Creating and applying a data model for an Augmented Documentation of Cultural Heritage

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Abstract

In the present work we propose a data model to support an augmented type of documentation of cultural heritage, one addressed to the wider public. Since more and more collections of artifacts are being digitized and published on the Web, the way they are presented and their content should also adapt to the audience that now has access to it. We propose that the documentation be extended to include facts about the interpretation of the artifacts and about usually unseen connections between them and between our contemporary lives and the past. The sections of this work describe the process of creating the data model for the augmented documentation, applying it to real-life data and producing the augmented part of the documentation. A short discussion follows about the use of augmented documentation in practice as well as some general conclusions and next steps.

Keywords

data model, cultural heritage documentation, cultural heritage experiences, storytelling

1. Introduction

In recent years, the number of Cultural Heritage Institutions that publish their collections on the Web has increased rapidly. Many of those collections are open to the public. In many cases however, the presented data are not addressed to the wider audience that now has access to them but resemble more closely the documentation created for use within the scientific community. At the same time, there are specialties that could benefit greatly from enriched cultural heritage collections which they could explore and gather information. Teachers, students, authors and cultural experiences designers are some. The augmented documentation is a proposed methodology for presenting enriched cultural heritage knowledge through the documentation of artifacts and archaeological sites or monuments.

In past presentations we had talked about the idea, structure and main goals of augmented documentation [1]. In the present work we dwell into the data model that was created to host it and the steps we followed in order to apply it to real-life data. An account is also given on the

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challenges of producing the augmented part of the documentation and on the potential its use shows.

In the sections that follow we mention works related to our own (Section 2). Next, we briefly describe the concept of augmented documentation, the motivation behind its creation and the requirements for this type of documentation (Section 3) and we make an introduction to our data model(Section 4). After that, a report is given on the various aspects of the process we followed to apply our model to data from the research project Voeska (Section 5). Last, the use of augmented documentation in practice is discussed (Section 6) and a few conclusions and next steps are listed (Section 7).

2. Related work

The idea of reflecting on the past and its connection to our present was central in the CrossCult project, too. Its "reflective topics" played a central part in the ontology that was created and served as the bonds that connect artifacts and events across Europe heritage and as starting points for discovering alternative narrations inside the knowledge web of semantic links that was created [2, 3, 4]. The Narratives in Digital Libraries project proposes the use of narratives as a means to explore digital libraries such as Europeana[1], connect artifacts to concepts and capture the interest of visitors [5]. They developed the "Narrative Ontology" and a dedicated software for creating the narratives. The Agora project introduced the term "digital hermeneutics" and its main goal is to use historical events in order to produce an interpretation of an artifact's historical context. The relationships between objects and events or events between one another are grouped and ultimately create a narrative [6]. Another interesting project is mythLOD. In this project a knowledge graph was created that connects mythological events described in literature to their depiction in artwork from a variety of artists, locations and periods. Cultural heritage experts annotated the artifacts with references to literature pieces that mention the same episode. The links created between artifacts and myths provide an alternative knowledge experience to the users of the provided platforms [7]. Last, the SPICE project introduces Citizen Curation as a way to engage the interest of groups of people that are usually less involved with museum activities [8]. During this project, visitors were guided through the exhibits of a museum by scripts organized according to themes that they could relate to their own lives. Additionally, the visitors could create new scripts for other visitors to follow.

Despite the similarities concerning the ultimate goal, to stimulate the visitors' interest and curiosity, our approach is somewhat different than the described projects, as it will be shown in the sections that follow. The SPICE project's approach seems closer to our own, however our focus lies closer to making alternate views of cultural heritage available in the documentation itself, so that they can later on fuel the creation of any type of experience. For our data model, we chose to build on already developed schemata and keep it simple in order to focus more on developing a methodology for creating the augmented content itself.

[1] https://www.europeana.eu/de

3. Augmented documentation of cultural heritage

The idea of augmenting the documentation of cultural heritage came during past research projects, while observing the advantages that a well-designed narrative or experience offers for fostering public engagement and historical empathy [9] to visitors of cultural heritage sites and museums [10, 11, 12]. The CHESS project[2] [13] focused on the application of personalized digital storytelling as a story-centric, as opposed to object-centric, approach to heritage communication, highlighting the context of the exhibits function. We experimented with the power of digital storytelling and identified the multidisciplinary aspect [14] and the challenges involved in its creation [15]. The EMOTIVE project[3] aimed to enhance the impact of digital storytelling, prioritizing a more direct and affective perspective on the archaeological content - that of the people of the past - and researching designs that promote reflection through sociality and dialogue. To support the design needs of the project, we prepared "interpretation cards" for artifacts that would be included in storytelling experiences [16]. Those cards were created by the content experts and given to the storytelling authors as a form of starting point or source of inspiration. Apart from descriptive characteristics, those cards contained information about the interpretation and importance of the artifacts or their context, connected them with sociological concepts and included two types of questions, questions that may rise from viewing the item and its description and questions to provoke a feeling of reflection over the past life of the artifact and its connection to universal values that are still relevant today. The use of the interpretation cards improved the engagement of the recipients and promoted their curiosity.

3.1. Motivation

The effects that the interpretation cards had in the overall experience of the participants showed us that the documentation of cultural heritage can by itself provide a starting point for the creation of meaningful stories and all types of activities for cultural heritage. We observed the content creators in their work and we also asked authors, teachers and other content creators about the type of information they seek when designing an activity or a narrative. Most of them agreed that a lot of effort is required to gain access to reliable sources of information. Even more so, to find information that has the ability to inspire them to create something original and meaningful.

Our idea is to integrate this type of information into the documentation of cultural heritage assets, especially those published on the Web, in order to give content providers scientifically accurate information that can also inspire them, give them the trigger they need to be creative.[1] describes the concept of augmented documentation in further detail. In the sections that follow, we elaborate on the steps to implement it so that it can be used in practice.

3.2. Requirements

The requirements for the data model of augmented documentation should combine the aspects of the EMOTIVE interpretation cards that engaged their audience, with good practices for the

[2]https://www.chessexperience.eu/
[3]https://emotiveproject.eu/

design and application of data models. The model should be easily applied to pre-existing data and be also easy for team members with no technical knowledge to comprehend and use.

For this first attempt to model augmented documentation, we decided to include an interpretation field for information on the context, interpretation and interesting facts about the asset and the two types of questions, as they were introduced in the interpretation cards. Additionally, the data should be enriched with links to external resources and controlled vocabularies should be utilized in every opportunity. The keywords controlled vocabulary in particular should be created using general socio-political terms that have a universal value and can link the assets beyond their type, provenance or chronology.

4. The data model

Taking into account the outcomes of our research on the requirements for augmented documentation, we identified the following basic elements for our model:

1. the fields that are usually part of a basic cultural heritage documentation,
2. one field for keywords,
3. one field for the interpretation or other interesting details of the artifact,
4. links to external resources, as many as possible, to ensure reusability,
5. information questions and their answers, and
6. reflection questions.

To address the requirements for the basic cultural heritage documentation content we chose to use the Europeana Data Model (EDM)[4] as the core model. EDM offers a simple and flexible way to describe cultural heritage assets while facilitating the creation of links to other web resources and, as a result, promoting the formation of a single knowledge graph for European cultural heritage [17]. Additionally, the large amount of data already published using this model will increase the interoperability of our own. The EDM model uses separate classes to represent the actual item which the metadata describes (edm:ProvidedCHO) from the source of its digital views (ore:Aggregation). In this way, a single physical item can have multiple Aggregations, meaning sources of digital representations linked to it. On the contrary, each Aggregation resource only links to a single ProvidedCHO. The model consists of originally created classes and properties, and others borrowed from the OAI Object Reuse and Exchange (ORE)[5], the Simple Knowledge Organization System (SKOS)[6], the Dublin Core elements, terms and types[7], the W3C Data Catalog Vocabulary (DCAT)[8], the Creative Commons[9] and the SIOC Services Ontology Module (SVCS)[10] namespaces. In our model we make use of a subset of the EDM original classes and properties, some of the Dublin Core elements and terms and the

[4]http://www.europeana.eu/schemas/edm/
[5]http://www.openarchives.org/ore/terms/
[6]http://www.w3.org/2004/02/skos/core/
[7]https://www.dublincore.org/specifications/dublin-core/dcmi-terms/
[8]http://www.w3.org/tr/vocab-dcat/
[9]http://creativecommons.org/ns
[10]http://rdfs.org/sioc/services#

ore:Aggregation class. Finally, we expect resources of type skos:Concept to be the values of select properties, as explained in Section 5.2.

To ensure the ability to support more complex cultural heritage documentation requirements in the future, we chose to associate our model with CIDOC CRM[11] by introducing the E18_Physical_Thing and E27_Site classes for moveable finds or archaeological sites and monuments respectively. For modeling the questions and answers as well as their connection to the assets, we researched the options given by CIDOC CRM and other schemata for cultural heritage but did not find an acceptable semantic representation of what we intended to achieve. We wanted to avoid creating our own classes at this early stage of the endeavor, so we chose a more generalized approach and made use of classes from the schema.org[12] ontology. We defined the cultural heritage assets as instances of the Thing class and the questions and answers as Question and Answer. An overview of the model can be seen in Figure 1.

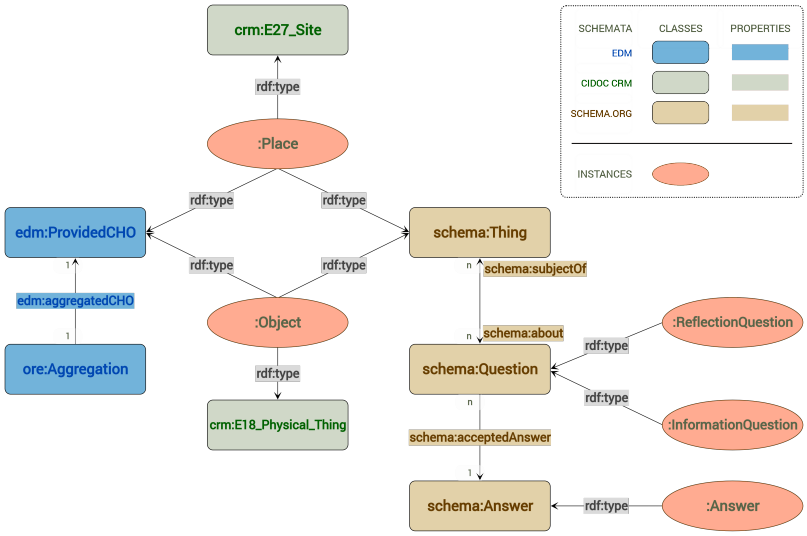

Figure 1: An overview of the classes in the Augmented Documentation data model.

As an edm:ProvidedCHO, each one of our assets is linked by the incoming edm:aggregatedCHO property to a single ore:Aggregation that carries its digital representations. Depending on the asset being a moveable find or an archaeological site or monument, it also becomes a crm:E18_Physical_Thing or a crm:E27_Site. As a schema:Thing, it is connected to instances of the schema:Question class via the schema:subjectOf and, its reverse, the schema:about property. An asset can be linked to multiple questions and a question to multiple assets. Furthermore, the instances of schema:Question that are Information Questions are linked to their answer by the schema:acceptedAnswer property. A single answer can be the schema:acceptedAnswer of multiple questions.

For modeling the interpretation field, a generalized approach was adopted once more. Since

[11]http://www.cidoc-crm.org/cidoc-crm/
[12]https://schema.org/

the assets are instances of either the E18_Physical_Thing or the E27_Site class, we use the P3_has_note property from CIDOC CRM for the interpretation text. The final model contains the majority of properties of the EDM model, the P3_has_note property from CIDOC CRM, the text, acceptedAnswer, subjectOf and about properties from schema.org and uses for the questions and answers some of the DublinCore properties that are also present in the EDM. Figures 2 and 3 show the full schema for cultural heritage assets and for questions and answers respectively.

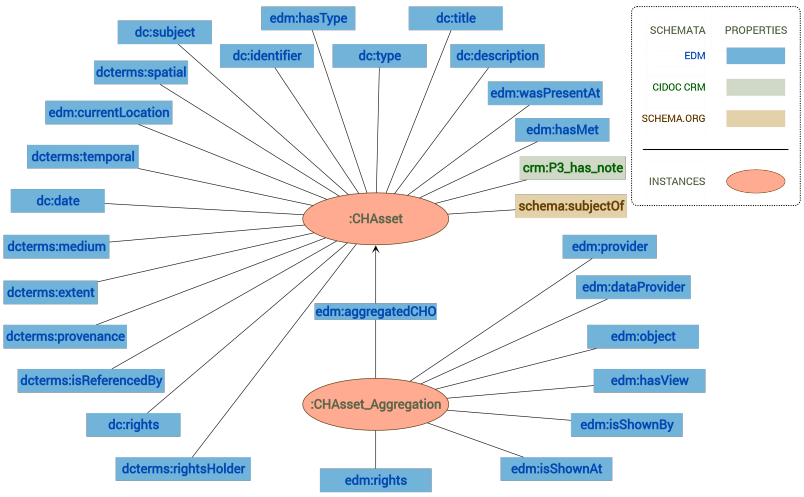

Figure 2: The cultural heritage asset properties.

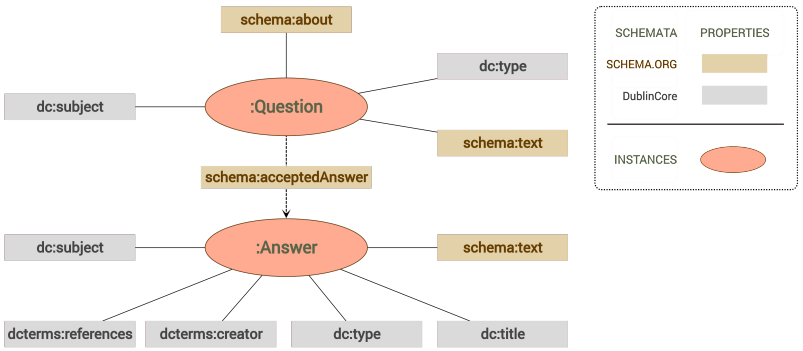

Figure 3: The full model for questions and answers.

The augmented documentation data model was designed to facilitate the creation of links with external web resources but also within the same collection, thus offering multiple ways in which it can be explored. Though the cultural heritage assets are the obvious entry point for such an exploration, the answers can serve this purpose as well. They were designed as autonomous texts with a title, authors, references and keywords. So, one can just as easily begin the discovery

by reading an answer and, through the questions connected to it, be redirected to associated items in the collection. For example, a text about burial gifts in the dataset presented in Section 5 can lead to 11 cultural heritage assets via the question "What was the purpose of burial gifts?". The questions are shared between assets and offer one more, less obvious, way to discover the collection, especially in the case of reflection questions which are meant to be generalized and focused on universal concepts, values and situations. Finally, the encouragement to use controlled vocabularies and links to external resources as much as possible can further enhance the reusability and accessibility of the collection. The keywords, in particular, if chosen based on a specific strategy, can highlight deeper connections between the assets in the same way as the reflection questions.

5. Applying the data model

In Cultural Heritage, as in other domains that rely on descriptions and interpretations of the facts as well as in measurements of their characteristics, the application of a data model and the conformance with good practices such as FAIR data, often raises challenges. The organization level of the original data can vary greatly, from hand-written reports to fully organized data tables or complex digital collection management systems. Furthermore, the documentation in most cases is created having a human reader and not a machine as the recipient. The approach one follows in order to apply a data model should account for the particular characteristics of the data and requires the assistance of cultural heritage experts. In this section we describe some of the challenges we faced while applying the augmented documentation data model to real-life documentation data.

The Voeska project[13] was a three-year research project (2020-2023), funded by the Greek government and the European Union, that aimed to promote the cultural heritage of Arta, a city in Western Mainland Greece. One of the tasks was to create a digital repository containing the documentation for part of the collection of artifacts and archaeological sites or monuments under the jurisdiction of the local Ephorate of Antiquities. This gave us the opportunity to test the idea of augmented documentation and, as a result, our data model.

In the sub-sections that follow we describe our approach to apply our data model to preexisting cultural heritage data and then create the augmented part of the documentation. The steps towards implementing this Augmented Documentation can be summarized as follows:

1. An initial assessment of the data was made.
2. We decided which controlled vocabularies to use.
3. The data was cleaned and an initial enrichment was applied.
4. The augmented part of the documentation was created.

5.1. The original data

As is the case with most data collections of cultural heritage institutions, the original data was created through the course of many years and its primary purpose was to be used within the

[13] https://voeska.com/

Ephorate of Antiquities for cataloging moveable finds and sites and to keep track of artifacts on display and in storage. The largest part of the data for the Voeska project was extracted from a collection management system into excel spreadsheets while other datatables were created using data from other sources. The total number of processed records was 638, all written in Greek. These include artifacts and sites from Ancient, Byzantine and a few from Ottoman times from the Arta area.

In the original data, the use of controlled vocabularies was limited to a hierarchy and a list of plain text terms for artifact types and building materials. No specific documentation strategy had been followed in the descriptions and titles, and fields such as the dimensions or chronology of the assets did not follow a single format. Last, on rare occasions values were found misplaced in a column other than the expected one. Working together with cultural heritage experts and content creators we studied the data and designed the next steps towards processing them and, eventually, augmenting them.

5.2. Controlled vocabularies

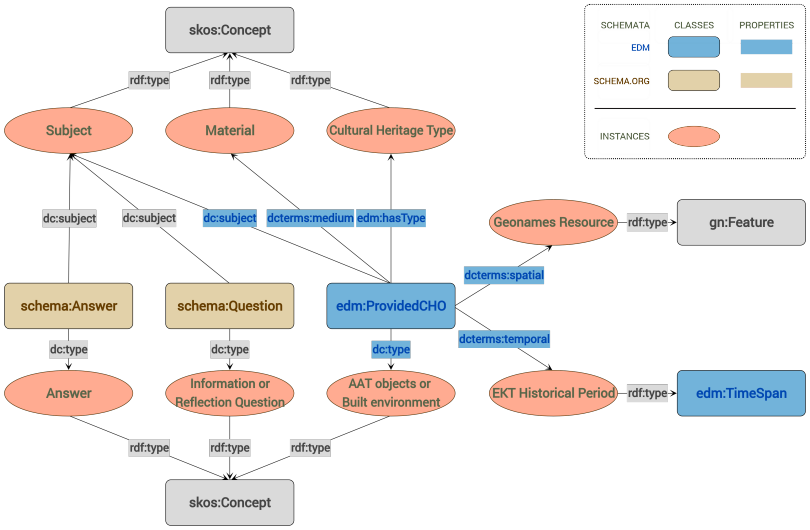

Figure 4: A plan of the use of controlled vocabularies.

The next step was to decide where to use controlled vocabularies and which ones. As mentioned previously, there were already sets of plain text terms in place for assets types and for building materials. In addition to those, we decided to create or adopt controlled vocabularies for historical periods, keywords and for the spatial provenance of the assets. Finally, we assigned to all assets either the objects or the Built environment concept from the Art and Architecture Thesaurus (AAT)[14] as a basic type and we created three Simple Knowledge Organization Schema (SKOS)[15] concepts that represent a type for the reflection questions, the information questions

[14]https://vocab.getty.edu/aat/
[15]https://www.w3.org/TR/skos-reference

and the answers in our collection.

The controlled vocabularies were created or chosen as follows:

- We created the asset types based on the preexisting hierarchy and using SKOS. We extended it to support archaeological sites and monuments and we linked the terms to others from the AAT.
- The materials vocabulary was also created using the SKOS schema and was based on the preexisting list of materials. It was linked to terms from the FISH Building Materials Thesaurus[16].
- For the historical periods we thought it best to use the Greek Historical Periods vocabulary[17] created by the National Documentation Center.
- For the spatial provenance of the assets, we asked the experts to assemble a list of the archaeological sites and monuments in the area of interest. We then checked the Geonames[18] geographical database for corresponding records and created the locations that didn't already exist to form the final list of Geonames Features.
- The keywords list was the last one to be created. We ended up with another SKOS vocabulary linked to a small subset of the ICONCLASS[19] vocabulary.

All vocabularies have labels in both Greek and English language.

5.3. Data pre-processing

As a result of the challenges and issues mentioned in Section 5.1, the simple mapping of table columns to properties in our data model would not give the desired results. Since the amount of data was not very large, most of the work was done manually, together with the experts. A crucial first step completed by the experts was to group the records according to their spatial provenance, because this information could not be easily derived from the original datatables. Information about the asset's discovery was also searched and added to the data by the experts at this stage. Additionally, some text formatting tasks were completed. The texts for the dating and dimensions were changed in order to follow the same format and some small grammatical and format errors were corrected. After that, the mapping to the new data model began.

First, concept URIs replaced the original values where needed. For asset types especially, two URIs were added, one for the specific type of asset and another for the general category of object or site. URIs were also filled in for the spatial provenance, historical period and building materials of each asset. For the current location of the artifacts, two values were created, one that retains the original text and another that contains a Geoname Feature URI and corresponds to the geographical location of the museum or exhibition space in the area of Arta where the asset is exhibited or stored. No values for keywords were added at this time, since this is part of the augmentation of the data.

For the columns corresponding to the dating of the asset, two options were given. If a year range could be inferred from the textual value, then an edm:Timespan instance was created

[16] http://purl.org/heritagedata/schemes/eh_tbm
[17] https://www.semantics.gr/authorities/vocabularies/historical-periods
[18] https://www.geonames.org/
[19] https://iconclass.org/

that had as a label the initial chronology textual value and as limits (edm:begin and edm:end) the years as described in the text. Some basic rules were set for the conversion of approximate dates, like “early Xth century”, “3rd quarter of Xth century” etc. For all other cases, and as a fallback for future incomplete inputs, the original text value was left as it was.

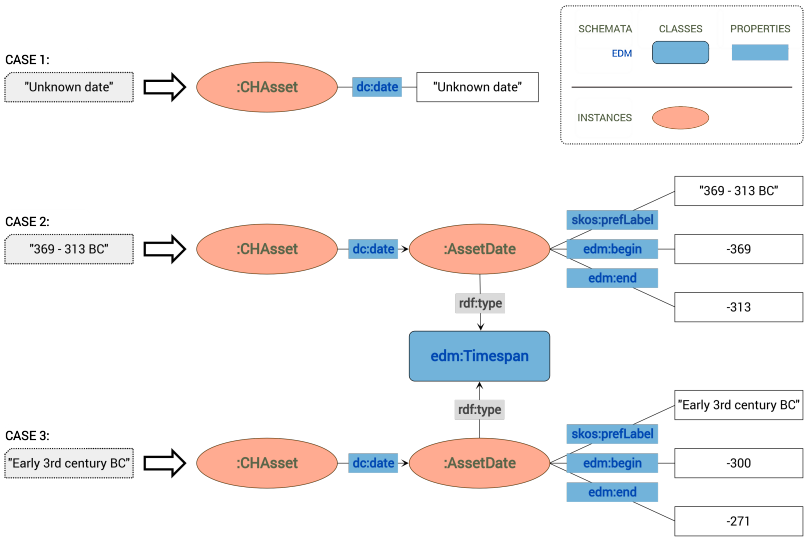

Figure 5: Examples of processing the date statements.

Apart from applying the data model, an initial cleaning and enrichment was also done during this stage. Small mistakes were corrected varying from grammatical mistakes to corrections of the asset chronology and additional bibliography was appended. Also, it was decided that the Wikidata and DBpedia databases will be used as sources for linking to historical figures and events. The first enrichment of the data with such links was done during this stage.

After reorganizing the data, as described above, we were ready to proceed with augmenting the assets documentation.

5.4. Augmenting the data

The process of adding the augmented part of the documentation proved to be the most difficult and time consuming. It was done manually and involved a combination of research, precision and inspiration. The participation of both cultural heritage experts and authors was required to assure the credibility of the information while tending to the aesthetic value of the outcome as well. All the resulting documentation records are in Greek.

Before starting to work on the content itself, some general rules needed to be defined and a strategy to be drawn. First, we wanted the content of the documentation to look uniform to the visitors of the digital collection. The grammar and spelling should follow the same rules in the description and interpretation texts, as should the formatting of the titles and the reasoning behind the choice of keywords. Also, we should avoid long texts and prefer to append this excess content as answers to information questions. Finally, the texts should be simple enough

to be understood by a wider audience while retaining the scientific facts. To achieve that we decided to smoothen the strictly scientific and technical parts of the text by adding explanations for the scientific terms either in parentheses inside the texts or in the form of information questions.

The production of the augmented content included formatting the existing texts and writing new ones. The challenges were many. There was often debate over which facts to include and which not when a text was growing large. Also, which term to explain and which not and whether to leave the explanation in a parenthesis or create an information question. One big challenge was to determine if a text was simple enough or if it needed additional processing. Another one was to come up with questions that can truly make the recipient reflect on the connection of their own lives to the past.

We followed an iterative methodology. In each iteration we selected some assets to augment, we researched the bibliography about them and the context they belonged to and then continued to write the interpretation text, transform their documentation, mostly the titles and descriptions, and added questions and keywords. 2-3 people with background in cultural heritage usually participated in this stage and 2 more towards the end of the project. The result was evaluated by other members of the team (up to 10 people), preferably those that did not have good knowledge of the cultural heritage domain. Their comments and, especially, their questions were noted, the documentation went through a review, changes were made and then it was evaluated again until we were satisfied that our goals were fulfilled. Then another set of assets were selected, transformed, evaluated, reviewed etc.

By the end of the project, 360 of the collection's assets were at least partially augmented, 81 of which fully[20]. 87 include an interpretation text, 144 are linked to keywords and 122 are linked to questions. Table 1 shows how the questions are shared among the assets and Figure 6 shows how the keywords, grouped by the top concepts of the vocabulary, are distributed.

Table 1
Questions usage summary.

	Either type	Information Questions	Reflection Questions
Total questions	125	82	43
Linked to 2 or more assets	50	25	25
Linked to 5 or more assets	14	6	8
Max questions per asset	9	7	5

5.4.1. The RestAPI

The augmented data were stored in a Jena Fuseki triple store[21]. To allow easier access to it, we created a RestAPI that exposes the linked data in JSON object format but can also forward SPARQL queries to the triple store and return the response. The API contains methods for searching assets or questions and answers based on multiple criteria, for returning assets by

[20] You can find some examples of augmented cultural heritage assets here: https://voeska.athenarc.gr/augmented-doc/items (in Greek language)
[21] https://jena.apache.org/documentation/fuseki2/

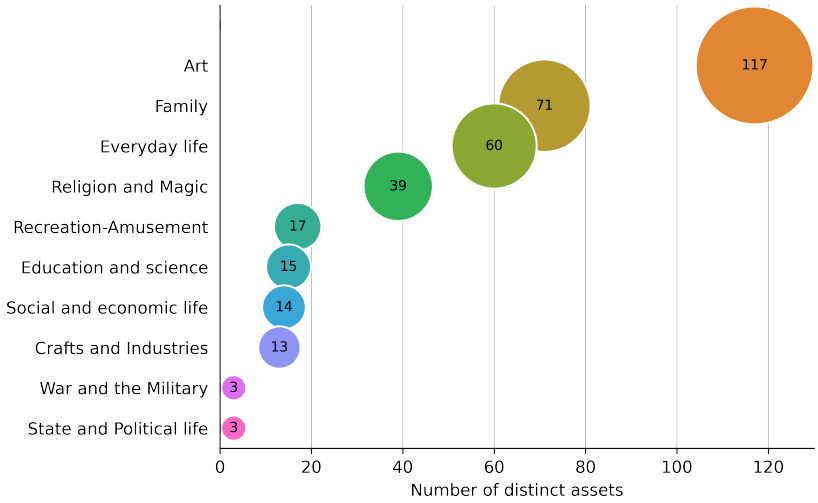

Figure 6: Usage of keywords grouped by the top concepts of the vocabulary.

their uri and for returning information about the usage of the controlled vocabularies. Searches in the triple store can alternatively return only snapshots of the assets, meaning only a few characteristic parameters, that can serve for displaying in search result lists or in similar occasions.

Searches by values from one of our controlled vocabularies take into account the hierarchy of the terms. When a term is searched the executed query returns the results that match this term or any term under it in the vocabulary tree. In this way, when this method is made available to end users through a frontend application, they can still discover all the assets even if they only use general terms, which may be more familiar to them.

6. Augmented documentation in practice

The augmented documentation created in the context of the Voeska project has been put in practice in several creative and educational contexts. It served as a basis for the creation of a variety of digital storytelling experiences, for on-site or remote visits to monuments of the city of Arta. An example for on-site visit is the mobile application “Letters from the Past”, a digital storytelling experience which covers different eras and provides the possibility to link cultural artifacts to heritage sites. The core concept is centered around an ancient scribe, who undertakes the task of writing a series of letters, as requested by his clients. The Letters span over various time periods and involve a wide variety of people, both fictitious and real: men, women, aristocrats, peasants, craftsmen, monks, artists, and kings. Each Letter is connected to one of Arta’s monuments or archaeological sites and to multiple artifacts that are relevant to its topic. The augmented documentation was a key contributing component for this experience, serving a double purpose. Firstly, it served as an inspiration to the creator of the storytelling content, providing direct access not only to the documentation information about the monuments, but

also to an efficient way to directly identify relevant artifacts that can be presented along with it. The historical context offered in the augmented documentation, combined with the relevant keywords could inspire the creation of the fictional letter, whereas parts of monument and artifacts documentation was offered as relevant historical information snippets combined with the letters.

The augmented documentation has also been used in the context of creative and participatory digital storytelling workshops, organized in two different educational contexts. 39 junior high students in the classroom were invited to work in small groups to create brief digital exhibitions following specific themes. The augmented documentation was offered as material the children could explore to select interesting objects relevant to the selected theme and re-use the relevant information in parts of the exhibition. Similar creative workshops were organized in the context of a digital storytelling course. 6 students worked in 3 groups to create digital storytelling experiences inspired by the augmentation documentation and working with two specific sets of artifacts, related to the Ancient Temple of Apollo and the Ancient Necropolis. The augmented documentation functioned as a source of inspiration for the story theme and plot while at the same time offering direct access to the primary source data, thus supporting a creative outcome based on solid archaeological evidence.

Finally, apart from workshops we organized interview sessions with teachers of primary and secondary school in order to present them with the idea of augmented documentation and get their feedback on ways to use it in education. 16 teachers participated in total and were also asked to fill in an evaluation questionnaire. Among other comments, teachers argued that this approach: “offers a sense of connection of the historical knowledge with the present and gives teachers a stimulus to create similar activities”, “(offers) rich content, easy to understand, easy to utilize”, “stimulates interest and can be used to bring to the surface skills and abilities of students that are not "visible" in a traditional lesson” and “(is) fun! Learning that will stand the test of time”. The complete analysis of the evaluation results of the aforementioned evaluation activities are out of the scope for the present work and will be reported elsewhere.

7. Conclusion and next steps

Creating the augmented documentation has been an adventure. The process was long and difficult but the results from putting it in practice have so far been more than positive. In our opinion it offers the opportunity for cultural heritage institutions to promote their collections while introducing to the public a view of the artifacts that would be difficult to discover without help. This view could make them more curious about the past and maybe more wondrous about their own connection to it.

In the next steps we plan to work further on the proposed methodology for producing the content of augmented documentation. Also, we intend to explore the various ways in which the data model links the assets. We can create user interfaces with advanced search, navigation and visualization of the data. Finally, we could take advantage of the emergence of AI and large language models (LLM) to try and make the process of creating the augmented content more sustainable. For example, a LLM could make it easier to achieve uniformity in the texts and titles.

To sum up, augmented documentation aims to make you dream of the past and reflect on your present. Our wish is that it offers to a wider public the same inspiration that we felt while designing it and watching it come to life.

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