator designs scenarios through the platform, structuring the environment in which the learner interacts to acquire knowledge. In accordance with the views of supporters of constructionism, the learner uses ViSTPro not only to monitor the playback of the scenario but also to interact with it. The learner is provided with the opportunity to control the playback and express questions in order to receive further explanations. In the second case the learner uses the platform in order to create scenarios by himself/herself, a process which enhances his/her role and enables him/her to learn through experience (active experimentation). This way the learner sets goals and works methodically to achieve them. This process creates internal satisfaction and enhances learner motivation.

Future work will further explore the use of the PerFECt framework to better understand how other software applications and systems promoting creativity and learning could be further enhanced and repurposed to promote rich social interactions. Such a platform that will be analyzed and enhanced in this manner is eShadow (Christoulakis et al., 2013; Moraiti et al., 2016; Moumoutzis et al., 2018). eShadow promotes an innovative digital storytelling approach inspired by traditional shadow theatre and it also provides extensions addressing other storytelling traditions such as digital marionettes (Moumoutzis et al., 2017). The analysis of eShadow using the PerFECt framework will identify interesting workflows that address the transition of its users from the end user role to the expert user role, how related external tools can promote this transition and facilitate the development of digital media authoring skills. Yet another domain that will be addressed refers to learning personalization (Yoshinov et al., 2016; Yoshinov & Kotseva, 2016) addressing issues related to the use of digital tools to offer learning opportunities that are tailored to personal needs and expectations by individual users. Finally a very interesting domain to analyze using the lens of the PerFECt framework is serious games (Paneva-Marinova, & Pavlov, 2018; Márkus et al., 2018) taking into account its importance to developing student creativity, learning engagement and collaboration within communities.

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