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Editorial message

Dear Colleagues,

It is with pleasure to announce the new issue of the **Journal of Integrated Information Management (JIIM)** publication. JIIM is an international, multidisciplinary, blind peer-reviewed journal that publishes research efforts on all aspects and issues regarding Information Science and Integrated Information Management.

Expressing our commitment to promoting high-grade quality scientific papers, we present you with the current issue, which contains four articles.

The first paper presents a study that focuses on spatiotemporal historical data organized in an OWL Protégé ontology environment. It aims at exploring the possibilities of using deduction logic tools in correlating alternate names of geographic regions related to time periods and presenting spatiotemporal interconnections. The application paradigm includes spatial data of local regions and sites of contemporary Greece and Turkey related to Hellenic historical archaeological sites temporally distributed in an extended period from Neolithic Age to the 19th century.

The following paper attempts to identify medical and health scientists' attitude towards the use of hybrid journals, social media and academic networks and the selection factors of publication medium, including alternative metrics. A quantitative survey was conducted, based on a structured questionnaire, focusing on Health Sciences and Medicine, with a population sample mainly consisting of hospital healthcare professionals. Most participants agreed that publishing in hybrid journals results in a significantly high cost for the authors which cannot be paid without funding support and probably affects the validity of the evaluation procedures

In the next paper readers will be informed of how the designing of a software tool was done, for computer-assisted learning and translation of Egyptian-Coptic into Greek. The software design emphasizes the ability of processing inscriptions on artifacts through a simple interactive interface for its usage by Greek-speaking scholars of Humanities, having just essential familiarization with computers.

The last paper contributes to the study of cultural heritage by exploring the possibility of delving deeper into a number of its fields through a single monument. For this purpose, authors applied contemporary informal education approaches to the design of an educational program for cultural monuments taking Hadrian's aqueduct as the starting point. 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.

We are aiming at making JIIM a reputable scientific communication channel, and we are now welcoming submissions for the upcoming journal issues as well as proposals for Special Issues. Your proposal should be no more than five pages and include at least an executive summary, a proper justification why the Special Issue is needed and how it is suitable with the JIIM topics. Special Issues proposals should be sent directly via email to the Assistant Editor-in-chief (dkouis@uniwa.gr).

Finally, we expect your contribution and active support with remarks and points of improvement.

Assistant Professor - Assistant Editor-in-chief

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Seeking for the evolutionary history of lands based on ontology organized spatiotemporal data and reasoning tools

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Abstract: *The present study focuses on spatiotemporal historical data organized in an OWL Protégé ontology environment. It aims at exploring the possibilities of using deduction logic tools in correlating alternate names of geographic regions related to time periods and presenting spatiotemporal interconnections. The application paradigm includes spatial data of local regions and sites of contemporary Greece and Turkey related to Hellenic historical archaeological sites temporally distributed in an extended period from Neolithic Age to the 19th century. The results are presented through advanced visualization tools embedded in the Protégé environment.*

Purpose: *The present study focuses on spatiotemporal historical data organized in an OWL Protégé ontology environment. It aims at exploring the possibilities of using deduction logic tools in correlating alternate names of geographic regions related to time periods and presenting spatiotemporal interconnections.*

Design/methodology/approach: *Methodology follows the systematic review paradigm and includes the development of a protocol for the following elements. Protocol for the inclusion of different types of entities. Protocol for the ways of standard use and expansion, in this case TNG and AAT vocabularies. Protocol for the description of entities within the ontological framework and finally a set of rules for the selection of vocabularies and authority tools. Literature search was conducted grouped in units to the corresponding protocols and likewise research results were tested per protocol.*

Findings: *The central idea of this study was the exploitation of embodied Deduction Logic tools in an ontology environment in order to reveal evolutionary history topics (as the relation of historical named entities based on their temporal features), as well as to connect historical monuments to places described by their real then used name apart from their contemporary identification.*

Originality/value: *The work could have a practical informational application as its ability to connect to google maps and Wikipedia and other linked data can turn it into a useful information tool.*

This work can also be used as a paradigm for cooperation between humanities and computational semantics, since there are a lot of available techniques that can enrich the information research and retrieval in digital humanities repositories, leading to

the emergence of 'hidden' treasures in contexts not studied and exploited yet.

Index Terms: *ontologies, spatiotemporal data, metadata, controlled vocabularies*

I. INTRODUCTION

Spatiotemporal data [1] are data that are related to both space and time. Spatiotemporal data mining refers to the process of extracting knowledge from spatiotemporal data. Spatiotemporal data processes include seeking for the evolutionary history of cities and lands, disclosing complex weather data series, predicting physical events, and determining global warming trends in the case of the planet climate. Relational spatial and temporal data mining are of increasing importance in the frame of GPS devices and web-based maps including historical references. CIDOC CRM standard has also been used as a tool for configuring events as time instances in an ontology framework presenting plant decoration elements throughout history [2].

Data mining techniques can be applied to various types of spatiotemporal data: multimedia and text data, local or web data, raw or organized (semi or fully organized) data. These techniques are borrowed from various domains, such as time-series theory [3], data graphs and networks [4], concept maps [5] and moving-object data [6]. Time-series statistical analysis includes generalized linear models, factor analysis, discriminant analysis and principal component analysis [7].

II. EVOLUTIONARY HISTORY OF REGIONS BASED ON SPATIOTEMPORAL RELATIONS

The issue examined here is the disclosure of the historical chains of geographical named entities referring to the same land through the mediation of cities and historical sites/monuments of various periods placed in the certain geographic region. The correlation of the recorded time periods of the heyday of the regions to the heyday time of the cities along with the building time of the monuments and the establishment of sites leads to the unveiling of the encrypted equivalence of the geographical named entities.

The case study examined here for the unfolding of the proposed methodology is the wider area of the Mediterranean Sea, where indeed there are many instances

of geographical places, which had flourished under different names and different cultures and civilizations in an extended time span from Neolithic period until nearly our days. A great part of these regions belongs to the same linguistically ethnic community, even though they followed quite different religious cultures, such as the Greek or Cretan regions, which passed from polytheistic cults to Christianity. Another part concerns cultures of similar religious characteristics but different languages, such as the Roman conquest of Greece or the Venetian occupation of extended areas of the Greek peninsula, islands and mainly Crete. Lastly, a great part is related to the full occupation of lands by a quite different ethnic community with no linguistic or religious relation, such as the ancient and medieval lands of the East Roman Empire, which were inhabited by Slavic populations and/or conquered by the Ottomans. Especially in the last case the place names have totally been altered.

An example of the first kind of change is passing from the territorial layout of the ancient Greek cities to the Byzantine themata as administrative districts. At a second stage one can observe the adoption of Venetian administrative divisions of sestieri and territoria in Crete. Accordingly, in other parts of the Mediterranean in areas under Turkish authority we observe the use of Ottoman Turkish names for the previously Greek names of districts of Asia Minor and other major cities.

Cases included, in this exploratory paradigm, are the districts of Minoan Crete, Roman Crete, Byzantine Crete and the Venetian Crete, geographic areas of ancient civilizations now in the dominion of other nations (such as Ephesus in former Lydia and currently in Turkey), provinces which slipped from classical Rome provinces to East Roman Empire themata (such as Nicopolis in Epirus), as well as milestone-cities passed from Late Byzantine to Ottoman Empire (such as Athens, Constantinople/ Istanbul, Smyrni/ Izmir, Adrianople/ Edirne).

III. THE TOOLS USED

In an effort to standardize the content elements of the ontology, several controlled vocabulary tools, authority files and public domain ontologies were used. Also, through this standardization process an effort was made to provide linked data and interconnect the ontology at hand with external authority sources such as LC Authority Files linking to existing bibliographic sources and Wikipedia content. Specifically:

Spatial data have been verified against the Getty Thesaurus of Geographic Names (TGN) [8] and the relevant geospatial tree was checked with the spatial class of the ontology. This process resulted in verification of names and provided source ids linking them to the aforementioned external source.

An example is given below, concerning the hierarchy trees of Iraklion (regional division) in TGN Thesaurus (Fig. 1).



Figure 1. Hierarchy tree of the term 'Iraklion (regional division)' in TGN Thesaurus, Source: Getty Research Institute, TGN

At the same time geospatial coordinates were incorporated and google maps became accessible from the ontology environment, thus expanding its usability and potential uses. This information was recorded in two relevant data properties -longitude and latitude-incorporated into the ontology at hand. By inserting the latitude and longitude of a place in decimal form divided by comma in the google maps search box, one can be transferred at the requested geographic area.

An example of geographical coordinates of Knossos in the form of data properties is given below (Fig. 2):



Figure 2. Latitude and longitude, given as datatype properties of Knossos

Temporal data were verified against the public domain ontology PeriodO [9], mostly for providing temporal information that is referenced to relevant sources and offering proof for the validity of its recording and naming. As PeriodO provides also temporal data linked to geospatial data thus creating a particular reference for every region in relation to its historical stage within the world history, it proved to be an essential tool for the building of temporal class and the contents' validity. Connecting the ontology at hand with PeriodO's relevant historical period and its interconnection to spatial information served as a mean to relate the ontology to a valuable external source. In addition, PeriodO's active links provided the opportunity to utilize linked data. Links to PeriodO were created at the annotation part of the temporal classes.

An example is given below, concerning the PeriodO authority page about Minoan Period (3100-2050 BC) (Fig. 3) connected to the temporal class of the ontology: Minoan.Millennium2ndBC. The connection is accomplished through the annotation part of the relative class (Fig. 4).

Label	StartY	Stop	Spatial coverage	Pub. date
16 view Age de Bronze	3200 BC	1050 BC	Greece	2018
19 view Bronze Ancien	3200 BC	2100 BC	Greece	2019
20 view Helladique	3100 BC	ca 1050 BC	Greece	2016
21 view Minoan	3100 BC	ca 1050 BC	Crete	2018
22 view Helladique Ancien	3100 BC	2050 BC	Greece	2019
23 view Helladique Ancien I	3100 BC	2700 BC	Greece	2019
24 view Minoan Ancien	3100 BC	2100-2050 BC	Crete	2019

Figure 3. PeriodO authority page about Minoan 3100 BC – ca 1050 BC | Crete

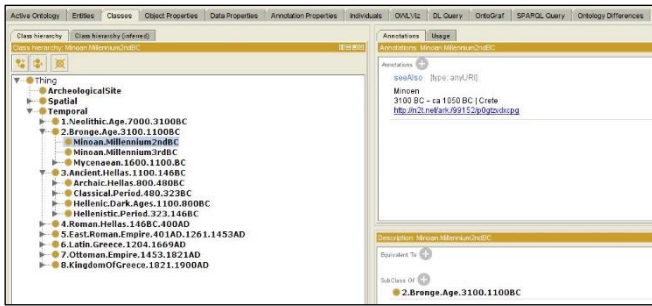


Figure 4. Annotation of temporal class: Minoan.Millennium2ndBC with the PeriodO authority page about Minoan period

Furthermore, as we were dealing with monuments and cultural manifestations the Getty Art and Architecture Thesaurus (AAT) was consulted in order to depict style periods as part of temporal data (such as Neolithic, Minoan, Mycenaean periods). Links to AAT Getty [10] were inserted at the annotation part of either spatial classes with temporal characteristics or temporal classes with spatial characteristics.

Topical elements were also incorporated as it became evident that subjects related to geospatial and temporal data can offer a holistic approach to the intellectual content and provide a more complete information package. Topical elements were verified against both AAT and the LC Subject Authorities (<https://authorities.loc.gov/>) thus expanding the possibility of creating linked data on this end as well. Topical terms were given along with their AAT id and provided link to the aforementioned external source. In addition, links to Wikipedia data were provided expanding the ontology's informational capabilities. All these links were created at the annotation part of certain monuments (individuals), like in the paradigms of the Temple of Artemis and Knossos Palace (see also Table 2).

An example is given below, concerning the hierarchy tree of *Early Minoan* term on ATT Getty Thesaurus (Fig. 5).

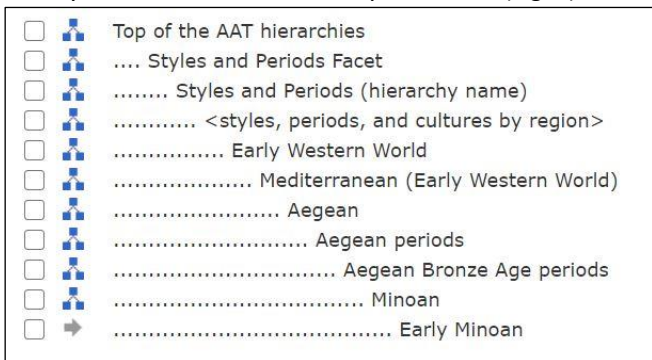


Figure 5. Hierarchy tree of the term 'Early Minoan' in ATT Getty Thesaurus.

As it has already been mentioned, an effort was made to connect the embedded spatial and temporal classes with the nearest to them terms of Getty Thesaurus of Geographical Names (TGN), as well as to the terms of Getty Art & Architecture Thesaurus (AAT). This is accomplished by putting the relevant permanent link in the annotation part of the relevant class: Class Heraklion.Region has been interconnected to the term Iraklion (regional division) of

TGN Thesaurus. Class Minoan.Knossos has been interconnected to the term Early Minoan of ATT Getty Thesaurus.

IV. THE STRUCTURE OF A SPATIOTEMPORAL ONTOLOGY OF MEDITERRANEAN REGIONS

Ontology is a sophisticated data structure organized in the form of a hierarchy of classes (collections of similar objects/ individuals) enriched with customized relations between individuals of the same or different classes (object properties with domain and range certain classes) and defined features of individuals of a certain class (datatype properties with domain a certain class and range a certain data type as text, number, date, etc.).

The open-source environment OWL Protégé 4.3 (<https://protege.stanford.edu/>) was used.

An exceptional feature of the OWL Protégé ontologies is the capability of application of *inference* mechanisms, in case of a previous characterization of some classes with some certain properties, such as the connection of flourishing of the places of a region to specific historical periods. Reasoning engines can be activated and give additional hierarchical relationships, apart from those initially defined. As we will see later in detail (Case 2 – Fig. 6) the connection of Ionia to 6th cent. BC period is used by the reasoning engine, which concludes that Ionia belongs hierarchically to the current Izmir.Province including Ephesus, while Ephesus has been explicitly defined as a place of Izmir.Province.

The developed spatio-temporal ontology has the following structure:

Classes: *Archaeological Site* (the class which includes certain archaeological sites and archaeological monuments in general). *Spatial* (the class of all the spatial elements: wider or narrower, current or past regions and cities). *Temporal* (the class of all the temporal elements: wider or narrower periods in various cultural contexts).

Spatial contains the following subclasses: *Past_region*, *Current_region*. *Past_region* contains: *Ancient_Crete*, *Minor.Asia*, *Ancient_Aegean*, *East_Roman_Thema*, *Venetian_Crete*. *Ancient_Crete* contains: *Cydonia*, *Minoan.Knossos*, *Minoan.Phaestos*, *Minoan.Malia*, *Roman.Gortyna*. *Ancient_Aegean* contains *Rhodes*. *Minor.Asia* contains *Ionia*, *Lydia* etc. *Venetian_Crete* contains: *Venetian_sestieri* (administrative divisions of Venetian Crete in 13th cent), *Venetian_territoria* (administrative divisions of Venetian Crete in 14th cent and then). *Venetian_sestieri* contains: *Candie*, *Castello*, *Dorsoduro*, *San.Marco*, *San.Polo*, *Santa.Croce*, *Santi.Apostoli*. *Venetian_territoria* contains: *Candia*, *Canea*, *Rettimo*, *Siteia*. *Current_region* contains: *Greece*, *Turkey*. *Greece* contains: *Central.Macedonia.Region*, *Crete.Region*, *Epirus.Region*, *South.Aegean.Region*. *Crete.Region* contains: *Apokoronas.Region*, *Chania.Region*, *Faistos.Region*, *Gortyna.Region*, *Heraklion.Region*, *Hersonissos.Region*, *Kissamos.Region*, *Sfakia.Region*, *Sitia.Region*. *South.Aegean.Region* contains: *Rhodes.Region* etc. *Turkey*

contains: Edirne.Province, Istanbul.Province, Izmir.Province.

Temporal contains the following subclasses: Neolithic.Age.6800.3100BC, Bronze.Age.3200.1100BC, Ancient.Hellas.1100.146BC, Roman.Hellas.146BC.330AD, East.Roman.Empire.330AD.1261.1453AD, Latin.Greece.1204.1669AD, Ottoman.Empire.1453.1821AD, KingdomOfGreece.1821.1900AD. Neolithic.Age contains 7th to 3rd millennia BC. Bronze.Age contains: 3rd and 2nd Minoan millennia BC and Mycenaean.1600.1100BC. Ancient.Hellas contains: Hellenic.Dark.Ages.1100.685 BC, Archaic.Hellas.700.480BC, Classical.Period.480.323BC Hellenistic.Period.323.146BC. All of these temporal subclasses contain the corresponding centuries as subclasses. Temporal subclasses were formed based on PeriodO references.

Object properties: Flourishes_in (any spatial element as geographical region or city flourished in a certain temporal element as millennium, century or year). Built_in (any archaeological site or monument erected in a certain temporal element). Is positioned_in (any archaeological site or monument lies now in a certain current spatial element as a contemporary city).

Datatype properties: Latitude and longitude coordinates are defined using as Domain: Spatial and Range: Decimal.

The spatiotemporal properties presented above could be alternatively implemented as datatype properties with range date. Every effort was made to make the structure of the ontology perspicuous enough, so as to provide references to all historical periods used. PeriodO was a great source and whenever there was a gap in information, the LC authorities were used. AAT's *styles and periods* section were used as an auxiliary tool offering the interconnection of time period and subject element.

In the limitations of this effort, one should take into account that when using datatype properties, these could not be displayed in the diagrams produced by the incorporated visualization tools. Therefore, we decided to use only object properties for the implementation of the spatiotemporal relations. This was definitely a drawback for the visualization aspect, although the ontology structure itself was complete.

Visualizations of the ontology structure focusing on a certain class were produced by Ontograf, a visualization software incorporated into Protégé 4.3. Protégé 4.3 version was used as it provides better visualization capabilities than the latter version 5.5 or webprotege.

IV. EXTRACTION OF HISTORICAL REGIONS' RELATIONS THROUGH DEDUCTION LOGIC RULES

First-order or predicate logic is the logic used for the proof of predicates (or compounds of logically connected predicates, called well-formed formulas). Predicate calculus is one step further than simple propositional calculus which does not use quantifiers; therefore, propositional logic is the foundation of first-order logic.

First-order logic is the simplest logic, differentiated from higher-order logics, where predicates can also have

predicates as their arguments and function quantifiers are also allowed.

A deductive classifier is an inference engine applied to hierarchical structures of classes and subclasses mutually connected through certain relations. The classifier both determines the overall validity of the defined relations and extracts new relations, not explicitly declared in the initial scheme.

First-order deductive classifiers are incorporated in OWL Protégé environment, giving us the capacity to extract encrypted spatiotemporal relations, as connections of historical regions to assigned historical temporal entities and inclusion (membership in terms of ontology) of nowadays cities to past regions. The supposition for the activation of the reasoner is the previous equivalent definition of the class under question through an object property restriction on the range classes connected through logical operators. Furthermore, examples of the equivalent definition of a class and the concluded uncovered additional classifications of that class along with additional memberships are given below.

All cases included in the ontology are tabularized as depicted in Table 1.

Table 1. Spatio-temporal elements of the archeological sites (monuments) included in the ontology

Monument/ Archaeological site	year/ century	ancient city name of the period	modern city name	region name of the period	modern region name
Temple of Artemis	440 BC	Ephesus	Kuşadasi	Ionia	Izmir.Province
Agia Photini	17 th c AD	Izmir	Smyrni	Izmir.Province	Izmir.Province
Temple of Athena Lindia	300 BC	Lindos	Lindos	Rhodes	Rhodes.Region
Knossos.Palace	2 nd m. BC	Knossos		Minoan.Knossos	Heraklion.Region
Phaestos.Palace	2 nd m. BC	Phaestos		Minoan.Phaistos	Faistos.Region
Malia.Palace	2 nd m. BC	Malia	Malia	Minoan.Malia	Hersonissos.Region
Zakro.Palace	2 nd m. BC	Zakros	Zakros	Minoan.Zakros	Sitia.Region
Lissos.site	3 rd BC	Lissos	Sougia	Cydonia	Sfakia.Region
Lissos. Asclepieion	3 rd BC	Lissos	Sougia	Cydonia	Sfakia.Region
Agios Kirikos	1436 AD	Lissos	Sougia	South. Canea	Sfakia.Region
Gortyna. Praetorium	1st c AD	Gortyna	Gortyna	Roman .Gortyna	Gortyna.Region
Rotonda	6 th c AD	Kissamos	Kissamos	Krētēs. thema.Kissamos	Kissamos.Region
St.George	1243 AD	Alikianos	Alikianos	North. Dorsoduro	Chania.Region
Basilica.St.Mark	1239 1303	Chandax	Heraklion	Candie	Heraklion.Region
St.Nicolas	11 th AD	Vamos	Vamos	Krētēs. thema. Apokoronas	Apokoronas.Region
St.Minas	1862 AD	Heraklion	Heraklion	Heraklion	Heraklion.Region
Agia.Sophia	537 AD	Constantinople	Istanbul	Thrace. thema	Istanbul.Province
St.Dimitrius	5th c AD	Thessalonica	Thessaloniki	Thessalonike. thema	Central.Macedonia. Region
Macedonian Tower	10th c AD	Edirne	Adrianople	Makedonia. thema	Edirne.Province
Byzantine.Walls	555 AD	Nicopolis	Preveza	Nicopolis.thema	Epirus.Region
Parthenon	430 AD	Athenae	Athenae	Classical.Athens	Attica.Region
Monastery of Daphni	[Byzantine] 11 th c. AD	Athenae	Athens, Haidari (Prefecture of Attiki)	Hellas. thema	Attica.Region
Monastery of Osios Loukas	[Byzantine] 11th AD	Thebes	Steiri, Boeotia	Hellas.thema	Boeotia.Region

Table 2. Tabularized data and their matching verifications to external sources/paths to linked data

Monument	Temple of Athena Lindia	Temple of Artemis	Knossos Palace
Matching linked data	Wikipedia https://en.wikipedia.org/wiki/Temple_of_Athena_Lindia	LC https://lccn.loc.gov/sh91004849 Wikipedia https://en.wikipedia.org/wiki/Temple_of_Artemis	LC https://lccn.loc.gov/sh85096911 Wikipedia https://en.wikipedia.org/wiki/Knossos
Year/Century	3rd cent.BC	440 BC	2nd m. BC
Verification			PeriodO https://client.perio.do/?page=period-view&backendID=web-https%3A%2F%2Fdata.perio.do%2F&authorityID=p0qv6m8&periodID=p0qv6m85m6c
Ancient city name of the period	Rhodes	Ephesus	Knossos
Verification	TGN http://vocab.getty.edu/tgn/7011266	LC https://lccn.loc.gov/sh85044266	LC http://vocab.getty.edu/tgn/7228703
Modern city name	Lindos	Kuşadasi	
Region name of the period	Rhodes	Ionia	Minoan Knossos
Verification by style period	http://vocab.getty.edu/aat/300020111	AAT http://vocab.getty.edu/aat/300386027	AAT http://vocab.getty.edu/aat/300020224
Modern region name	Rhodes.Region	Izmir.Province	Herakleion.Region
GEO verification	TGN http://vocab.getty.edu/tgn/7011265	TGN http://vocab.getty.edu/tgn/1001053 Google maps	TGN http://vocab.getty.edu/tgn/7002690 Google maps

All elements of Table 2 were verified against the tools described above giving us a table with links to external resources.

A sample of this work relevant to paradigms presented here is presented in Table 2.

Paradigm 1. The class *Rhodes* (ancient Rhodes) belongs by definition to *Past Region* spatial category, specifically to *Ancient Aegean*. Defining *Rhodes* equivalently as an AND conjunction of the contemporary *Rhodes.Region* and the *anonymous* class of the spatial elements flourished in 3rd cent. BC, the reasoner infers the following additional classifications and memberships: *Rhodes* becomes also subclass of the contemporary *Rhodes.Region* and it gets as member *Lindos* (Fig. 6), since *Lindos* has also flourished in 3rd cent. BC, and belonged by definition to contemporary *Rhodes.Region* (Fig. 6). In this way, *Temple of Athena Lindia*, an instance of *ArchaeologicalSite*, built in 3rd cent. BC and being situated in *Lindos* (Fig. 7), is indirectly connected to ancient *Rhodes*.

The defined and implied relations focusing on class *Rhodes* are shown in detail in Fig. 8.

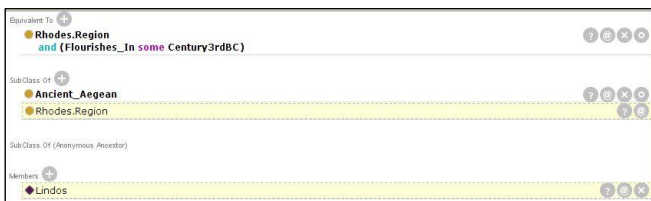


Figure 6. The class *Rhodes*.



Figure 7. The individual *Lindos*.

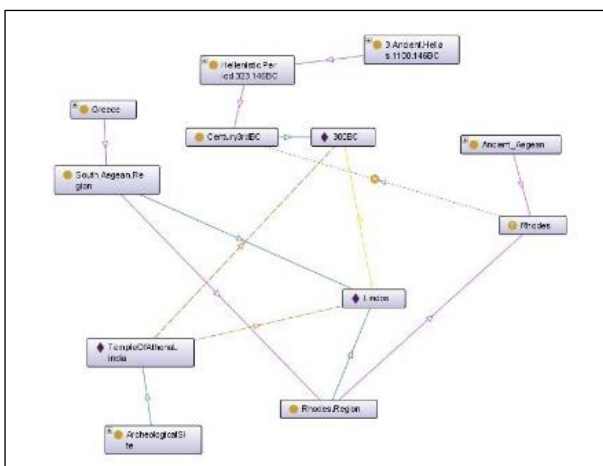


Figure 8. Classes, individuals and relations of *Rhodes*, produced by Ontograf

Paradigm 2. The class *Ionia* belongs by definition to *Past Region* spatial category, specifically to *Asia Minor*. Defining *Ionia* equivalently as an AND conjunction of the contemporary *Izmir.Province* and the *anonymous* class of the spatial elements flourishing in 6th cent. BC, the reasoner

infers the following additional classifications and memberships: *Ionia* becomes also subclass of the contemporary *Izmir.Province* and it gets as member *Ephesus* (Fig. 9), since *Ephesus* had also flourished in 6th cent. BC, and belongs by definition to contemporary *Izmir.Province* (Fig. 10). In this way, *Temple of Artemis*, an instance of *Archaeological Site*, built in 6th cent. BC and being situated in *Ephesus* (Fig. 11), is indirectly connected to ancient *Ionia*. The historical network is extended here with *Izmir.Smyrni* city, another defined instance of *Izmir.Province*, where *Saint Photini* (another instance of *Archaeological Site*) was built in 17th cent AD.

The defined and implied relations focusing on *Ionia* class are shown in detail in Fig. 12.

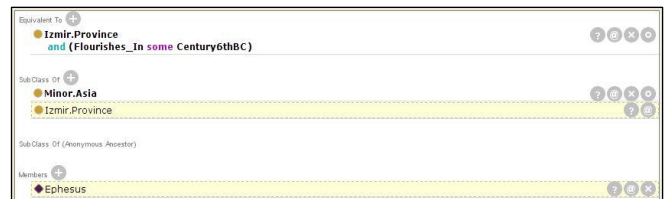


Figure 9. The class *Ionia*.

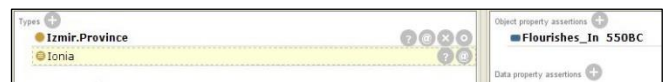


Figure 10. The individual *Izmir.Smyrni*.



Figure 11. The individual *Temple of Artemis*

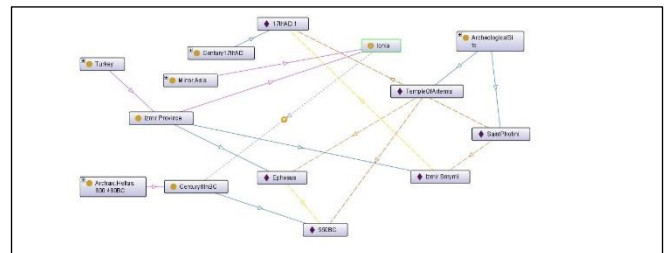


Figure 12. Classes, individuals and relations around ancient *Ionia*, produced by Ontograf

Paradigm 3. The class *Minoan.Knossos* belongs by definition to *Past Region* spatial category, specifically to *Ancient.Crete*. Defining *Minoan.Knossos* equivalently as an AND conjunction of the contemporary *Heraklion.Region* and the *anonymous* class of the spatial elements flourishing in 2nd Mill. BC, the reasoner infers the following additional classifications and memberships: *Minoan.Knossos* becomes also subclass of the contemporary *Heraklion.Region* and it gets as member *Knossos*, since *Knossos* had also flourished in 2nd Mill. BC, and belongs by definition to contemporary *Heraklion.Region*. In this way, *Knossos Palace*, an instance of *ArchaeologicalSite*, built in 2nd Mill. BC and being situated in *Knossos*, is indirectly connected to ancient *Minoan.Knossos*. The historical network is extended in the case of

Heraklion.Region to two other periods: The Venetian Crete and the 19th Cent. Crete being just liberated from Ottoman occupation. Venetian sestiere *Candie* identified with Heraklion.Region is connected to Chandax.Heraklion where sits the Basilica of St.Mark, being built between 1239 AD and 1303 AD. In Liberated Crete Heraklion, an instance of Heraklion.Region is related through Heraklion.Region class to Minoan and Venetian Crete, along with St.Minas church, being built in 1862 AD in Heraklion, rendering it an instance of the class *Archeological Site*.

The defined and implied relations focusing on ancient *Minoan.Knossos* and *Candie*, connected to contemporary *Heraklion.Region* are presented in detail in Fig. 13.

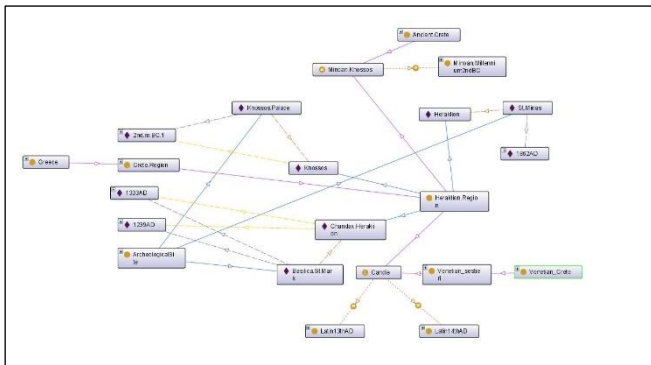


Figure 13. Classes, individuals and relations around *Minoan Knossos* and *Candie* (a Venetian Crete territory, produced by Ontograf).

V. A TIME TRAVEL / TRANSTEMPORAL VIEW OF GEOGRAPHICAL REGIONS

After completing the structure of certain geographical regions through the ages, one can benefit from the rich information stored along with the graphical capabilities of the Protégé environment so that he has a condensed history of any selected region. Various places of a wider area, such as Heraklion and Knossos, often mentioned with different names (Chandax and Heraklion), belonging to Heraklion region are connected with their historical names (Candie and Minoan Knossos). The graphical representation of this spatio-temporal structure can be accompanied by multimedia content (photos or videos), which have been inserted in the annotation part of the relative individuals. Such a diachronic view of Heraklion region is depicted below (Fig. 14), through Knossos, Chandax and Heraklion from the Minoan, Venetian and modern periods of the area, accompanied by illustrative monuments of those periods, Knossos palace, San Marco basilica and Saint Minas church respectively.

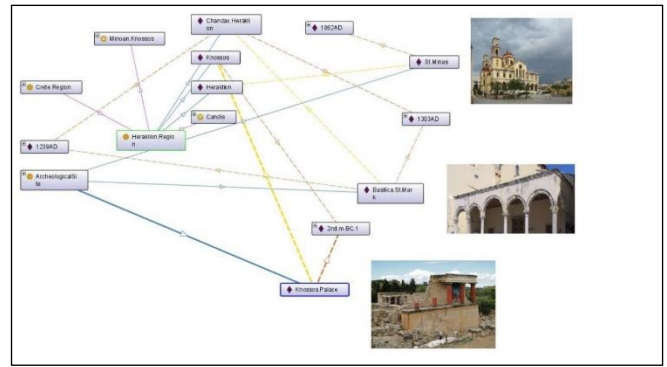


Figure 14. A time travel view of the Heraklion region.

VI. CONCLUSIONS AND FURTHER RESEARCH

The central idea of this study was the exploitation of embodied Deduction Logic tools in an ontology environment in order to reveal evolutionary history topics (as the relation of historical named entities based on their temporal features), as well as to connect historical monuments to places described by their initial then changed name apart from their contemporary identification.

This approach can be also followed in other spatiotemporal frames, such as evolutionary history of philosophical or scientific terminology, where the 'spatial' part is the concept world of philosophical or scientific notions. An interesting research could be the automatic extraction of chains of alchemical/ chemical terms from the ancient times until the scientific revolution in chemistry in the 18th century.

The work could have a practical informational application as its ability to connect to google maps and Wikipedia and other linked data can turn it into a useful information tool.

This work can be also used as a paradigm for cooperation between humanities and computational semantics, since there are a lot of available techniques that can enrich the information research and retrieval in digital humanities repositories, leading to the emergence of 'hidden' treasures in contexts not studied and exploited yet.

Furthermore, in building and assessing the ontology an interdisciplinary collaboration took place which was very important: not only the cooperation across disciplines was of importance, but also the communication mechanisms that lead to the implementation of a tool that can be used for facilitating digital humanities' projects.

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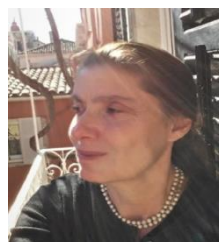
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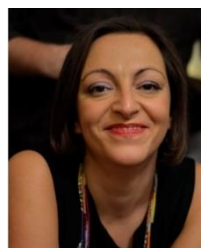
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Medical and health sciences' community attitudes towards hybrid journals, academic networks, social media and research evaluation metrics: a perspective from Greece

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Abstract:

Purpose – The present paper attempts to identify medical and health scientists' attitude towards the use of hybrid journals, social media and academic networks and the selection factors of publication medium, including alternative metrics.

Design/methodology/approach - A quantitative survey was conducted, based on a structured questionnaire. It focused on Health Sciences and Medicine, with a population sample mainly consisting of hospital healthcare professionals. Likert scale, simple multiple-choice and ranking type questions were used.

Analysis: 215 completed questionnaires were gathered and various statistics parameters were correlated with the demographic data (profession, experience, gender).

Findings - Most participants agreed that publishing in hybrid journals results in a significantly high cost for the authors which cannot be paid without funding support and probably affects the validity of the evaluation procedures. They also agreed that an open article published in a hybrid journal needs a shorter time for the peer review process, receives more citations and contributes essentially to the research process. Most of the participants use or would like to use ResearchGate and Google Scholar services. Social media involvement was considerably low in participants' responses. The number of publications and the prestige / credibility of the publishing media are considered to be the most important factors in research evaluation and in publishing media selection respectively.

Originality/value - No survey has been reported recently that focuses on health professionals' attitude towards Open Access movement in Greece. It is valuable to explore this community's attitude because of their extremely active publishing profile, which decisively affects their career and largely contributes to research progress and national innovation.

Index Terms — hybrid journals, academic networks, social media, research evaluation metrics, medical and health sciences, Open Access.

I. INTRODUCTION

The massive progress in digital technology, along with the explosive pace of the production of scientific papers, has changed the scientific communication and publishing landscape radically. In an entirely digitised environment, scientists from different research fields and social backgrounds can collaborate without limitations (e.g., geographical, cultural, etc.) by using revolutionary technological tools. There is a great need for scientists to communicate without obstacles, to improve their ideas, invent new methods, avoid mistakes or repetitions and contribute to research progress in terms of scientific validity and accuracy.

Since scientific knowledge is considered a democratic value, *Openness* appears inevitable for the dissemination of science. Therefore, the Open Access (OA) movement which started to form at the end of 20th century and was officially established with the 3B (Budapest¹, Berlin², Bethesda³) [1] declarations, initiated the process of the scientific publishing radical transformation. Suber's [2] definition of OA reveals the revolutionary essence of this movement: "Open access literature is digital, online, free of charge, and free of most copyright and licensing restrictions."

There are two dominant models of Open Access publishing: the Gold Open Access model which refers to publications that are freely available to the public at the time of their publication and the Green Open Access model, according to which an accepted manuscript can be submitted by the author to a digital repository before, after, or along with its publication.

Reference the Gold model, *big publishers* came up with new pathways, in an attempt to align with the advancements that the OA movement has brought to the scholarly journals and achieve a transition in a cost-neutral way. The pure or full Gold Open Access journals refer to publications whose content is freely accessible, without any type of subscription fees, and authors usually need to pay the Article Publication or Processing Charges (APCs). There

¹ <http://www.budapestopenaccessinitiative.org/read>

² <http://legacy.earlham.edu/~peters/fos/bethesda.htm>

³ <https://openaccess.mpg.de/Berlin-Declaration>

are also many journals that do not charge APCs at all (see in Directory of Open Access Journals web site for journals without APCs⁴), as they rely on external funding. Another form of OA publishing is the hybrid journals introduced in 1998 by Thomas Walker [3]. He suggested that authors could pay for free access visibility of their articles in *closed* (subscription) journals. This idea was later refined by David Prosser [4]. According to the hybrid OA model, subscription journals give the alternative to authors to pay APCs, if they wish their work to be immediately available to the public. As most of the publishers' income comes from subscriptions and APCs, they promote hybrid journal model as the best and more viable solution for the transition to pure Gold OA journals. Nevertheless, hybrid OA is considered by many to be the worst of both worlds [1], [5], creating an expensive model [6], that results in the *double-dipping phenomenon*, thus making this model unacceptable to many APC budget holders, over half of whom limit spending to fully OA journals [6], [7]. On the other hand, APCs proponents consider hybrid journals an intermediate step towards to pure Gold OA journals where all contents are openly accessible to people, with APCs paid by authors and no subscription fees paid by libraries [8].

From the above discussion, it becomes evident that the landscape of scientific publishing and the perspectives of a broader access to researcher's work are in a transition phase. The transition is expected to last years, without any clear indication of the resultant new publishing model. Additionally, an essential prerequisite for a successful transition is the cultural change of the involved research community. Authors need a strong motive to fully embrace the principles of the Open Access movement and to subsequently contribute to the development of a new publishing model. Many factors, including research output evaluation metrics, social media and academic networks, seem to affect scientists' attitudes and need to be investigated and given serious consideration before planning a strategy for the smooth change to the new era of scientific publishing.

In this context, the present research attempts to identify the attitudes and perspectives of academics and professionals within medical and health sciences, towards the new landscape that is being formed for publishing and how they are evaluating and disseminating their research. More specifically, the objectives of this survey are to profile medical and healthcare researchers' attitudes towards hybrid journals, in terms of potential citations, research progress, publication time, evaluation objectivity, APCs and funding. Additionally, the medical and healthcare researcher's behaviour is being investigated towards social media and academic networks' use in research dissemination and certain criteria (including alternative metrics) for the research evaluation.

Comparing the results of the presented survey with the results of similar studies, show that the Greek medical

community shares the same attitude characteristics as their colleagues at international level.

II. RELATED WORK

According to **Pool's research (2016) [9]**, 64% of 6.679 academics would be satisfied with the replacement of the existing subscription model with an OA, where the research results would be accessible to the public, increasing the impact and readability levels of the research in question. However, scientists appear to be confused and skeptical towards the option to publish in Open Access journals. Although they recognise the advantages of the OA, at the same time they do not seem to have an in-depth understanding of its fundamental principles [10], [11], [12]. They are cautious about the impact of open access publication on their scientific community and whether this will affect their future intentions to publish in freely accessible media [13], [14].

Moreover, the authors' charges for being included in hybrid journals are quite high, and therefore libraries often complain to the publishers, asking for lower prices, including the cost of their subscriptions. In comparison, organisations make deals known as *offset deals* to ensure lower prices [9]. In developing countries, scientists disagree with the APCs, because they believe that research has a significant social value. Therefore, research output should be considered common property and for the good of the public [15]. In recent studies, high cost is highlighted as a potential obstacle to OA publishing for authors and institutions that cannot afford to pay the imposed fees [16], [15], [17]. OA was initially adopted in developing countries because scholars in these countries had the opportunity through OA to get their work seen by scholars from around the world, something that would otherwise not have been available [18].

In Health Sciences and Medicine (HSM), compared with Social Sciences and Humanities (SSH), scientists think that APCs are reasonable because the publication of their articles is more likely to be funded by the organisation for which they work, or by other institutions [19], [14], [15]. A recent study shows that the scientists who manage to get published in the top medical journals are mostly older, work as academics, have the time and financial support. Also, English is their native language [20]. Consequently, older scientists trust their professional experience acquired over years and the traditional peer-review system of subscription-based journals [13]. To some extent, this can be justified by the fact that senior health scientists managed to gain recognition long before the emergence of the OA movement [15]. Unlike older scientists, younger ones are more positive towards technological developments and more open to collaborative networks to increase the number of their citations [10]. The main reason for this is that in an extremely competitive environment, where the paper production is intensive, professional recognition depends on scholarly publishing [21], [13]. Moreover, health scientists seem to connect Open Access only with APCs, and they

⁴ <https://doaj.org/faq#fees>

hesitate to publish their work in pre-prints repositories [19], [22]. Nevertheless, COVID-19 pandemic has profoundly affected health researchers' publication behavior as they use more pre-prints option to communicate their work early and broadly (Preprints and Rapid Communication of COVID-19 research⁵).

Despite the ever-growing number of social networks and their high usage rates, scientists use social media mostly to maintain an online profile, make themselves and their research outcomes more discoverable and find posted work, rather than strengthen collaborations and social interaction [23], [24]. They believe that social networks can harm their career and do not consider them to be trustworthy media. Therefore, they keep a conscious distance [25]. Notably, younger scientists are more cautious about participating in social media because of their continuous professional anxiety due to tenure-track positions searching. Senior scientists, on the contrary, feel more confident using social networks [25], [26], [27]. Procter et al. [28] also mentions that it is mostly male senior scientists who use social media for dissemination purposes. Moreover, significant heterogeneity and inconsistencies of altmetrics measurements and values along with the gaming and commercial characteristics which give to research activities [29], question the reliability of the results [30], [31], and can be misleading in the world of science. It is worth mentioning that journals widely utilise social media for dissemination. It is reported that top medical journals have Facebook and Twitter presence [32]. A large number of journals ask for authors to provide abstracts suitable for the social media (e.g., Twitter), to promote their work [33] or encourage them to participate actively in Wikipedia [34], [35]. Additionally, clinical surveys, systematic reviews and meta-analysis receive a large number of tweets, because their context is attractive to the public [36].

To conclude, openness emphasises the social and political aspect of science and manages to transform scientific knowledge for the good of the public, so that is transparent and creatively usable by everyone. In the field of Health Sciences and Medicine, in particular, there is an urgent need for the benefits of OA principles to be highlighted because of the intense pace of research publications, the continuous discovery of drugs and therapeutic methods, especially during emergency periods (e.g. pandemic events such as COVID-19). The progress in medical research and the new scholarly communication and publishing models have a direct impact on public health services improvement and society in general. Therefore, it is crucial for scientists to understand the principles of the OA movement in depth and to implement them beneficially for their research, taking advantage of the technological developments.

III. METHODOLOGY

For investigating the effect of the new publishing, dissemination and evaluation research models on the health sciences and medicine researchers' attitude, a quantitative

survey was conducted based on a structured questionnaire, which is divided into the four sections accompanied by the corresponding questions (See Appendix A).

The questions were inspired by similar surveys such as Taylor & Francis 2014 [37] and Vlachaki [38]. The main difference with this survey compared to similar ones is that it focuses on a particular scientific field, health sciences and medicine and the community of Greek health professionals and researchers. No such survey has been reported in recent years in Greece reference health professionals' attitude towards Open Access movement. There is value in assessing health professionals' attitudes towards the new models of scientific publishing, dissemination and evaluation because of this community's extremely active publishing profile. The population sample to which the survey was addressed consisted of academic doctors, doctors in the National Health System (NHS doctors), medical residents, nursing and paramedical staff, postgraduate medical students and health sciences and medical researchers. The survey participants were or continue to be related to the General Hospital of Athens "Hippocraton". The population sample is considered quite representative because of its high diversity since it includes a variety of personnel categories and its high mobility since quite of the participants move to other public or private hospitals around the country. The results of the present survey can be a starting point for research in all hospitals in national level or in other scientific fields and will allow useful conclusions and considerations about OA potentials in international level.

Concerning the types of questions and the calculation of the results, the answers for the first part (Part A - Hybrid Journals) were based on the psychometric Likert scale, which is often used in structured protocols such as questionnaires, for the evaluation of population attitude or opinion. There was a restriction to 4 instead of 5 answer selections which are commonly used, to achieve more concrete results by minimising the *fence-sitter phenomenon*, meaning to prevent respondents to take the easy way out rather than really express their real opinion. For Part B a simple multiple-choice question was used, allowing participants to select the social media and academic networks in which they did or did not participate, or those that they would like to use in the future. For Part C and D (Decisive factors for the evaluation of research - Publishing outlet selection factors), ranking type questions were used. For each factor included in the questions, the following statistics were calculated per professional category, years of professional experience and gender.

- **Ranking Score** (RS - low ranking score = high importance): is calculated by the following equation: $x_1 * w_1 + x_2 * w_2 + \dots + x_n * w_n$, where x is the number of answer choice and w the weight of the ranked position (in our case, for the Part C with 6 factors the #1 choice has a weight equal to 1, #2 choice has a weight equal to 2, etc.).
- **Mean Ranking Score** (MRS): is calculated by the following equation:

⁵ <https://asapbio.org/preprints-and-covid-19>

$$\frac{RS}{\text{total count of responses}}$$

- **Ordinal Ranking Score (ORS)**: is the order values (1st, 2nd, 3rd, etc.) of a factor based on the Ranking Score in ascending sorting (from lower to higher).
- **Min-Max Normalised Ordinal Ranking Score (MMN-ORS)**: is a rescaling method and is used for a more accurate results representation as far as concerns the Ordinal Ranking Score values and its calculation is based on Ranking Scores. The following formula provides the needed values.

$$MMN - RS = a + (RS_i - \min(RS))(b - a) / (\max(RS) - \min(RS))$$

where *a* and *b* are an arbitrary set of values for the rescaling (e.g. for the Part C list with 6 items *a* = 1 and *b* = 6), *RS_i* is the ranking score for an item and *min(RS)* and *max(RS)* are the minimum and maximum ranking scores for all items.

It was regarded as necessary to implement a pilot of the questionnaire aiming to collect useful observations and comments. Next, the questionnaire was sent electronically through the Lime Survey platform, except for a few cases where it was completed manually by the participants. It is worth mentioning that the questionnaire was accompanied by the appropriate text, which ensures the confidentiality of participants' data.

As soon as 215 completed questionnaires were gathered in January 2020, data processing began. Table 1 depicts the demographic characteristics of the population sample (professional category, years of professional experience and gender). The completed questionnaires represent 51% of the 425 people in total, which ensures the validity of the survey.

Table 1. Population sample - demographic characteristics

Professional category	#	%	Years of prof. experience	#	%
Academic doctors	42	19,5%	1 to 10	50	23,3%
NHS doctors	107	49,8%	10 to 20	88	40,9%
Nursing	24	11,2%	20+	77	35,8%
Paramedical staff	10	4,7%	Male	105	48,8%
Other	32	14,9%	Female	110	51,2%
Total	215				

IV. RESULTS

In the first section of the survey (Part A) entitled as *Hybrid Journals*, participants were asked to define their position regarding hybrid journals' debate topics. In particular, they were asked to choose between agree, somewhat agree, somewhat disagree or disagree (according to the Likert scale) with statements such as (a) the positive effect on citations number for publishing OA articles in this type of journals (Q1 & Q2), (b) the time needed for an article following the APC model to be evaluated (peer review process) and published (Q3), (c) the impact of hybrid-journals' publishing model on the research process and scientific advancement in general (Q4), (d) the economic burden that APCs place on authors or research institutions and the funding options (Q5 & Q6) plus (e) the impact on the quality of the peer review process (Q7).

Based on the results depicted in Figure 1, most participants expressed their agreement (Q5 - 88% agree and somewhat agree) with the opinion that publishing in hybrid journals has a high cost for the authors (APCs). It is essential to point out that participants agree that an open article published in a hybrid journal will probably receive more citations compared to a Toll-Accessed (TA) article or an article deposited in a repository of pre-prints (Q2 - 84% agree and somewhat agree). Moreover, the participants align with the idea that hybrid journals substantially contribute to the research process and scientific advancement (Q4 - 77% agree and somewhat agree). Most participants also agree that articles published in hybrid journals would receive more citations, as they combine advantages of the subscription journals and the OA benefits (Q1 - 77% agree and somewhat agree). With a lower score but still above 70% of participants approve the statement that in hybrid journals time for the peer review process and publishing is shorter for articles that follow the APC model (Q3 - 75% agree and somewhat agree). They also recognise that the APCs are too high for authors to pay without support from funders (Q6 - 71% agree and somewhat agree), and because of the financial incentive, there is a significant chance that objective and valid evaluation procedures might not be followed (Q7- 71% agree and somewhat agree). Finally, no differences were observed compared to the overall results based on demographic characteristics of the population sample such as professional category, years of professional experience and gender.

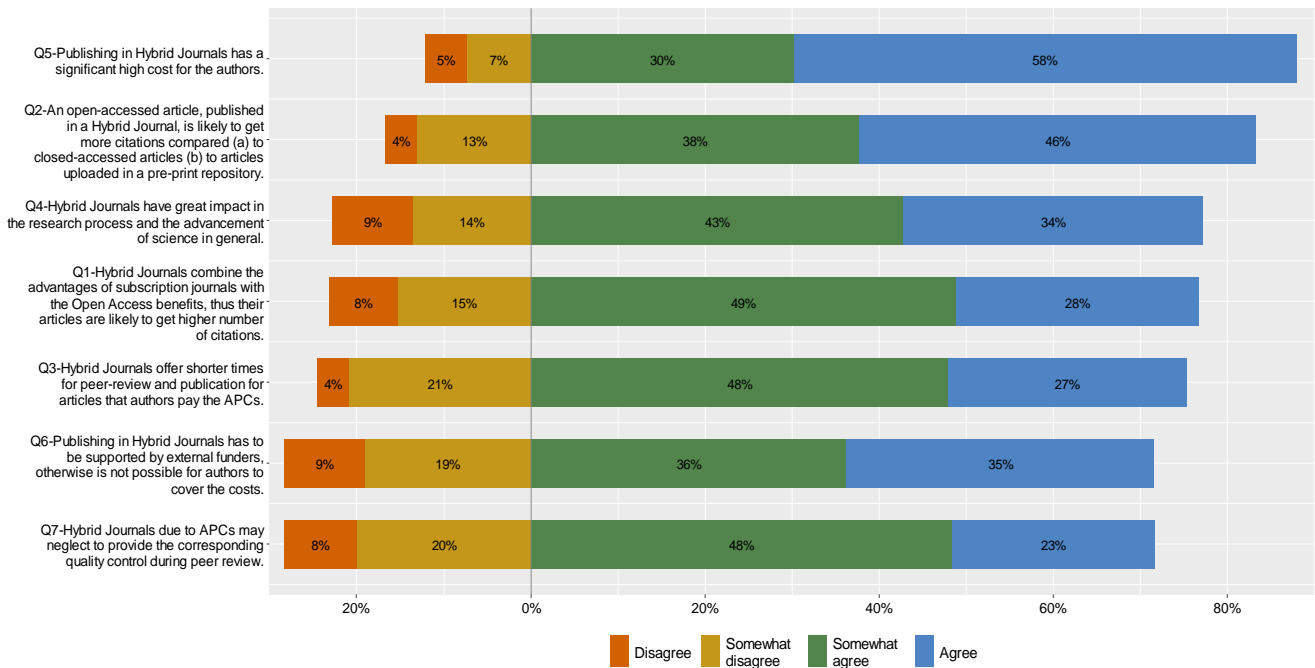


Figure 1. Hybrid Journals

The next question aims to determine the level of participants' engagement in social media and academic networks websites as new trends for the dissemination of their research activities. Figure 2 clearly illustrates that most of the participants use or would like to use ResearchGate (53% use - 17% would like to use) and Google Scholar (48% use - 17% would like to use) services. It is worth mentioning

that 73% of Academic doctors already use ResearchGate compared to only 48% of the NHS doctors. Social media such as Facebook (16% use - 7% would like to use), Youtube (11% use - 13% would like to use) and Twitter (7% use - 10% would like to use), were considerably low in participants' responses both in terms of current participation, or the possibility of its use in the future.

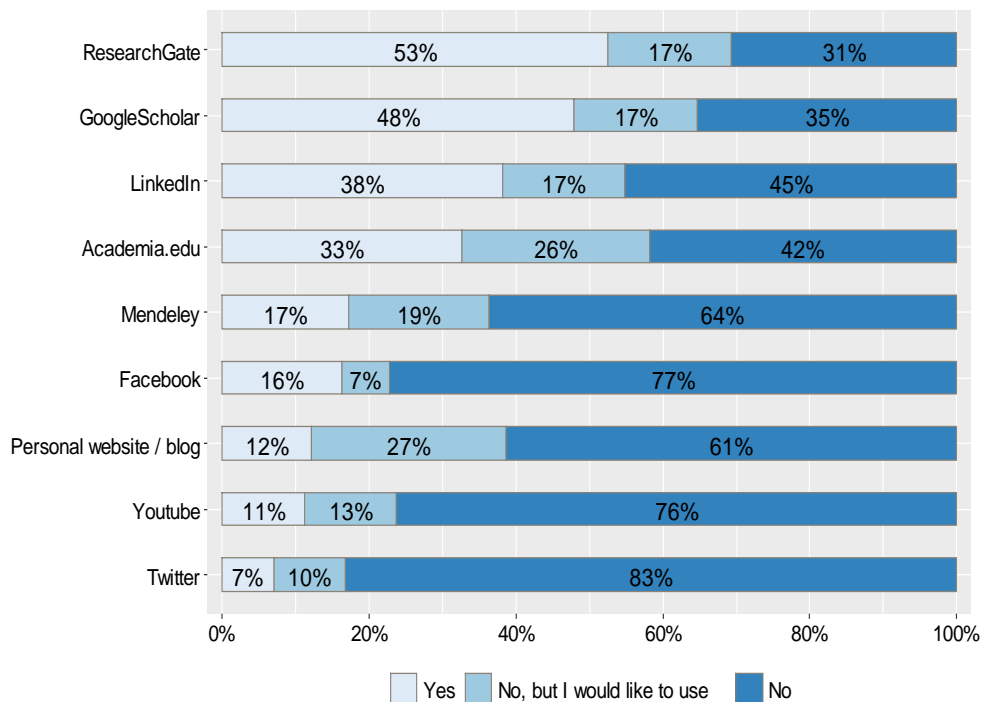


Figure 2. Social media and Academic Networks participation

In the third section (Part C), participants were also asked to rank in order of importance, decisive factors for the evaluation of their or other colleagues' research. Traditional (the number of publications, citations, the impact factor of the journals that a researcher publishes, the author's h-index) as much as social media factors (e.g., views, downloads) were included in order to trace the acceptance level of social media and academic networks by the participants.

In Figure 3, the stacked chart depicts the percentage of ranking choices per factor (e.g. 1st, 2nd, 3rd etc.). Also, in Table 2 the RS, the MRS and the ORS values for all participants are presented. Also, the Min-Max normalised Ordinal Ranking Score (MMN-ORS) has been calculated for all participants and per professional category, years of professional experience and gender. The colour index in column ORS is applied to the rest of the table's columns. As it can be seen by the results, the most important factor for the research evaluation is the number of publications (MMN-ORS value 1). The total number of citations and the researcher's h-index follow in second and third place, with MMN-ORS values 1.1 (very close to the number of publications) and 1.7, respectively. The impact factors of the journals is ranked as 4th with the normalised ranking value equal to 2.2. Last in the ranking list appeared the two factors related to altmetrics such as views/downloads and mentions

or citations in social media with scores 3.9 and 6, respectively. It is apparent that traditional factors got remarkably similar ranking values (as the min-max normalisation method helped to prove), and as expected they dominate over altmetrics.

Participants' responses combined with the demographic characteristics, revealed a few differences that are worth mentioning and are illustrated in Table 2 by the colour index that is being used. In particular, the paramedical staff ranked first in order the number of citations and the h-index. The impact factors of the journals came third and the number of publications followed in the fourth place. Moreover, academic doctors considered the impact factors of the journals to be as important as the number of publications and the doctors of the National Health System gave priority to citations, instead of the number of publications. Moreover, nursing staff ranked impact factors of the journals higher than the h-index. Regarding gender, women appear to think that the number of citations is equally important along with the number of publications. As far as professional experience is concerned, participants with 10-20 years of experience consider the number of citations as the most important factor for research evaluation, whilst those participants with more than 20 years of experience rank as the third most important the impact factors of the journals they publish their work.

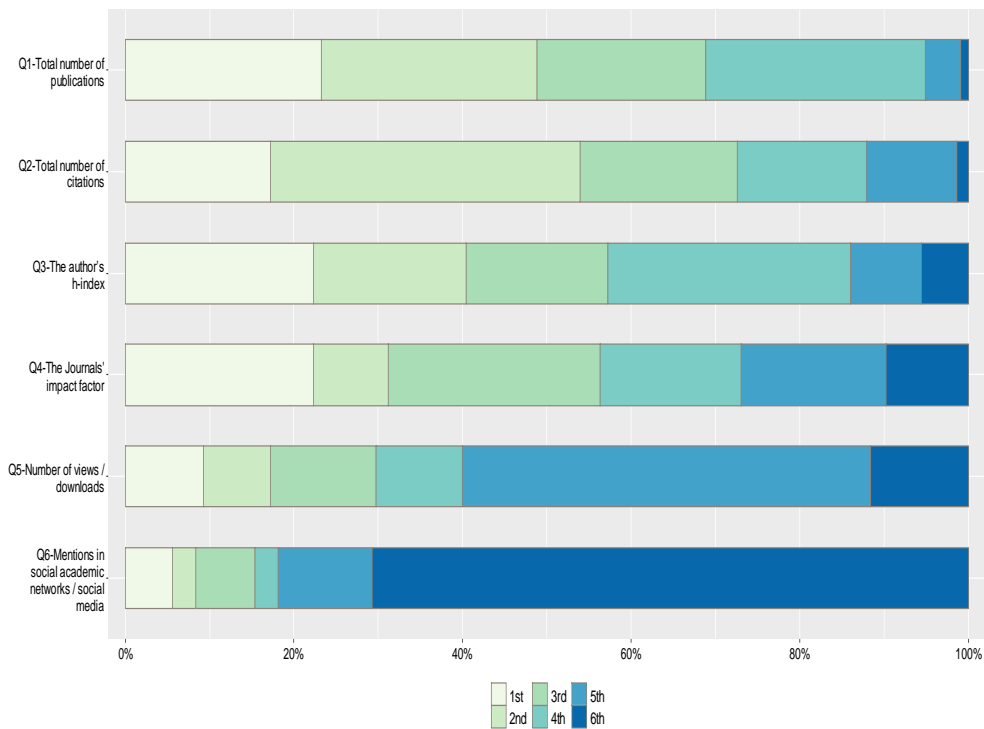


Figure 3. Decisive factors for the evaluation of research

Table 2. Part C Statistics (RS, MRS, ARS for all responders and MMN-ARC values per category, years of professional experience and gender)

	All participants			Min-Max normalised Absolute Ranking Score									
	RS	MRS	ORS	All	Acad. Doc.	NHS Doc.	Nurs. Staff	Par. Staff	1-10y	10-20y	>20y	Male	Female
Q1. Total number of publications	570	2,7	1 st	1,0	1,0	1,1	1,0	1,6	1,0	1,2	1,0	1,0	1,0
Q2. Total number of citations	580	2,7	2 nd	1,1	1,3	1,0	1,5	1,0	1,3	1,0	1,4	1,2	1,0
Q3. The author's h-index	644	3,0	3 rd	1,7	1,4	1,6	3,5	1,0	1,3	1,7	2,2	1,4	1,9
Q4. The Journals' impact factor	703	3,3	4 th	2,2	1,0	2,7	3,2	1,3	2,6	2,4	2,0	2,0	2,4
Q5. Number of views / downloads	893	4,2	5 th	3,9	4,0	3,8	4,0	4,7	3,8	3,5	4,7	3,8	4,0
Q6. Mentions in social academic networks / social media	1125	5,2	6 th	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0	6,0

In the last section (Part D), participants were asked to rank the most important criteria for publishing outlet selection. As derived from Figure 4 and Table 3, the prestige and credibility of the publishing media seem to play a crucial role. In other words, the journal reputation dominates researchers' viewpoints when it comes to publishing their work (MMN-ORS value 1). The short peer review and publication time and a trustworthy evaluation system are also essential criteria for the researchers and this element

therefore took the second (MMN-ORS value 2.8) and third position (MMN-ORS value 3.6) in their final ranking. Furthermore, researchers evaluate higher the importance of including the scientific journals, they publish their work, in major citation indexes (MMN-ORS value 4.1) compared to supporting open access (MMN-ORS value 4.8) or open peer review processes (MMN-ORS value 5.5). These results somehow contradict their views that open access offers lots of benefits, as was illustrated from the results of Part A.

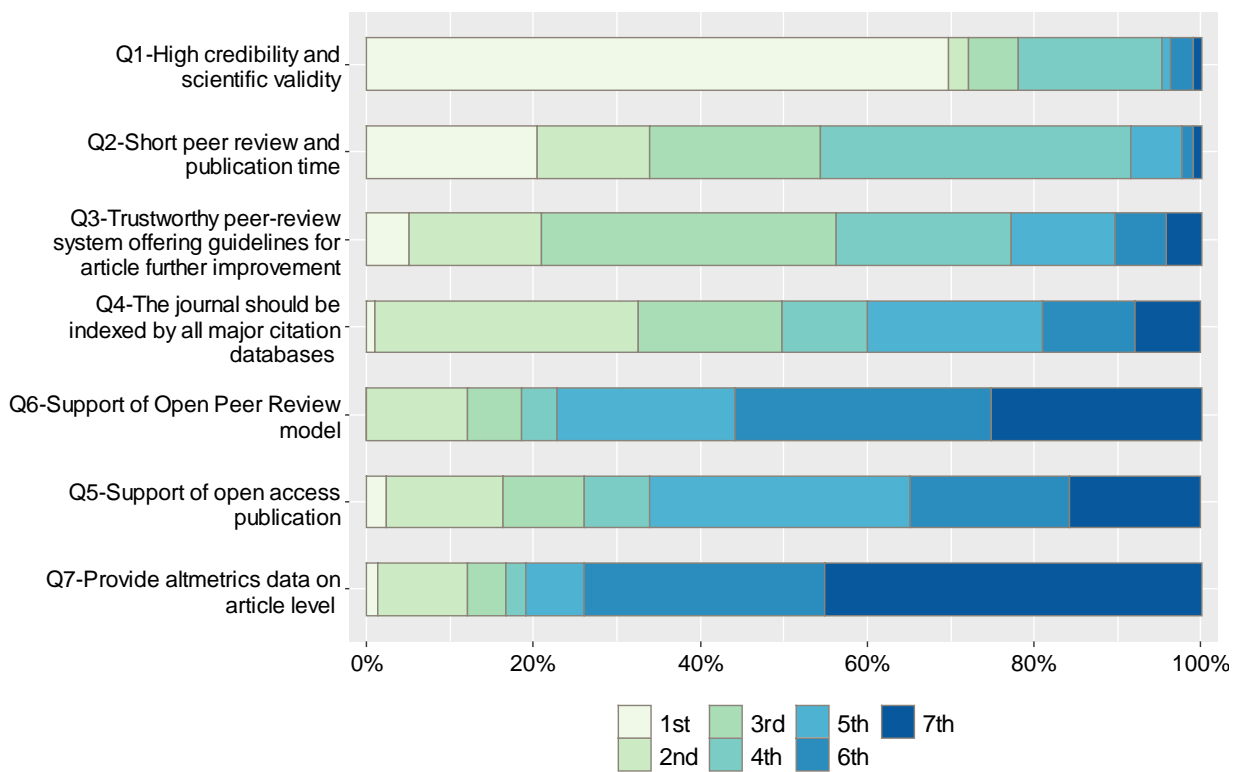


Figure 4. Publishing outlet selection factors

Table 3. Part D normalised final ranking values per category, years of professional experience and gender

	All participants			Min-Max normalised Absolute Ranking Score									
	RS	MRS	ORS	All	Acad. Doc.	NHS Doc.	Nurs. Staff	Par. Staff	1-10y	10-20y	>20y	Male	Female
Q1. High credibility and scientific validity	407	1,9	1 st	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Q2. Short peer review and publication time.	651	3,0	2 nd	2,8	2,4	2,8	3,2	3,8	1,7	2,9	3,1	2,6	3,0
Q3. Trustworthy peer-review system offering guidelines for article further improvement.	763	3,5	3 rd	3,6	2,8	3,7	3,9	4,5	3,0	3,6	3,89	3,4	3,7
Q4. The journal should be indexed by all major citation databases	825	3,8	4 th	4,1	2,6	4,5	5,0	3,6	3,6	4,4	3,9	3,9	4,2
Q5. Support of open access publication	1015	4,7	5 th	5,5	5,2	5,6	5,5	5,2	5,7	5,2	5,7	5,3	5,6
Q6. Support of Open Peer Review model	1134	5,3	6 th	6,3	6,5	6,3	5,3	5,6	6,3	5,9	6,9	6,5	6,2
Q7. Provide altmetrics data on article level	1225	5,7	7 th	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0

In common with Part C, this part of the survey (Part D) shows that altmetrics is considered to be the least important factor when selecting publishing media. Finally, the responses combined with the demographic data did not conclude to any noteworthy differences compared with the total results.

V. DISCUSSION

Most of the findings in the present survey are aligned with the outcomes of similar research efforts, as discussed in the introduction section. Going deeper into the analysis of the results, it became evident that participants generally did not have any negative attitude towards hybrid-journals, except for the APC issue (Part A – Q5 and Q6). They seem to believe that OA articles in hybrid journals may get higher number of citations (Part A - Q1 and Q4) as a result of the already established reputation of the publication outlet. Also, they positively respond to the statement that the peer-review process is of shorter duration when APC model is followed (Part A – Q3). Further, they agree that authors, through hybrid journals, contribute constructively to the science and knowledge progress (Part A – Q3) and at the same time, they accomplish higher levels of credibility and reputation for themselves [39]. The OA papers’ citation advantage (OACA) [40], [41], [42] is being supported by a large number of studies that prove their higher visibility [43], [44], [45], [46]. Nevertheless, the majority of high impact journals follow the subscription model, indicating authors' preferences for them. In the minds of authors, hybrid journals combine the already established reputation and high-quality characteristics of the prominent, traditional publications with the option that articles can be accessed through APCs [47].

The rooted selectivity of healthcare professionals (maybe stronger than in other disciplines) to publish in prestigious subscription journals with high credibility and scientific validity (Part D – Q1) combined with their views that the total number of publications/citations and the researcher’s h-index (Part C – Q1, Q2 and Q3) are the most decisive factors for the evaluation of their work [48], [49],

[50] partially justifies their positive attitude towards hybrid journals. As Sotubdeh et al. [43], indicates, the selectivity of the authors in choosing the author-pays outlet to publish their high-quality papers, signifies the overall prestige of the OA papers published in the model. However, the present survey revealed that 71% of them agree with the opinion that due to the financial incentive, there is a high probability that the evaluation process is less strict when the APC model is followed (Part A - Q7). Besides, Zhang and Watson [51] reinforce the above conclusions by reporting clearly in their survey the low average impact factor of free open access journals and the much lower citation rates compared with open access journals, APC or subscription journals and confirm once again the dominance of journal prestige and quality factors when researchers select a publication outlet.

Regarding academic, social networks and social media usage, the same motivation is cited as for the aforementioned OA scientific publishing. In particular, scientists create accounts mainly for increasing profile visibility, posting and accessing papers and information consumption instead for active online discussion, collaboration, or a more convenient form of reference management [23], [52].

Nevertheless, there is a high level of awareness of academic networks such as ResearchGate, LinkedIn, Academia.edu, Mendeley etc, mainly due to the substantial number of documents uploaded by users, especially for ResearchGate [24], [23]. The response results in Part B of the questionnaire are reinforcing all the above factors by reporting that most of the participants use or would like to use ResearchGate (70%) while the Academia.edu, LinkedIn, and Mendeley received substantially lower usage percentages (e.g., Mendeley with 36% had the lowest usage). This could be interpreted partly by participants' ignorance of the new academic networks and the researchers' cautiousness towards them. It is reported that researchers from the hard sciences – engineering and technology, medical and health sciences and natural science – experience it as *spamming* and a *waste of time* or as a considerable barrier under the tenure gun [25], [27]. It is

worth mentioning that the Google Scholar high usage percentage (65%) in this survey could be justified by the fact that scientists in Health Sciences and Medicine are using Google Scholar for biomedical papers retrieval on a regular basis and for the variety of scientific literature types offered [53].

In the US there is clearly a growing use of social media (YouTube, FB, Twitter) among healthcare professionals. Unlike in Western Europe, social media usage remains quite small except for in the Netherlands and the United Kingdom. It specifically grew from 2009 to 2011 via networks such as FB (from 10% to 67%) and YouTube (from 2% to 19%) [54]. Additionally, over 2000 healthcare providers have active Twitter accounts [55]. However, Joung et al. [56] also discovered very low levels of social media and social scientific networks usage by healthcare professionals, which is in alignment with the very low rate responses for Twitter (17%) and YouTube (24%) and the moderate usage of the other academic networks reported in the present survey.

VI. CONCLUSIONS

The traditional factors (citations, authors' h-index, journals' impact factors) along with the publication time and the trustworthy peer review process appear to be the most important criteria in scientists' minds when it comes to publishing, disseminating and evaluating their work. Regardless of demographic characteristics (professional category, years of professional experience, gender), last in the ranking for evaluation and publishing outlet selection are the usage of metrics (downloads, views) and the altmetrics (mentions in academic networks / social media).

It is rather apparent that the beneficial use of the OA concept from publication models to social and academic networks remains *foggy* and still has not reached the desirable levels of trust. Although scientists seem to recognise the benefits deriving from OA, as revealed in the first section of the survey, they mainly focus on how to increase the number of citations, their profile recognition or to publish more, obviously because of the tenure, or career promotion pressure. It is also necessary to outline that scientists (including health professionals) seem to ignore or to avoid using the Green OA model since they hesitate to publish their work in pre-prints repositories [19], [22]. Therefore, more informative guidance has to be provided on research into the distinctive differences among OA models [57].

For the establishment of a new framework of scientific dissemination and evaluation, the career development process should be radically reformed to *unchain* scientists from publishing overload anxiety. Specialised OA training courses, webinars, educational seminars and workshops organised and offered by libraries could be a valuable solution for scientists to adopt a more holistic perspective about the beneficial use of OA models, thus boosting the research advancements and scientific progress. Moreover, the large number of users registered in

social media and academic networks could affect the way that research outcomes are communicated to society and give a more interdisciplinary, revolutionary and inclusive character of science.

Conclusively, a high priority issue is the establishment of an interactive collaboration among policymakers, researchers, publishers, and funders, through the OA communication channels, thus contributing positively to the Open Science goals which appear to form the new framework for scientific communication and publishing at an international level.

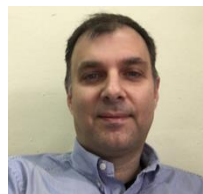
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Computer-Assisted Translation of Egyptian-Coptic into Greek

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Abstract:

Purpose - The Coptic language is the final evolutionary stage of Ancient Egyptian, firstly attested in the 1st century CE (Old Coptic) until the 16th century CE, which survives nowadays as the liturgical language of the Coptic Orthodox Church. Egyptian-Coptic had been transliterated through the alphabetization of written Egyptian, based on the Greek script. In this work, the designing of a software tool is presented, for the computer-assisted learning and translation of Egyptian-Coptic into Greek.

Design/methodology/approach - The software design herein emphasizes the ability of processing inscriptions on artifacts through a simple interactive interface for its usage by Greek-speaking scholars of Humanities, having just essential familiarization with computers. For this purpose, a model of processing has been selected, based on an existing software tool for other ancient languages, which is being currently modified for processing Coptic scripts.

Findings - Especially in Greece, several museums and institutions preserve known manuscripts and artifacts of this language and art. Besides the large number of Coptic corpora (gospels and scriptures), a significant and historically important part of texts is found on Coptic artifacts, being difficult to be automatically processed, especially in a Greek context. Considering the above issues, it had been decided in the research project to implement a semi-automated approach, which will allow the user to choose the processed unit, whether this will be smaller, equal or larger than word, following a word-by-word computer-assisted translation into Greek.

Originality/value - Considering the cultural importance of Coptic, they create a continuous of almost 5000 years of written sources in Egyptian language, with an undisputable value in the diachronic history of languages, and prove the unsurpassed cultural relationship between the Ancient Greek and Egyptian civilizations. Therefore, the development of the presented software application aims at further facilitating the Greek-speaking researchers and scholars of Coptic to study this language in depth.

Index Terms - computer-assisted translation, Coptic, Egyptian, cultural heritage digitization, cultural informatics applications, software for ancient language translation.

I. INTRODUCTION

The Egyptian-Coptic script is the final phase of the long-standing evolution of the Ancient Egyptian language, one of the oldest written languages of the world, which appeared since the 33rd century BCE, belonging to the Afro-Asiatic (alias Hamito-Semitic) family of languages [1]. These evolutionary phases had been [2, 3]:

- The Old or Archaic Egyptian (2600 - 2100 BCE), found on the monumental inscriptions of the Ancient Kingdom (e.g., at the Pyramids), and having two writing systems with a parallel function and appearance developed: the hieroglyphic and the hieratic script; the latter being a simpler form of the former.
- The Middle or Classical Egyptian (ca. 2100 - 1300 BCE) that mark the classical phase of the language, during the Middle Kingdom.
- The Late Egyptian (ca. 1300 - 600 BCE) that differed particularly in grammar, also having many linguistic loans of Semitic, Hittite and African origin.
- The Demotic Egyptian (ca. 650 BCE - 300 CE) of the Late and Greco-Roman periods, when significant changes happened in the structural function of the language, due to foreign linguistic influences; the corresponding writing system that appeared around 650 BCE is the evolution of Hieratic, it is read from right to left and lasted for about a thousand years [4]; therefore, it coexisted with Coptic during the last three centuries of its existence; Tomas Young [5] firstly concluded that this script is a mixture of alphabetic and hieroglyphic signs, in his attempt to decipher hieroglyphics.
- The Coptic (300 BCE - 1500 CE), which is the last phase of the evolution of the vernacular language, with the simultaneous use of the Greek alphabet; the grammatical rules of the Late Egyptian had been generally retained along with an important part of the Egyptian vocabulary, containing Greek and other words of Pharaonic origin; nowadays it survives as the liturgical language of the Coptic Orthodox Church, written in an alphabetical script.

A. The Coptic Language

Since 332 BCE, Egypt was conquered by Alexander the

Great, and consequently the language of the conqueror (i.e., Greek) became the standard one for the documents of public administration, instead of Egyptian. Since the end of the 1st century CE, when the Christian religion had started spreading in the Eastern Mediterranean, those Egyptians who followed Christianity seemed reluctant to use the Demotic Egyptian script for writing their sacred texts, because it had a direct connection to the former pagan religion. Therefore, they preferred to transliterate the Egyptian language by using the letters of the Greek alphabet, thus creating the Coptic script. Coptic became the dominant way of writing for secular and sacred texts, by the 5th century CE.

The influence of Greek in the creation of the Coptic language was decisive, being evidenced by the number of Greek loans. For example, in the database of Freie Universität Berlin there are 8,000 Egyptian-Coptic entries and 3,250 Egyptian-Greek entries [6]. A wide range of documentary texts from the later Roman, Byzantine, and early Islamic periods are included in the Coptic corpora. They constitute a rich, extensive and original translated Christian literature of particular importance for the early history of Christian monasticism, being considered excellent witnesses of great Gnostic, Manichaean and Hermetic texts [7].

Six distinct dialects and various sub-dialects appear in Coptic. These are [1]: the Sahidic dialect (also known as the “dialect of Upper Egypt” or former Thebaic), the Bohairic dialect (also known as the “dialect of Lower Egypt” or Memphitic), the Fayyumic dialect (or Bashmuric), the Akhmimic dialect, the Lycopolitan dialect (alias Subakhmimic or Assiutic), and the Oxyrhynchite dialect (or Mesokemic). Each dialect comprises a corpus with separate linguistic features and occasionally separate thematic features. Although eventually Coptic was replaced by Arabic, as the language of daily life in Egypt, it remains today as a functional language in the Christian communities of Egypt and the expatriate Coptic communities around the world [1].

B. Artifacts and Objectives

The Coptic artifacts represent an amazing patchwork of cultures, constituting a unique transition from paganism to Christianity and finally to Islam, bringing together the old with the new, so creating an amazing, distinct and holistic identity. Museums and institutions preserve evidence of this language and art. Especially in Greece, known artifacts and manuscripts can be found on display or at archives in four museums (the Byzantine and Christian Museum of Athens, the Benaki Museum at Athens, the Museum of Modern Greek Culture at Athens and the Peloponnesian Folklore Foundation “V. Papantoniou” at Nafplion), the Holy Monastery of Iveron on Mount Athos and the National Library of Greece at Athens.

Coptic scripts can be found in various materials of different durability, such as rocks (limestone), ivory, wood, clay, fabric (silk, linen, wool), and papyri, being difficult to be automatically processed because of their nature. Especially for Greek scholars, digital resources are totally absent.

Therefore, the development of the presented herein software application aims at facilitating the researchers and scholars of Coptic to study this language in depth, by making it easier for them to learn and study Coptic, without being exceptionally familiarized with computers.

II. MATERIALS AND METHODS

The methodology of developing a software tool for the study of Coptic by scholars of the Humanities can be dictated by three factors: the nature of the artifacts to be studied, the features of the particular script and the existing software applications for this purpose. As mentioned previously, the nature of the artifacts varies, having though as a common characteristic that the ability of automated processing of text is rare. The usual scenario is to have a photo of the text on an artifact and then to use a program of pattern recognition, if any, as a first step for its translation. Another way is to have a software tool that may facilitate a computer-assisted translation, word-by-word, i.e., by inserting a word and getting its translation back in a given language. The translation of single words, one at a time, is often useful for texts that can be inscriptions on artifacts, without syntactic cohesion, fragmentary or corrupted. For this purpose, the features of the script have to be studied and the relevant software applications that follow.

A. The Coptic Script

A writing system or script reflects the phonological and phonetic system of the corresponding language. In this respect, although the Coptic script marks the final stage of the ancient Egyptian language, it is not exactly an evolution or a simplification of the previous writing systems (hieroglyphic, hieratic and demotic), since the Egyptians adopted the Greek alphabet, at this stage of linguistic depiction. After the conquest of Egypt by Alexander the Great, in 332 BCE, the influence of Greek vocabulary in Coptic led to the adoption of Greek terminology in administrative affairs and to the progressive integration of Greek words into the Demotic Egyptian (Old Coptic). The spoken Egyptian language was written in Greek characters; therefore, the Coptic alphabet initially reflects the phonological values of the Greek prototype [1]. In addition though, the Coptic alphabet is enriched with eight more signs for representing the consonants that does not exist in the Greek language. Consequently, a script of 32 signs is formed, corresponding to 26 distinctive sounds.

B. Relevant Software Tools

The computational tools for deciphering or translating texts of ancient languages are based on the design of processing software, with the existence and assistance of corresponding lexical databases. For example, there is a unique application developed by Snyder et al. [8], with the aim of automatically deciphering the Ugaritic language, a lost but well-known language classified as Western Semitic of the 14th century BCE, written in a cuneiform alphabet of consonants [9]. Snyder et al. [8] developed here a statistical model of unsupervised machine translation (i.e., without

human intervention), which uses a dictionary of the Hebrew language, due to the affinity of Ugaritic with Hebrew. The results have remarkable decryption accuracy (90.53%), but show that no matter how accurate an unsupervised system is, it still requires some human intervention for the rest of the text [10]. The system of Snyder et al. [8] though is a machine-translation one for a language previously unknown; this is not at all the case herein.

Regarding Coptic, there are several digital resources, mainly databases but also Natural Language Processing (NLP) tools, some notable ones developed by the Koptische/Coptic Electronic Language and Literature International Alliance (KELLIA) Project [11] that indicate the international interest on digital Coptic. These resources of KELLIA Project comprise an online dictionary that includes a virtual keyboard option for entering Coptic characters [12], a treebank with full syntactic annotations, a search engine [11], an optical character recognition (OCR) tool and various NLP tools and services [13] that are being developed for part-of-speech tagging, lemmatization and language-of-origin tagging [14]. Desirable software tools are also a converter of Coptic characters into the Unicode Coptic character set and a tokenizer [14].

C. Processing Issues

Despite the plethora of software resources, presented in the previous subsection (*II.B. Relevant Software Tools*), several processing issues emerge, regarding Coptic. The need for tokenization has been already mentioned because of the agglutinative morphology of Coptic [14], while another related issue is that Coptic was originally written in manuscripts without spaces between words (*scriptio continua*) [12]. These two particular features seriously complicate automated processing, along with the frequent existence of diacritics (such as supralinear strokes or circumflexes), punctuation and abbreviations that require a *normalizer* for further machine-enabled processing [14]. In overall, there are multi-word entries from corpora and units smaller than words for productive derivations and incorporation [12]. Finally, the existing software tools are focused on corpora, without a particular concern of inscriptions on artifacts that may lack syntactic cohesion, can be fragmentary or corrupted, and without providing a translation into Greek, in spite of their immense cultural and linguistic affinity [15].

Considering the above issues, it had been decided in the herein research project to implement a semi-automated approach, which will allow the user to choose the processed unit, whether this will be smaller, equal or larger than word, following a word-by-word computer-assisted translation into Greek. The software design emphasizes the ability of processing inscriptions on artifacts through a simple interactive interface for its usage by scholars of Humanities, having just essential familiarization with computers. For this purpose, another model of processing has been selected

[16], based on an existing software tool for ancient languages [17], which has been successfully used for processing Linear-B script [10, 18] and is being also modified for processing Linear-A script [19].

III. RESULTS

According to the previous decision, the developed software tool consists of three main modules: the Coptic-Greek digital dictionary, the search-engine and the interface. From these three modules only two are visible to the user: the dictionary and the interface; they will be briefly described in the respective sub-sections, below. The search-engine has been implemented in Visual C# computer programming language. It receives a sequence of Coptic characters as input and it returns a matching translation into Greek, along with an accompanied commentary, if any found in the digital dictionary. Otherwise, an appropriate message is displayed.

A. The Digital Dictionary

The Coptic-Greek digital dictionary is a lexical database being implemented as a single spreadsheet file (Figure 1). There, the Coptic words are sorted into lists firstly by size, according to the number of their characters, and then alphabetically in each separate list. This particular setting makes it easier for the search-engine to achieve a faster retrieval. The structure of each list includes three columns: the first one contains a transliteration of the words in Coptic; the second one has the corresponding translation into Greek; the third one contains a commentary on the corresponding Coptic word (e.g., original source, dialect, part-of-speech, etc.). The information contained in the dictionary can be modified or enriched easily, through the spreadsheet application (in this case, the Microsoft Office Excel). The data sources for this lexical database include Coptic dictionaries available both in printed form [20] and online [21-22]. The commentary of their entries is being translated into Greek (by the authors). The initial dataset for testing/validation includes scripts on artifacts and manuscripts exhibited at the *Byzantine and Christian Museum of Athens*, the *Benaki Museum* (Athens) and the *National Library of Greece* [1].

B. The Interface

The application's interface is being designed as a window-screen very simple to use (Figure 2). The entire user-guide is accessible on screen by activating the Help button, first on the right side of the window-screen. The Coptic characters are placed on a virtual keyboard on the left side of the window-screen, in alphabetical order. The users can select the characters of a word by activating the corresponding icons on the virtual keyboard. The sequence of the selected characters is displayed on the central upper text-box (*Coptic Word*).

	A	B	C
1	Coptic	Greek	Comments
2	αιδι	αυξάνω, μεγαλώνω, μεγεθύνω	
3	διογ	ταξιδεύω, πηγαίνω	(πιθανόν), το νόημα είναι άγνωστο
4	δογω	παύω	
5	αβηω	—	άγνωστο νόημα, επίθετο που χρησιμοποιείται για κάποια εδώδιμα
6	αλογ	παιδί, νέος	
7	αιπε	αρχιμανδρίτης	
8	αψαι	πληθαίνω, πολλαπλασιάζω	
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Figure 1. A sample of the digital dictionary.

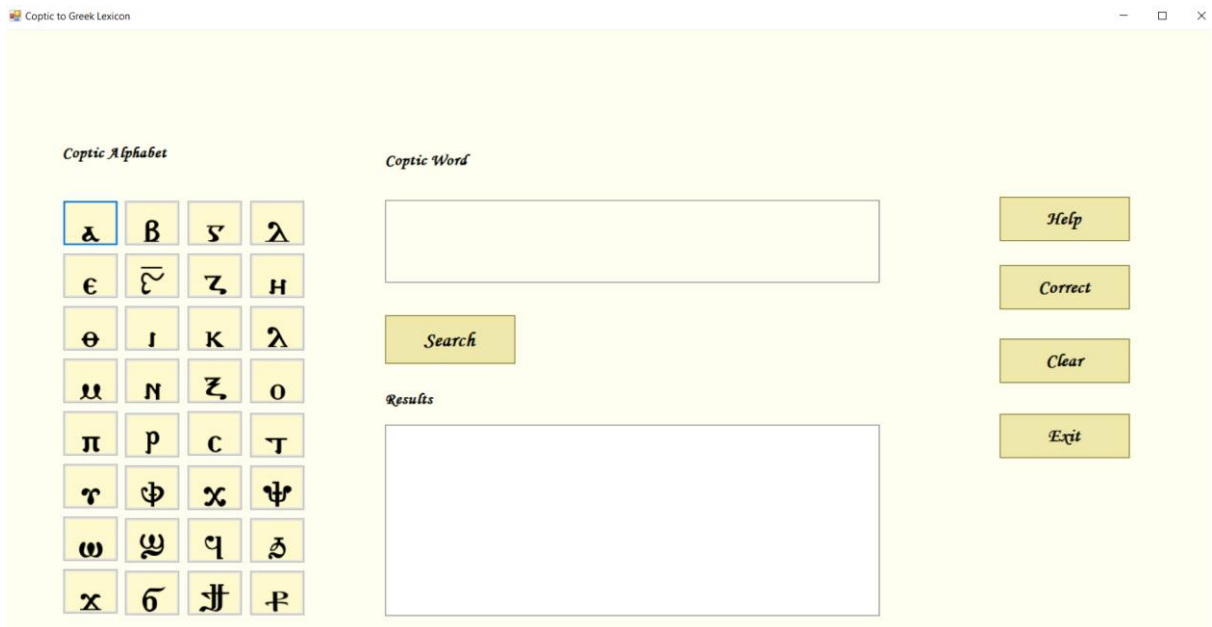


Figure 2. The interface of the software application.

If an icon is selected incorrectly, it can be deleted by activating the Correct button, second on the right side of the window-screen. The search-engine is activated through the Search button, in the center of the window-screen. If the formed word exists in the dictionary, then the Greek translation and the corresponding comments appear in the text-box below the Search button (*Results*), otherwise a failure message is displayed there.

The users can then activate the Clear button, third on the right side of the window-screen, to repeat the search with a new word. Various messages that may appear in pop-up windows inform the user of incorrect/failed actions. By activating the Exit button, last on the right column of the window-screen, the users may close the session and the application; alternatively, the standard “x” button can be used, on the upper right corner of the window-screen. Finally, each translation session is simultaneously recorded

and thus saved in a simple text-file, which can be printed afterwards. In this way, the entire inscription of an artifact can be printed in a translated form, being commented as well, for facilitating both the synchronous and the asynchronous study of the artifact.

IV. DISCUSSION

Regarding the results of linguistic software applications, as presented in the previous section, the more complex the software is, the less supervised the application may be. Systems that translate text from one language (or script) to another (here from Coptic into Greek) can be also considered as computer-assisted translation systems, rather than a standalone application. Here, the human participation is still necessary, in various parts and tasks of the software tool, because language rules or phenomena cannot always be formulated in a computationally

unsupervised manner. The unsupervised processing may work well mainly on manuscripts, yet, it cannot perform adequately in the cases of artifacts, corrupted or fragmentary text that may also lack syntactic cohesion (see subsection II.C. *Processing Issues*). On the contrary, a supervised software tool, like the one presented herein, may also facilitate the teaching/learning of the target-language (i.e., Coptic), as demonstrated in a similar case [18].

In this respect, the current software development process modifies an existing digital platform for translating Coptic into Greek. The development of similar software systems could greatly aid the painstaking efforts of the researchers involved and also contribute to the rescue of the studied artifacts from possible physical damage, through digitization. In addition, the translation, study and interpretation of existing texts, but also the facilitation of reading new ones that may be discovered, are enhanced, since such applications can be supported by rich, recent and explanatory databases, with the ability of continuous enrichment.

V. CONCLUSION

Although Coptic is considered a dead language, its study and digitizing efforts remain undiminished. In Greece, there is a plethora of artifacts, which Coptic script is found on, but the theoretical background for Coptic is poor and the software tools related to this language for Greek are absent. Under the auspices of the University of West Attica, it was deemed necessary to develop a similar software tool, according to the existing methodology related to other non-spoken languages (i.e., Linear-A and Linear-B). This software development is being adapted for computer-assisted translation of Coptic into Greek, in such a way as to meet the complex features of the Coptic language. This software system introduces a digital platform for deciphering, translating and interpreting existing ancient texts by digitizing them, which can be also used for teaching the rendered languages. Therefore, it can become another promising tool for the digitization of cultural heritage, a model of computer-assisted processing of ancient languages, and an aid for the scholar of the Coptic language.

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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 was used 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 Kifissos 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 m³. On the façade, there was the inscription "The emperor Caesar Titus Aelius Hadrianus Antoninus Augustus Pius, holding consular power for the third time, holding tribunitian 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 beforehand, 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 m³ / 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.

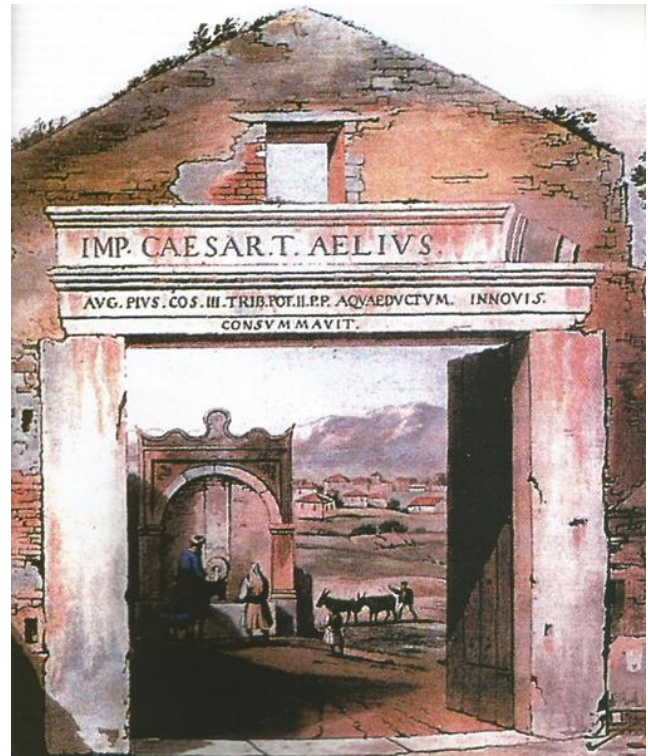


Figure 2. The Mediterranean door or the Gate of Boubounistra in the eastern walls of Athens, as it appears in the size of the wall photograph at the Syntagma metro station. The door was made of the marble from the ancient façade of Hadrian's reservoir.

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 and one 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"

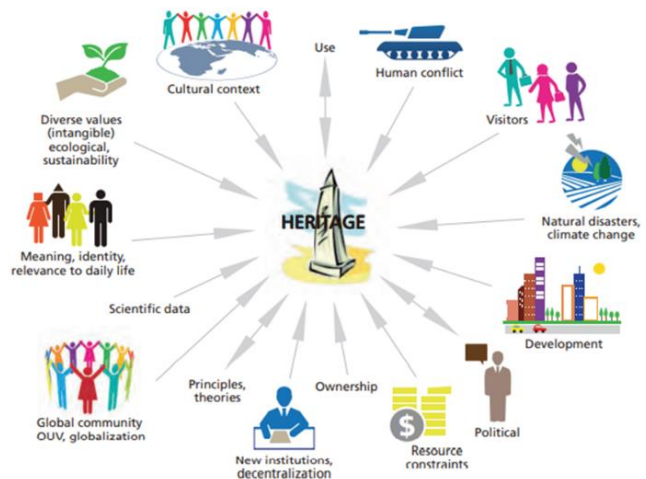
Cultural management: An Introduction

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].

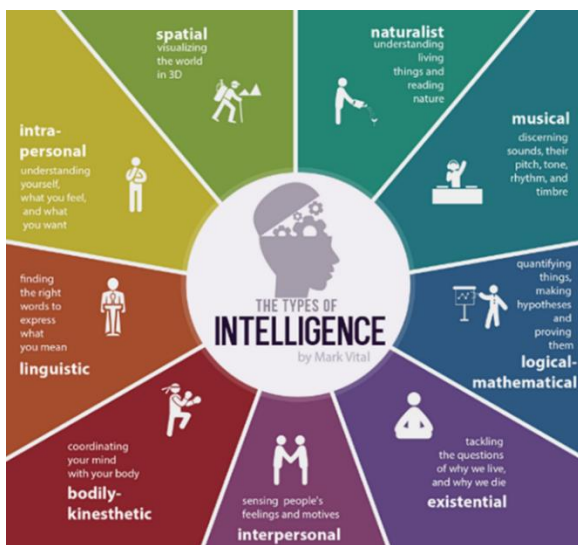
On the basis of the above scheme (Scheme 1), given the value of the monument, and for the purpose of focusing mainly on two parameters – the visitors and the relation of the monument with the community's everyday life – we have designed an educational activity for youth. The activity is based on contemporary 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. high 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 Stymphilos: 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.

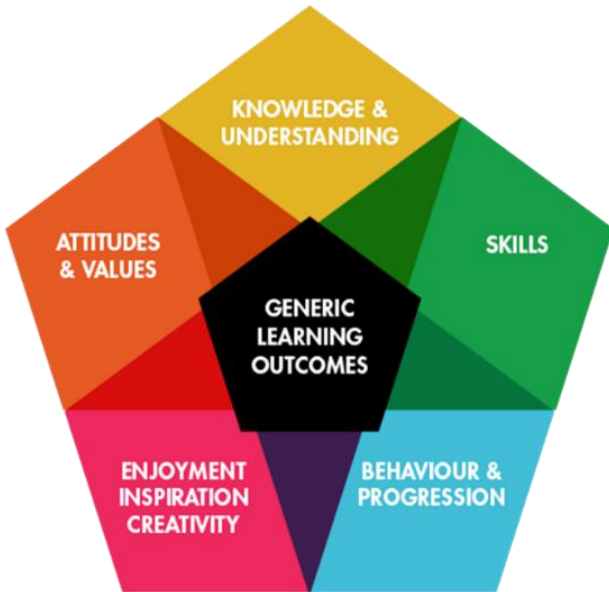
9. Activity completion - feedback

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 Arditos 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 Arditos 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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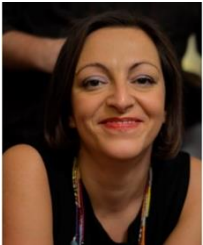
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