Introducing Map Mashups in Primary School

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1. Introduction

Map mashups are so popular that a lot of people incorrectly assume that all mashups use maps. Since early 2005, when Google Maps service was released, most of the major online service providers have offered a mapping service for users and a mapping API for developers (over 50 powerful and reliable APIs related to mapping and geo-location are already available).

Today, the online mapping space has exploded. A vast range of applications to all geographical domains (such as marketing and ecology) are available and many of them are rather popular to web users. The educational uses of map mashups are also present. Maps are useful in any subject, in particular geography, social studies, science, and even math and Greek/English studies. Obviously, map mashup technology is able to play an important role in many subjects and at all levels of education.

The last year, at Harokopio University of Athens and in cooperation with the biggest private school in Greece, we have examined the use of map mashups in primary education. Specifically, we have developed and evaluated a map mashup prototype application to assist the subject of history at the 5th Grade of the Greek Primary School. This paper is not focused on the technical aspects of the application. Instead, it presents its functionality and several guidelines as being drawn from the feedback of the pupils, during a long and precious evaluation process. The discussion is organized as follows. Section 2 briefly presents the subject and the prototype. Section 3 focuses on its functionality and the outcomes of the evaluation process. Finally, Section 4 concludes the discussion.

2. The Subject and the Prototype

At the 5th Grade of the Greek Primary School, the pupils get, among others, the history subject. Its curriculum comprises of the following main Sections (PI-Schools 2010): (a) Greeks and Romans, (b) The Byzantine Empire changes capital and religion, (c) Expansion and development of the Byzantine Empire, (d) The Byzantine Empire and the neighbouring people, (e) The peak of the Byzantine Empire, (f) The Fall of the Byzantine Empire, and (g) Topics of Byzantine history and local history.

The textbook is unique to all pupils, according to the directive of the Greek Ministry of Education. It is a modern book (Glentis et al. 2008), with simple language and many illustrations. On the other hand, the book provides a limited number of printed maps. Additionally, most of them are rather abstractive and, in general, low-quality maps.

The Scope of the mashup application, we have developed at Harokopio University, is to enrich the map content of the book and to familiarize the pupils with the geographic space of the Mediterranean Sea, the Middle East, and Central Europe. In other words, we have attempted to highlight the geographical aspects of the Roman and Byzantine Empires and show how the geographical space affects the people's lives and history.

The prototype application has been built in pure HTML using OpenLayers (Openlayers 2010). OpenLayers is a pure JavaScript library for displaying map data in web browsers, with no server-side dependencies. OpenLayers is a Free Software, developed for and by the Open Source software community, and implements a (still-developing) JavaScript API for building rich web-based geographic applications (such as the commercial Google Maps and MSN Bing Maps APIs). Furthermore, OpenLayers implements industry-standard methods for geographic data access, such as the OpenGIS Consortium's Web Mapping Service (WMS) and Web Feature Service (WFS) protocols.

Figure 1 presents the user interface of the application. The interface consists of a map window (where the satellite image of the current political map of the Mediterranean Sea and the surrounding areas are drawn) and a series of buttons, which implement the application functionality. The user may use these buttons to show the main towns of the era and the main rivers on the background map. S/he can also choose the main historical events and make them drawn on the map (e.g., boundaries, invasions, etc.). Finally, s/he can show on floating windows more content (such as maps and illustrations available on the web and/or the textbook) as being accessible though appropriate links in the comments box (at the bottom of the interface).

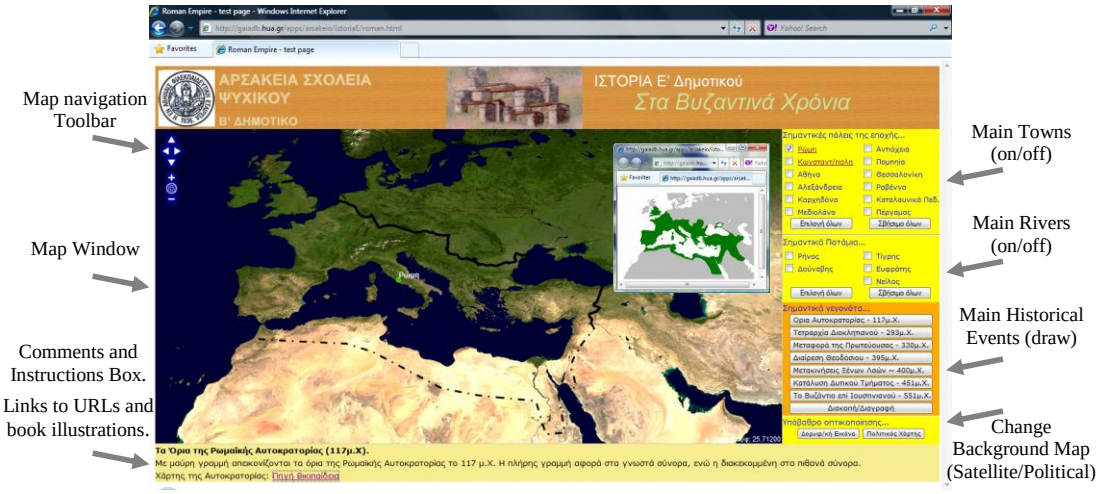


Figure 1. The user interface of the prototype (here the Romam Empire in 117 AD). Available at http://gaiadb.hua.gr/apps/arsakeio/istoriaE/

Currently, the application visualizes the towns, the rivers and the events listed in Table 1. These events refer to the temporal interval shown in Figure 2. Notice that, the application content is strictly limited to what is included in the textbook. This is one of the guidelines in building efficient map mashups for the primary school raised at the evaluation phase (see next Section).

Table 1. Geographic Features and Historical Events visualized in the prototype.

Towns	Rivers	Events
Rome	Danube	The Roman Empire (117 AD)
Constantinople	Rhine	Diocletian's Tetrarchy (293 AD)
Athens	Nile	The Capital of the Byzantine Empire in Constantinople (330 AD)
Alexandria	Euphrates	Theodosius Division (395 AD)

Carthage	Tigris	Invasions of the Roman Empire (Goths, Huns, etc.)
Mediolanum		The Western Empire Collapses (451 AD)
Antioch		The Byzantine Expansion during Justinian's reign (551 AD)
Pompeii		
Thessaloniki		
Ravenna		
Chalons		
Pergamos		

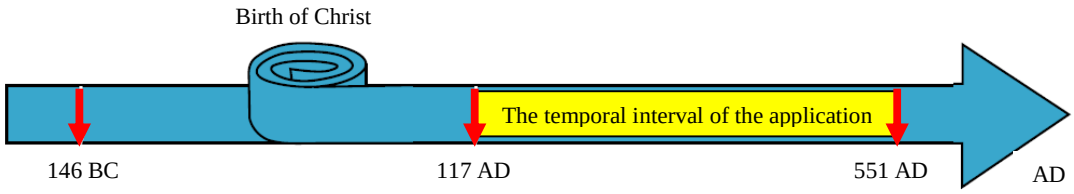


Figure 2. The time axis and the period the prototype currently refers to.

The default background map is the MODIS (Moderate Resolution Imaging Spectroradiometer) layer, retrieved from NASA Jet Propulsion Laboratory Server (http://jpl.nasa.gov) by posing the following GetMap request, according to the OGC's WMS specification:

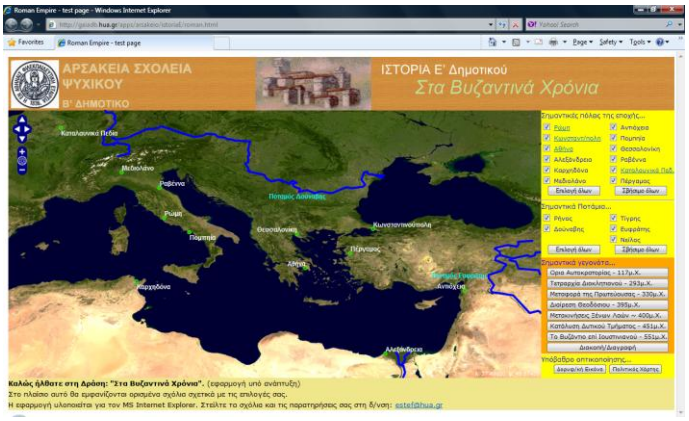
```
http://wms.jpl.nasa.gov/wms.cgi?
SERVICE=WMS&VERSION=1.1.1&
REQUEST=GetMap&
LAYERS=modis&
BBOX=20,20,64,62&STYLES=&SRS=EPSG:4326&
WIDTH=2000&HEIGHT=1000&FORMAT=image/png
```

This image resolution (2000x1000 pixels) is adequate provided that the zoom buttons in the toolbox (Figure 1) allows limited zoom levels (up to three times, X3). The user may switch the MODIS layer (satellite image) to a political map of the same region, showing the boundaries of the contemporary countries (Figure 3d). The latter has been compiled for the needs of the prototype and is stored locally at HUA Server, along with the application.

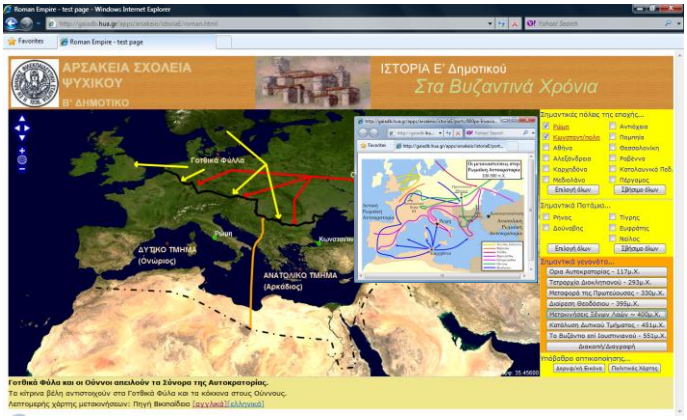
The geometric features (towns and rivers) and the geometries assigned to the historical events in Table 1 are drawn using the OpenLayers library constructs. The source data have been collected from various sources in Wikipedia (Wikipedia 2010) and the Digital Atlas of Roman and Medieval Civilization developed by the Center for Geographic Analysis at Harvard University (Darcm 2010).

3. Evaluation and Guidelines

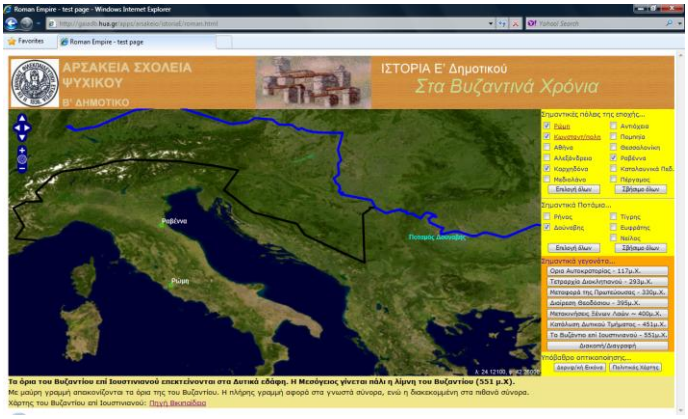
Both the content and functionality of the application have been evaluated preciously and at multiple levels. First, the author has cooperated closely with the corresponding teachers of the biggest private school in Greece, during the development phase, to clarify the application scope and content.



(a)



(b)



(c)

(d)

Figure 3. Example screens of the prototype.

The initial prototype has been presented to a limited number of pupils (five) in the school. Their feeling and comments have been decoded and leaded to significant changes in the initial version. The revised version has been presented to two regular classes of 33 pupils each (66 in total). Their feedback was really positive. Their comments have also been collected and leaded to minor revisions. The third version of the prototype is currently available at http://gaiadb.hua.gr/apps/arsakeio/istoriaE/.

The whole process, including the development, the presentations and the revisions, helped us understand the significance of the application in education, while raised several useful guidelines for future developments. As for the significance, the pupils understood (as stated by themselves) the following issues, which were not clear after reading the textbook:

- The distribution of the main towns during the Roman and Byzantine Empire was along the coastline of the Mediterranean Sea (due to commercial and climatic reasons, etc.; see Figure 3a)
- The physical boundaries (such as rivers and mountains) have been crucial since the roman era (Figure 3c: Part of the Byzantine Empire borders during Justinian's reign; the Danube and the Alps).
- The weakness to administrate and preserve large territories forced the Emperors to the division of the Empire several times (Diocletian, Theodosius, etc.). Figure 3b shows the Theodosius division and the main invasions of the Empire (Goths, Huns, etc.).

As guidelines for future developments, it is worthy to mention the following:

- The content of the application must be limited to what is included in the textbook. The pupils want to see in a more attractive way (e.g., though map visualizations), what they have already read in the book. Any additional content has been proved confusing and/or boring to them.
- A series of simple but illustrated activities using either paper or screen maps are very attractive to them. Example activities include (a) the re-design of boundaries on top of clear map backgrounds, (b) the comparisons with the contemporary status, and (c) the measurement and re-allocation of various figures and entities.

4. Conclusion

Today, the use of mapping mashups and APIs in education is a common practice. On the other hand, the introduction of these tools in the primary school is a risky venture. The pupils, although familiarized with the technology, they need special guidance in order to get a successful outcome.

At Harokopio University of Athens and in close cooperation with the biggest private school in Greece, we have developed a prototype application for highlighting the geographic aspects of the Roman and Byzantine Empires through map mashups. The application has been texted and evaluated preciously, based on both teachers and pupils' feedback. The main scope of the paper was to briefly present the functionality of the prototype and highlight the results of the evaluation process.

Future work includes the translation of the application in English and its extension to a wider temporal interval. Additionally, we plan to build similar tools for the subjects of history (another grades) and geography. Our first attempts, using alternative methods, for the Greek Mythology (Primary School, 3rd Grade) can be found at Stefanakis 2008.

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