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Hadrian's aqueduct in Athens. Educational activity project in the context of promoting cultural heritage among youth

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Purpose: *To contribute to the study of cultural heritage, as well as to explore the possibility of delving deeper into a number of its fields through a single monument.*

Design/methodology/approach: *Applying contemporary informal education approaches to the design of an educational program for cultural monuments taking Hadrian's aqueduct as the starting point.*

Findings: *The rich interdisciplinary approach that emerged from the study of a single monument, its capacity to "narrate" stories as well as the potential of its gainful employment by young people, aiming at their cultural awareness concerning world cultural heritage of monuments.*

Practical value: *understanding and applying learning theories for studying objects, realising the degree to which discussing objects contributes to and illuminates different aspects of material culture, given that learning is influenced by personal elements, too: one's interests, inclinations, the manner in which one prefers to learn, etc.*

Originality/value: *Examining how a monument of cultural heritage can be perceived through a broader and more interesting feel for its inherent meaning, instead of exclusively through its narrow morphological sense, remains relevant.*

Index Terms: cultural heritage, museum studies, informal education.

I. Hadrian's Aqueduct: historical elements

As the sources reveal, Athens has been characterized by water deficiency since antiquity **[1]**. Its extension, during the Roman period **[2]**, with the building of Hadrian's city in the north-east end of the classical city-state, is connected to the construction of a big aqueduct, which was built in the 2nd century A.D. and served to carry water from Mount Parnitha and Mount Pentelicus to Athens at a distance of 25 km. Between 117 and 138 A.D., the Roman Emperor Hadrian **[3]** started a water-supply system work by collecting the waters from the Attica basin and transmitting them to Athens, thus providing a solution to the water-supply problem **[4]**. This water supply system of 140 A.D. was in use up to 1925, when the Marathon Dam was constructed. In 1995, the metro tunnel ran into the aqueduct tunnel next to the district of Ampelokipoi, a point where new technology met the old one. Water is still running from the cut duct as it wasused up to 1800 years ago.

Emperor Hadrian's work, which his successor Antoninus Pius completed in 140 A.D., is one of the most important works of antiquity. It is a proof that Roman engineers had broad knowledge, as they managed to construct an underground pipeline water distribution system with a constant gradient which allowed the smooth flow of water to the city of Athens. A large part of the path comprised of underground tunnels, the widest of which had a cross-section 0,85-0,95 m. and was found 10-14 m. under the surface. Alongside the duct and within certain distances, there were drains, which were designed and constructed for filtering and tunnel maintenance. The water reached a large distribution tank called the main castellum at the foothills of Lycabettus at 136 m. altitude. The façade, which was preserved up to 1778 and was facing Athens, was made from marble, decorated with four pillars in the Ionian rhythm and a free arch in the middle. The water came from Mount Pentelicus via a tunnel, part of which was overground on arches, such as the extant one next to today's district of Nea Filadelfeia, and another part underground, built on spots where the ground was soft, or scabbled where the ground was hard.

Figure 1. Photo of an overground part of Hadrian's aqueduct in Nea Filadelfeia (photo taken by H. Alexandri).

The main tunnel of Hadrian's aqueduct is about 25 km long, at a depth ranging from 2,5 to 40 m., 0,70-0,80 m. wide and 1,20-1,60 m. high. It started in Metochi-Agia Triada in Mount Parnitha and ended in Souna (or Schinia) stream in Menidi. At that point, the two pipelines merged and

continued eastward under the Kiffissos riverbed to Koukouvaounes, Heraklion, and even further to the east ending at the circular tank of Chalandri. Then, it went south to the Nursing home (Diavolorema), following the route of today's Kifissias Avenue, always underground, heading to Ampelokipoi, and ended up in the reservoir at the foot of Lycabettus Hill. Shorter pipelines that ended up in this main tunnel brought the water from other sources of Mount Pentelicus and Mount Parnitha. The system had reservoirs where water filtration using the method of precipitation took place, and thus the water that reached Athens was clear.

Hadrian's reservoir was 9,36 m. wide, 26 m long, and 2 m. deep. Its capacity was about 500 m^3. On the façade, there was the inscription "The emperor Caesar Titus Aelius Hadrianus Antoninus Augustus Pius, holding consular power for the third time, holding tribunition power for the second time, father of the state, complete and dedicated the aqueduct which had been begun by his father the divine Hadrian in New Athens" (translation by S. Leigh).

The main tunnel of the Hadrian aqueduct was underground. It is obvious that there had been a comprehensive study by the technicians aforehand, so that the tunnel would have a stable slope and thus facilitate the water flow. Given that the slope they recommended was 1:600, the flow rate was 1 m^3 / sec. A slighter slope would cause accumulation of sediment due to low flow rate, while a higher slope would cause the tunnel to wear out rapidly. Due to too uneven ground, the necessity for the tunnel to run under the Kifissos riverbed and Chelidonou creek, and due to the very hard and soft ground that had to be bypassed, the tunnel did not run in a straight line, but instead, several times, followed a zigzag path, with the result that its length was about 25 km instead of 15 km., if it followed a straight line.

The tunnel was built with the use of shafts at the proper depth and at 30-35 m. intervals. The workers conducted the excavation of the tunnel according to the predetermined by the study depth. The shafts performed several functions such as providing air for the workers, removal of excavation earth materials, transport of building materials – stones or bricks to the parts where the ground was soft, and usability, after the end of the works, of inspecting and cleaning off the sediment, sand, gravel, and soil from the tunnel, and repair of damages from fall of the walls.

The diameter of the shaft was about 1,40 m. and wall damp proofing were done with hydraulic cement. From the reservoir to the city, the water was carried through lead pipes of small diameter. In 1870, part of one of them with 18 cm. diameter and 3 cm. thick was discovered.

Hadrian's aqueduct was constructed by applying scientific knowledge rules and a lot of labour-intensive manual work, a large part of which was underground. Nevertheless, with two exceptions, all Roman baths in Athens were constructed after Hadrian's aqueduct the function of which consolidated the Roman perception of everyday life in Athens. This novel situation changed the relation the Athenians had with water, as it is proved by the decrease of wells and reservoirs in some areas, not that the wells were abandoned or digging of new ones stopped. The number of 2nd century A.D. wells that were discovered in Agora is equal to the number of the total wells that were dug during the 2nd and 3rd centuries A.D. Moreover, the mean depth of the 2nd century A.D. wells (i.e., the period that Hadrian's aqueduct was constructed) was much greater (20 metres instead of 13,5) in comparison to that of the 2nd and 3rd centuries.

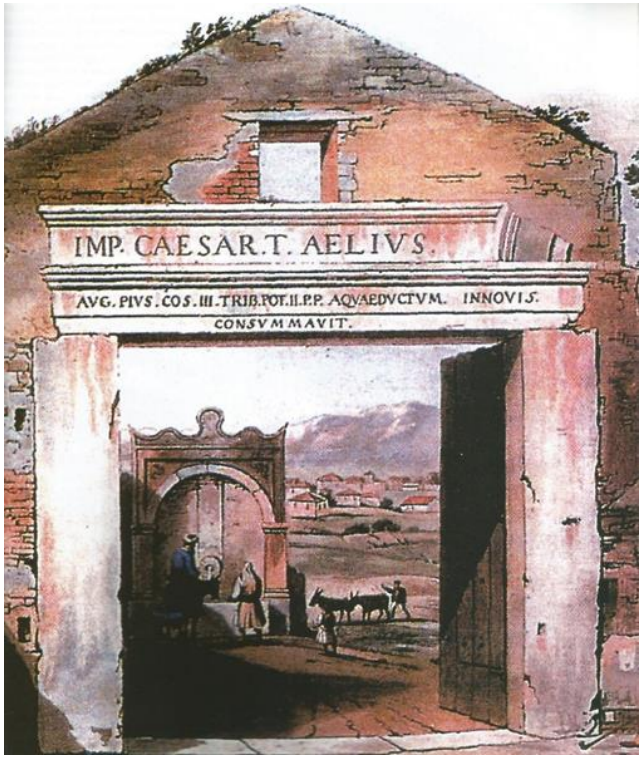


Figure 2. The Mediterranean door or the Gate of Boubounistra in the eastern walls of Athens, as it appears in the size of the wall photograph at the Syntagma metro station. The door was made of the marble from the ancient façade of Hadrian's reservoir.

Consequently, digging wells was harder, maybe because the underground water-table had been further degraded. The fact that new wells were dug in Agora during the 2nd century is evidence that water supply to the area was not provided by Hadrian's aqueduct, at least, not to the extent that it had rendered the older private modes of water supply useless. It must be noted that up to the end of the 4th century B.C. Rome had to use only local natural water sources in order to meet its needs. It was just in 312 B.C. – i.e., more than two centuries after the Pesistratos' Aqueduct of Athens – that a Roman aqueduct carrying water from neighbouring areas was built. During the following five centuries, five new aqueducts of larger – capacity, each of which supplied different city areas, were built. As the greatest mass of water was consumed by a small number of the privileged ones, the Roman aqueducts had a different social role from the contemporary ones, the aim and success of which was the total water supply to the population. Thus, taking also into consideration the archaeological findings, it does not go without saying that the construction of the Hadrian's aqueduct constituted general improvement in water supply to the whole population.

During the Ottoman rule, Hadrian's aqueduct was abandoned. But, after the transfer of the capital of the newly established Hellenic nation from Nafplio to Athens in 1834, the need for large amounts of water supply was pressing, the few taps were not enough and for this reason the inhabitants, like the ancient Athenians, drew water from numerous wells, which they dug in their house yards.

Around 1841, the Mayor of Athens, Venizelos, had excavations carried out next to the church Saint Dimitrios in Ampelokipoi, during which the ancient tunnel was discovered and cleaned as far as Psychiko, a distance of about 4000 km. However, neither the continuation of the tunnel from Ampelokipoi to the city nor the Lycabettus reservoir were found.

In 1855, the cleaning of the aqueduct went on up to Chalandri andone year later, the Municipality of Athens was granted a loan for the repair works of the known, by then, part of Hadrian's aqueduct, and thus its complete restoration was taken into consideration. In addition, the drains were repaired and covered. Lycabettus reservoir together with the tunnel from Ampelokipoi to the reservoir were discovered and repaired. Nevertheless, the tunnel was reconstructed, as the biggest part of the old one was damaged.

In 1875, the circular tank in Chalandri was cleaned and restored, and, during the two following years, they discovered the extension of Hadrian's aqueduct up to New Heraklion and Koukouvaounes.

In the years 1878 and 1879, Hadrian's aqueduct was cleaned as far the church of Holy Trinity at the foot of Mount Parnitha in Ampolis. During the same period, at the location Loutro, a circular tank the same as the one in Chalandri, which was connected to a substantial transverse aqueduct, was discovered.

In 1899, during Spyridon Merkouris' mayoralty, the cleaning of Hadrian's aqueduct started at the location Dimogli of Mount Parnitha up to the location Psalidi in Marousi, an overall length of 15 km. In 1995, during the metro tunnel excavation, under Panormou street in Ampelokipoi, the boring machine came across the tunnel of Hadrian's aqueduct tunnel. The depth on this spot was 17 m. We cannot but feel awe when observing the aqueduct tunnel, its meticulous construction, and the water still running, as this marvellous hydraulic structure has been continuously functioning for 1800 years.

II. Planning of the Educational Activity Project for Youth "One-day Visit to Hadrian's Aqueduct"

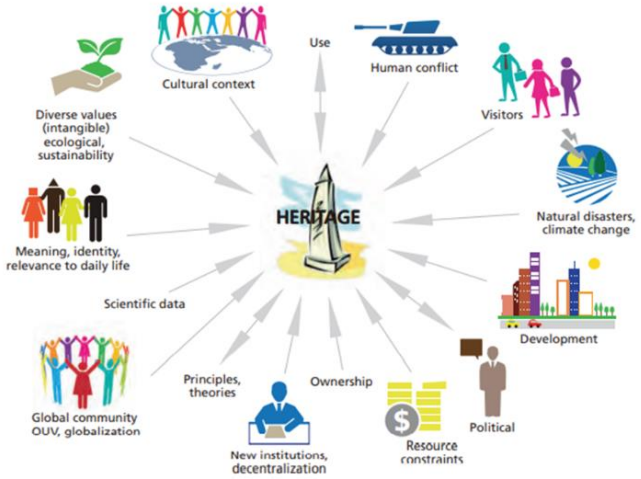
Cultural management: An Introduction

The cultural heritage of each country includes historical sites, places, built environment, collections, cultural practices, knowledge, and personal experiences. It constitutes an integral part of contemporary life, a dynamic reference point and a means of positive change development, as the enduring history and identity of each nation or country are traced in its cultural heritage **[5]**. Law 3028/2002 is the legal framework for the protection and prominence of a nation's cultural heritage.

On the basis of the aforementioned, Hadrian's aqueduct constitutes a significant monument of cultural heritage. It is included in the Permanent List of Archaeological Sites and Monuments of Greece according to Government Gazette 35/B/2-2-1962 **[6]**.

It has been repeatedly stated that citizens' awareness, education, and entertainment by acquaintance with cultural goods of their country, as well as facilitating citizens' approach to cultural heritage elements are necessary for asserting citizens' right to have access to cultural goods among others [7].

The following scheme (Scheme 1) depicts a contemporary, holistic approach to cultural goods, and the absolute necessity of their efficient management.



Scheme 1. Multiple dimensions of cultural heritage monuments. Source: WH-ManCulWH-Interactif (iccrom.org)

The lasting value of ancient hydraulic works is reflected in Hadrian's aqueduct. The technology and the materials used in the Roman period enabled the Aqueduct to function as the main source of water supply to Athens for almost 2000 years after its construction. It is important to mention that the fact that ancient works such as Hadrian's aqueduct – and there are several in Greece and all over the world' – owe their sustainability mainly to the function of water abstraction coming from their compartmental construction under the water table **[8]**.

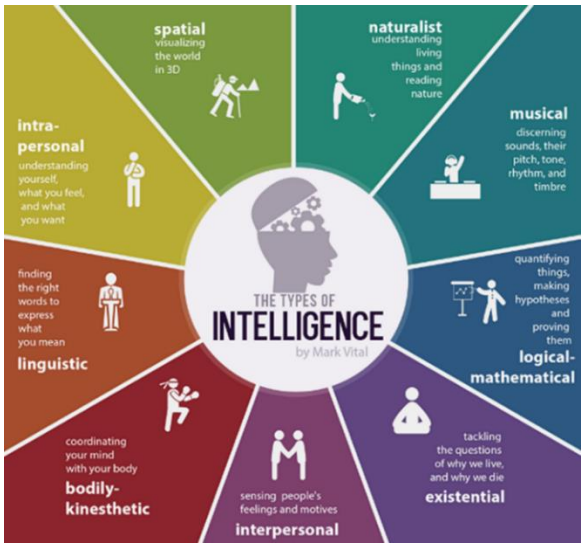
On the basis of the above scheme (Scheme 1), given the value of the monument, and for the purpose of focusing mainly on two parameters – the visitors and the relation of the monument with the community's everyday life – we have designed an educational activity for youth. The activity is based on contemporary concepts of informal education [**9**], i.e., experiential education **[10]**, in accordance with which education is considered an active exploration process by the participation of the senses and the theory of multiple intelligences **[11]** (and Scheme 2). On this basis, human intelligence may be "distinguished" into intelligence types (Scheme 2). It is also based on constructivism **[12]**, i.e., the theory which suggests that there is no knowledge independently of the student nor is it transmitted from teacher to student following a linear path, but instead it is acquired by the student on the basis of his/her previous experiences and interests. Constructivism is an approach to learning which holds that people actively construct or make

their own knowledge and that reality is determined by the experiences of the learners. Constructivism believes in personal construction of meaning by the learner through experience, and that meaning is influenced by the interaction of prior knowledge and new events. Moreover, constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning. This prior knowledge influences what new or modified knowledge an individual will construct from new learning experiences.

As it is known that there is no "general public" but groups of interpreters, in the present article we have designed an educational program addressed mainly to youth, i.e., persons aged 15-24, according to the definition by UNESCO **[13]**, aiming at their awareness of cultural heritage in general, in line with the UNESCO aim to provide the youth with the motive for monument preservation **[14]**, and, more specifically, Hadrian's aqueduct. For this reason, we have conducted a preliminary informal public survey with the students of the Department of Archival, Library and Information Studies in the context of humanities subjects. In more detail we tried, to identify what the students wish to know about the monument under consideration. The participants gave interesting answers among which they expressed the wish for a field trip, to follow the water tunnel course, and a graphic representation of the actual monument, so that they are enabled to integrate the monument into its era. These points have been taken into consideration for the suggested activities.

Moreover, we have drawn up a questionnaire on the project assessment based on the theory of Generic Learning Outcomes **[15]** (and Scheme 3), appended following the description of the educational activity. According to this theory, we have to look at learning as a broader concept and not as a mere pursuit of knowledge aim per se, by giving equal importance to both the students' entertainment and the contribution of the learning process to the formation of values and mindsets.

Educational activity description



Scheme 2. Multiple intelligences
Source: https://blog.adioma.com/9-types-of-intelligence-infographic/

At this point, the proposed activities are described within the context of planning and carrying out the educational action, which can be connected with the action "Schools Adopt a Monument" **[16]**, expanding the range of ages that can benefit from it. In addition, this specific action fulfils the criteria for integration into" Green Cultural Routes" organized by the Hellenic Ministry of Culture and Sports **[17]**. Planning includes a field trip by the target group, under the guidance/encouragement of the educator serving the role of "impression arranger" **[18]**, provided with pens, paper, paper-by-the-sheet, visual arts materials, and the questionnaire, which the participants are asked to fill in after the project completion (see Unit III) **[19]**.

1A. Starting point: two or more things about Hadrian's Aqueduct.
Intelligence type: Linguistic
Activity title: Ancient stories
Brief description:

At this point, the educator provides a summary of the historical elements that are stated in the first part of the present article. Moreover, ancient authors are made good use of, so that the participants can understand water scarcity in Athens, the need for water-supply, as well as the delight of those who visit places of natural beauty take. The texts we have chosen are cited in the Appendix. The participants, after having studied the sources, are asked to answer the following questions:

- How do you describe Athens regarding water resource adequacy?
- Can you understand the importance of this work for Athens?

According to a point of view, this present by Hadrian cannot be attributed to a long-term water shortage, but, rather, it must be related to the Roman know-how and the construction of aqueducts together with the notion of need for water supply to baths and public fountains **[1]**. The question the participants have to answer after reading the particular passage, is:

- Do you agree or disagree with this point of view? Why?

1B. Intelligence type: **Linguistic**
Activity title: Simple exercise in creative writing
Brief description:
The educator proceeds with urging:

- Think of an object in connection with water. Write three adjectives for it.

Having these in mind, write the main part of the story, which the object itself narrates using the first person, and present it to the group.

2. Intelligence type: Logical-mathematical
Activity title: Calculate the volume!
Description: Try and find the solutions to this easy problem
The main tunnel of Hadrian's aqueduct is 25 km. long, 0,70 m. wide and 1,40 m. heigh on average. How many cubic meters of water are in the tunnel?

The Lycabettus reservoir had a water capacity of about 500 cubic meters.
Make a comparison and find which of the two, the tunnel or the reservoir, had a higher capacity.
If the flow rate in Hadrian's aqueduct was 1 cubic meter per second, how many hours would it take to empty the tunnel, if it was full.

3. Intelligence type: Bodily-kinaesthetic
Activity title: Human sculpture, under the title "running water".
Brief description:
The participants, working in pairs, are asked to use pantomime to represent elements related to water such as wave, river, bridges like the ones from the aqueduct that have been saved and are visible, etc.

4A. Intelligence type: Musical
Activity title: Musical rivers
Brief description:
Listen to the famous work, The Blue Danube, by J. Strauss II **[20]**.

- What emotions do you experience?
- Can you identify the musical instruments played in this performance? Is there a predominant one?

4B. Listen to water sounds [21] for 5΄.

- What emotions do you experience?
- Can you think of a reason?

5A. Intelligence type: Interpersonal
Activity title: Inspiration by the Aqueduct
Brief description:
Production of a group assignment on the topic "Visible part of the Aqueduct". The participants sit in a circle. The first one starts creating a work on the subject of water by drawing or with the use of collage, and every 2 minutes the educator gives the cue and the work passes to the next one, so that the assignment goes on with all the participants.
Finally, we can ask the group (as feedback): what is your opinion about the development and the result of this assignment? How did you feel about continuing the work of the preceding person? How did you feel that someone else went on with / changed what you had done?

5B. Activity title: Mirroring
Brief description:
We assign a topic inspired by water (e.g., water, river, brook, fountain, etc.).
The group is divided into pairs. The two players sit opposite each other. At first, one player starts making movements relating to the topic. The player opposite copies them, the best he/she can, as a mirror. Afterwards, they change roles.

6A. Intelligence type: Visual / Spatial
Activity title: Working out a route.
Brief description:
Drawing inspiration from the corresponding educational material that has been produced on the Ilissos river **[22]**, you can walk alongside the proposed route, so that you can discover the course of the river that ran in Athens since the ancient times, and parts of it are still visible to date.

6B. Activity title: Making a maquette.
Brief description:
In Figure 3, you can see a hypothetical representation of the viaduct of a corresponding work, in the region of Stymphalia. In the Environment Museum of Stymphalia, you can see a maquette of the local aqueduct **[23]**. What do you observe as regards the materials and the construction method, so as to illustrate a pipe of Hadrian's aqueduct?

Figure 3. Source: G. Lolos: *King Adrian's water was introduced from Stymfilos: Hadrian aqueduct of Corinth and the transfer of water in Roman times, Piraeus Bank Group Cultural Foundation, Athens 2010, 23.*

7. Intelligence type: Intrapersonal
Activity title: Everlasting questions
Brief description:
The problem of water scarcity in Athens has been in existence since the ancient times. In what way do you believe that we could all contribute to its solution? Find information from certifying bodies related to this issue (e.g., Athens Water and Sewerage Company, National Technical University of Athens, etc.), and organize an "imaginary" public information campaign for the issue nowadays.
Work in the ancient times. Who worked? Did women in ancient Athens work? If yes, what kind of work and under which conditions? By way of illustration, you can seek information about Classical Athens on the website of the Foundation of the Hellenic World.

8. Intelligence type: Naturalistic
Activity title: Insects… differently
Brief description:
Certain visible spots of Hadrian's aqueduct are found in Philadelphia, on a green spot.
The artists Louis Bourgeois and Afroditi Liti have been inspired by the world of birds and insects. Draw yourselves inspiration by them as well and, on paper, make drawings or images that will depict insects.
Moreover, you can try and make small insects out of clay, so that you create a corner with your sculptures.

9. Activity completion - feedback
Activity title: Pack your case.
Brief description:

Every participant imagines that he/she has an imaginary case, which he/she will take with him/her when leaving the group. In it, he/she can put anything he/she wants, such as the memory of an event, members, a skill, or knowledge of something. We ask the participants what would they put into their case. In addition, they can put a symbolic gift which they can offer to the person next to them, explaining what exactly they offer and particularly to him/her.
After the program's completion, the participants are asked to fill in the following questionnaire:

III. Educational project assessment «one-day visit to Hadrian's Aqueduct» on the basis of Generic Learning Outcomes

Scheme 3. The generic learning outcomes, as set by E. Hooper-Greenhill (2007).

A)Knowledge and understanding
1. The educational activity "One-day Visit to Hadrian's Aqueduct" helped me in getting to know better (circle all that are true for you):
a) the concept of cultural heritage and its preservation
b) Hydraulic structures of the Roman era
c) the link between culture and environmental sustainability
d) none of the above

B) Behaviour and progression
2. After the educational activity (circle all that are true for you):
a) I will feel more concerned about the environment's protection and the water
b) I may visit places of cultural interest more often
c) I may start to concern myself with History
d) none of the above

C) Skills
3. The specific educational activity helped me to (circle all that are true for you):
a) find out about my skill (e.g., clay moulding, story narration, etc.) in:
……
b) to be eager to learn more about the topic:
……
c) learn how to work in a group
d) none of the above

D) Attitude and values
4. After the educational activity (circle all that are true for you):
a) I will feel more concerned about the environment's protection, e.g., start recycling
b) I have taken interest in the Roman era
c) I have taken interest in crafts
d) none of the above

E) Enjoyment, inspiration, creativity
5. Which part of the activity:
a) would you like to take part in again
……

b) would you describe to a friend
……

c) you will remember for a long time
……
d) did you like the least
……

6. My visit to Hadrian's Aqueduct today made me feel (circle the emoji that expresses your feeling):

☺ 😐 ☹

7. After visiting Hadrian's Aqueduct today, I will remember:
……
……
……

III. Conclusion

The project we propose constitutes an integrated, cross-curricular approach to awareness raising of world cultural heritage monuments among youth. This cross-curricular approach is based on experiential learning and modern pedagogical concepts, according to which it is the subjects (the learners) and not the object that play the leading role. In addition, it includes an assessment questionnaire. Due to the epidemic crisis, there could be no pilot project implementation, so as to proceed to the final development. As soon as the circumstances are conducive, we intend to go through this project phase.

IV. Appendix

The texts that are proposed for reading in the context of the first activity have been selected from the book by E. Chekimoglou **[1].**
"The city however is entirely dry. It suffers from a poor water-supply, and, because of its antiquity, the lay-out of the streets is chaotic".
Among others, Plutarchus writes characteristically: "Since the country was not supplied with water by ever-

flowing rivers, or lakes, or copious springs, but most of the inhabitants used wells which had been dug".

In a completely different style, the following excerpt from the dialogue Phaedrus by Plato praises, in its own way, the beauty of nature along the edge of Ardittos hill.

In the same dialogue, Socrates meets his friend Phaedrus. He accompanies him to a lush place with clear waters, next to the river Ilissos. They cross the river and arrive at the eastern bank at the edge of Ardittos hill.

- PHAEDRUS: Where would you please to sit?
- SOCRATES: Let us turn aside and go by the Ilissos; we will sit down at some quiet spot.
- PHAEDRUS: I am fortunate in not having my sandals, and as you have never any, I think that we may go along the brook and cool our feet in the water; this will be the easiest way, and at midday and in the summer is far from being unpleasant.
- SOCRATES: Lead on and look out for a place in which we can sit down.
- PHAEDRUS: Do you see the tallest plane-tree in the distance?
- SOCRATES: Yes.
- PHAEDRUS: There are shade and gentle breezes, and grass on which we

may either sit or lie down.

- SOCRATES: Move forward, then.
- PHAEDRUS: I should like to know, Socrates, whether the place is not somewhere here at which Boreas is said to have carried off Orithyia from the banks of the Ilissos.
- SOCRATES: Such is the tradition.
- PHAEDRUS: And is this the exact spot? The little stream is delightfully clear and bright; I can fancy that there might be maidens playing nearby.
- SOCRATES: I believe that the spot is not exactly here, but about a quarter of a mile lower down, where you cross to the temple Artemis, and there is, I think, some sort of an altar of Boreas at the place. But tell me. Isn't it the place you have been leading us?
- PHAEDRUS: Yes.
- SOCRATES: By Here, a fair resting place, full of summer sounds and scents. Here is this lofty and spreading plane-tree, and the agnus cast us high and clustering, in the fullest blossom and the greatest fragrance; and the stream which flows beneath the plane-tree is deliciously cold to the feet. Judging from the ornaments and images, this must be a spot sacred to Achelous and the Nymphs. How delightful is the breeze, so very sweet; and there is a sound in the air shrill and summerlike which makes answer to the chorus of the cicadae. But the greatest charm of all is the grass, like a pillow gently sloping to the head.

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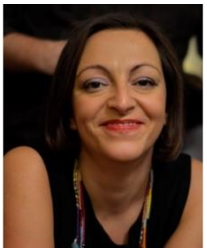

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