

Classical Heritage and Text-Based Second Language Learning in Three-Dimensional Virtual Library Environment

István Károly Boda^a, Erzsébet Tóth^b

^aDebrecen Reformed Theological University, Hungary
boda.istvan@drhe.hu

^bUniversity of Debrecen, Faculty of Informatics, Hungary
toth.erszebet@inf.unideb.hu

Abstract

In our paper we would like to discuss in detail the present status of our three-dimensional virtual library model (3DVLM) built on the hierarchical scheme of the ancient Library of Alexandria worked out in the so-called Pinakes by Callimachus in the 3rd century BC. The full content of the model, once completed, would provide a comprehensive overview of the classical heritage our culture is originated from. In this tradition Callimachus is considered to be one of the most talented Hellenistic scholar-poets. His brief epigrams were outstanding which reflected his allusive mind and erudition. In general, it is a great challenge for us to deliver the message of ancient times to the present-day culture, but it seems to be very difficult to convey this highly sophisticated content to the members of the young (and especially the y and z) generations of our times who have been brought up and educated in a completely different social and cultural environment. *Our basic idea is that language learning can serve as a common basis to transform and offer the ancient knowledge for the young generations of the internet era.* Moreover, we are aware that nowadays one of the preferred sources of information is Wikipedia. So we chose and carefully preprocessed some Wikipedia texts (in English) about Callimachus' life and works for the 3DVLM to assist our users in language learning and, at the same time, provide them short but valuable texts which are worth learning and memorizing.

In order that the selected texts could be easily understood and memorized we provided additional items which are necessary for language learners (e.g. vocabulary and thesaurus of rare or special words, expressions and idioms,

images and illustrations, selected concordances and quotations, encyclopedia entries, referred texts etc.). Because the organization of the primary texts and their relationships with the associated items are of great significance in the learning process, we tried to fully exploit the advantages and special features of the 3D environment of the MaxWhere Seminar System, visualizing and mapping the compiled material using various colors and typography, block elements, images, lists etc. on the one hand, and exploring the co-reference and intertextual relationships by maps and the spatial arrangement of the material, tables, hypertext links between the primary texts and the additional items etc. on the other hand. Since self-check and practice is inevitable in the learning process, we elaborated exercise materials related to the preprocessed library content by providing various exercises, questions, drills, tests, quizzes, puzzles etc. for our users.

We intend to achieve two main objectives using the 3DVLM. First, we would like to support and motivate our users to acquire in-depth knowledge of the ancient Alexandrian times. The learning philosophy of the model is to help its users understand and interpret the compiled material ‘at once’, supplying them with the necessary background and linguistic knowledge. Second, we firmly hope that our users will gradually improve their English linguistic competence in the course of reading, understanding and memorizing the preprocessed material provided by our virtual library.

Keywords: Callimachus; Library of Alexandria; three-dimensional virtual library model; MaxWhere Seminar System; text-based language learning

MSC: 68U05; 68U35; 91E10; 91E40

1. The Great Library of Alexandria and its mission

The Museion (Mouseion, Musaeum)¹ and its organic element, the Great Library resulted in a tradition by which the Ptolemies² provided more financial assistance to Greek culture in Alexandria³. This city is known to have been a novel, dominant cultural and learning center for the Greek East for centuries. The notable antecedents of the Museion research institution were those temples where manuscripts of different types were housed in great number for preservation and access. The Ptolemies rulers obtained the authentic texts of authors by purchase and the famous scholars who lived in the Museion carried out critical analysis on them and then entered these masterpieces onto the official canon of Greek literary works. Seneca says that the Ptolemies collected papyrus rolls to show their magnificent power to the world and by these efforts they intended to gain the cultural supremacy in Egypt [1].

The Library of Alexandria⁴ was founded in the 3rd century BC for Ptolemy I Soter’s initiative. No contemporary historical writings were left on its creation and

¹<https://en.wikipedia.org/wiki/Musaeum> (2020-01-12)

²https://en.wikipedia.org/wiki/Ptolemaic_Kingdom (2020-01-06)

³<https://en.wikipedia.org/wiki/Alexandria> (2020-01-08)

⁴https://en.wikipedia.org/wiki/Library_of_Alexandria (2020-01-07)

nobody is aware of its exact location in Alexandria [2]. Its “branch library” was established by Ptolemy III in the Serapeum, a temple given to the god Serapis. The Museion and the Alexandrian Library were demolished later and nothing remained from these institutions. Apart from this fact the Library of Alexandria began to represent and symbolize all libraries in ancient period. In addition, nowadays it is regarded to be as a generally accepted symbol of human knowledge and erudition. The Alexandrian Library enjoyed royal support to gather all the copies of Greek works in the world, so its mission was to be universal library in acquisition⁵. In fact its award was that it collected and preserved all the accumulated knowledge of the humanity in the ancient era [1].

2. Callimachus and his most impressive work, the Pinakes

Callimachus⁶ was born in Cyrene⁷ in Libya between 305 and 240 BC. He is considered to be as one of the most talented and celebrated scholar poets of the Alexandrian period. He spent the great part of his life in Alexandria and his royal patrons were Ptolemy II Philadelphus and Ptolemy III. A commentator to Plautus reports that he was employed as a librarian in the Library of Alexandria. Only 6 hymns, about 60 epigrams and some fragments remained from his works. His brief poems reflected that he acquired successfully the practice of perfect virtuosity and literary craftsmanship. He wrote his poems in a sophisticated style and applied allusions very often in his poetic texts by expressing his erudition [3]. The Byzantine lexicon, Suidas points to the fact that Callimachus carried out scientific research as a grammarian and created 800 writings in verse and prose [4].

Concerning Callimachus’ remarkable achievements we have to emphasize his immense bibliographical work which focused on arranging all the Greek literary works, once available in the holdings of the Alexandrian Library, into a comprehensive catalogue, the Pinakes⁸. Zenodotus of Ephesus as a head librarian provided a job to Callimachus to be his assistant. Therefore he was involved in building the catalogue of this outstanding Hellenistic collection. His catalogue was separated into six various parts and included bibliographical information about 120 000 papyrus rolls. His famous Pinakes is thought to be the first bibliographical work of ancient Greek literary documents. Let us quote the title of his catalogue’ system which is the following: *Pinakes (or Tables) of those who were eminent in every branch of learning, and what they wrote* [5]. The structure of his catalogue was consisted of the important groups of Greek poetry and five groups of prose: history, rhetoric, philosophy, medicine and law, and a miscellaneous group. On the whole, ten different genres of literature have been used as a category in his catalogue.

⁵https://en.wikipedia.org/wiki/Universal_library (2020-01-26)

⁶<https://en.wikipedia.org/wiki/Callimachus> (2020-01-14)

⁷https://en.wikipedia.org/wiki/Cyrene_Libya (2020-01-14)

⁸<https://en.wikipedia.org/wiki/Pinakes> (2020-01-15)

Callimachus organized the names of the authors in alphabetical order within the corresponding genres of literature, with a short biography, enumerated works of each Greek author (also in alphabetical order), and recorded the opening words and a reference to the number of lines of the work [5, 6].

3. The 3D virtual library model

Six years ago we initiated a 3D virtual library project focusing primarily on the field of Greek literature in the 3rd century BC as well as related texts (e.g. biographies of some prominent authors, historical and mythological texts etc.) as part of the CogInfoCom research [7, 8]. The project is based on a three-dimensional virtual library model (3DVLM) which adapted the main concepts of the classification system invented by Callimachus for the ancient Library of Alexandria. The current implementation of the model uses the innovative, cloud-based 3D environment of the MaxWhere Seminar System [9]. From the available 3D spaces offered by the MaxWhere system, we selected the *3D Castle space* which, like most of the 3D spaces, well suits the basic needs of the 3DVLM. The utmost feature of the model is the web-based focus and 3D organization of the virtual library content which perfectly fits the MaxWhere system.

The major concepts of the 3DVLM describe the organization and content of an abstract virtual library in 3D space. Because the detailed description of the 3DVLM can be found in our former publications [10, 11, 12, 13, 14], here we only briefly summarize the main concepts. In the current implementation of the 3DVLM the content is presented in **virtual rooms**, **cabinets**, **cabinet walls**, and (left and right) **corridors** (note that those concepts can be more or less metaphorical depending on the features of the applied 3D environment). A *virtual room* is the largest content unit which contains, in a specific spatial arrangement provided by the 3D space, the (primary) library content presented in several *cabinets*. In the current implementation of the 3DVLM the content of the cabinets is represented as web pages (hereafter referred to as *content pages*). The left and right *corridors* and the *cabinet walls* support the organization of the library content in order that it can be considered as a coherent whole. They represent different type of knowledge: the left corridors contain dictionary knowledge, the right corridors provide encyclopedic knowledge (mainly in a form of intertextual relationships, e.g. referring to other cabinets), and the cabinet walls are dedicated to harmonizing both type of knowledge functioning as a kind of collocations dictionary and thesaurus at the same time.

The 3DVLM provides an abstract framework for a **virtual library** based on various sources, chiefly from the internet (especially from Wikipedia). The current implementation of the library is focused on the primary and secondary (i.e. virtual) contents about Callimachus. They are arranged according to the ancient classification scheme invented by Callimachus using several categories (described in section 2). In the virtual library there are some dedicated web pages which support the information retrieval of the virtual library content.

- The first dedicated page is a *category page* which contains the list and explanation of the applied classification categories, including the name of some illustrious ancient authors with the title of their most important works for each category. The category page is based on the Wikipedia entry ‘Ancient Greek literature’⁹. Note that the most important biographical data for each referred author are generally available in the author’s Wikipedia entry the reference to which should be an essential, and therefore explicitly represented, part of the virtual library. More or less the same applies to the works of the authors because the main characteristics of the most important works (e.g. the opening words which had been recorded by Callimachus in the Pinakes) can be supposedly found in their corresponding Wikipedia entries.
- The second dedicated page is the *index page* which contains the main keywords used in the content pages of the virtual library as well as selected concordances of the keywords exploring their textual context. In the index page, the retrieval of the primary and secondary content is supported by links either to the related Wikipedia entries or to the corresponding content pages of the library.
- The third dedicated page is the *reference page* which contains all referred sources used in the virtual library.

4. Implementation of the 3D virtual library model in the MaxWhere system

In every available 3D space of the MaxWhere system there are a number of carefully arranged ‘smartboards’ which operate as multiple web browser windows. This unique and very flexible feature of the MaxWhere Seminar System allows web-based (i.e. HTML / CSS / JavaScript) content to be embedded and presented in 3D space, with the definite advantage of representing hypertext and hypermedia (mixed verbal and multimedia content, various colors and typography, links, images, animations, videos, interactive content etc.). Mapping the 3DVLM into the 3D space of the MaxWhere system is based on two simple rules:

- a *virtual room* corresponds to the 3D space itself (in our case, a large room in an ancient castle);
- the *cabinets* and *corridors* correspond to a group of adjoining smartboards established and arranged according to the architecture and design of the chosen 3D space (in our case, human-sized wooden frames arranged in the virtual room of the castle, see the figures below).

The smallest units (or ‘records’) of the presented virtual library content are located or ‘exhibited’ in designated smartboards representing the *cabinets* of the

⁹https://en.wikipedia.org/wiki/Ancient_Greek_literature (2020-01-21)

3DVLM in the virtual room. In the current implementation which aims to convey classical heritage for language learners, the content of every cabinet is a carefully prepared English text, selected from the collection of the virtual library. A significant advantage of the MaxWhere 3D environment is that, at least theoretically, no limitation to the size and number of verbal and multimedia texts presented in the smartboards.

From the left and right of every designated smartboard functioning as a cabinet, the two adjoining smartboards represent the left and right *corridors* providing additional information for the content of the corresponding cabinet. The content of the corridors helps the users of the virtual library to process (i.e. understand, interpret, memorize etc.) the ‘main’ content of the cabinet. Specifically, the content displayed in the smartboard representing the left corridor provides basic *vocabulary (or dictionary) knowledge* which is necessary to understand the text of the cabinet; in turn, the content displayed in the smartboard representing the right corridor presents *encyclopedic (or background) knowledge* about important people, mythological characters, places, events, or other details related to the content of the cabinet. Note that those “encyclopedic” entries establish strong *intertextual relationships* with the text of the cabinet.

The three pillars of the organization of knowledge in the 3DVLM (i.e. the cabinet content, the cabinet walls (see below), and the content of the left and right corridors), are illustrated in Table 1.

Exploiting the features of the MaxWhere Seminar System, especially the access to multiple adjoining smartboards in the 3D space, we introduced a new concept in the 3DVLM called **cabinet wall**. As on walls of rooms (or, in general, of buildings or any larger containers) there can be various pictures, decorations, colored patterns, graffiti etc., the walls of a cabinet can also contain such things. Considering the cabinets in the virtual rooms as metaphoric containers of selected contents from the virtual library, the cabinet walls in the model can have, and in turn can present, **additional linguistic information about certain keywords and their collocations** which occur within the text of the corresponding cabinet. In our model, the keyword–collocation construction presented in the cabinet wall is defined by *a selected syntactical pattern of certain groups of synonymous keywords* (hereafter called **microcontext**), where the constituents of the pattern can be replaced with the semantically related words or phrases (e.g. synonyms, antonyms, related or contrasted words etc., selected from synonyms dictionaries, thesauri or any appropriate linguistic corpora from the internet). Because a collocation “often provides insight into the meaning of a given word” [15], the microcontexts of selected keywords presented in the cabinet walls of the model are intended to help the users understand and memorize the meaning of their constituents and broaden their dictionary knowledge (including the grammatical patterns included in the microcontexts).

Based on a certain microcontext, we can compile rich and valid (i.e. linguistically correct) content for the cabinet walls selecting *concordances* and/or *quotations* from various sources (e.g. from the texts of cabinets, monolingual, production, col-

left corridor		cabinet		right corridor
		<i>[cabinet ceiling or top]</i>		
<i>[left corridor content]</i> selected vocabulary items for understanding the content of the cabinet	<i>[cabinet wall]</i>	<i>[cabinet content]</i> a preprocessed text to be understood, interpreted, memorized etc.	<i>[cabinet wall]</i>	<i>[right corridor content]</i> selected encyclopedic entries related to the content of the cabinet
		<i>[cabinet floor or front]</i>		
<i>[cabinet wall content]</i> a rich collection of examples (concordances, quotations etc.) for selected keywords occurring in a given collocation pattern				
cabinet walls				

Table 1: The three pillars of the organization of knowledge in the 3DVLM

locations and/or quotations dictionaries, printed and electronic books, linguistic corpora, and various web 2.0 and internet sources including Wikipedia items, authentic web pages etc.) by searching for the given keywords and collocation pattern of the microcontext. (Note that a given microcontext with the compiled concordances and quotations can be applied to more than one cabinets.) In case a selected concordance could not be understood without its broader context (or we just think that the context is really worth being presented), the full text, or a selected passage of it, can also be part of the content of the cabinet walls.

In the MaxWhere environment, the content of the cabinet walls can be presented, on the one hand, on designated smartboards which are spatially arranged around the smartboard representing the corresponding cabinet. On the other hand, the content of the cabinet walls can be linked to the content of the corresponding cabinet and thus can be presented on the same smartboard where the cabinet text itself presented.

5. Application of the 3D virtual library model for presenting selected Wikipedia texts about Callimachus

In the following we would like to demonstrate the features of the current implementation of the 3DVLM based on the 3D Castle space of the MaxWhere Seminar System. The 3D Castle space, designed by Ameda Cool Catz [9], offers 31 smartboards. All but one smartboards are arranged in five different rows with six columns of smartboards in each row. As a result, the five rows and six columns of smartboards form a geometric 5x6 pattern. The remaining single smartboard is placed on a virtual table in front of the other 30 smartboards. There is an aisle in the middle of the main room of the virtual castle which divides the set of smartboards into two equal parts: there are three columns from the left and another three from the right of the aisle [14]. The general view of the virtual castle can be seen in Fig. 1.



Figure 1: A screenshot of the 3D Castle space of the MaxWhere Seminar System showing the three parallel columns of smartboards from the left of the central aisle

In general, the smartboards placed in a given *column* present the same type of text. In each row, from left to right,

- the second and most important (the ‘main’) smartboard represents *a cabinet* containing the selected library content (in our case selected and preprocessed texts from Wikipedia about Callimachus and related topics),

- the first smartboard represents *the left corridor of the cabinet* of the corresponding row (containing a carefully compiled vocabulary including the pronunciation and definition of some “difficult” words as well as illustrating images, if necessary),
- the third smartboard represents *the right corridor of the cabinet* of the corresponding row (containing short texts, extracted mainly from the corresponding Wikipedia entries, on famous persons, places, mythological characters etc. referred to in the text of the cabinet).
- the fourth, fifth and sixth smartboards can, among other things, represent the *cabinet walls* of the corresponding cabinet, containing selected microcontexts from the ‘main’ smartboard. However, we can present here other types of text as well, for example interactive tests.

Let us see an example of the content and organization of the smartboards in the 3D space and the corresponding learning process which a motivated language learner could go through. The main smartboard in the second column of the first row presents a short text about Callimachus from Wikipedia [16] completed by a sentence from a book about the life and work of Callimachus [17]. This text should be read first (and then, hopefully, many times) in order to start the text-based learning process. There is a sentence emphasized in bold font type which serves as a kind of *mnemonic clue* for the whole text. In the text we marked with colored background some rare words (e.g. patronage, pharaoh, benefactor etc.) and some proper names and specific terms (e.g. Callimachus, Cyrene, Ptolemy, ancient Greek literature etc.). The meaning and pronunciation of some words can be looked up from the vocabulary presented on the smartboard from the left. We offer additional information about the marked proper names and terms on the smartboard from the right (e.g. entries about Cyrene, the Ptolemaic dynasty, and the ancient Greek literature). These texts are intended to gradually deepen the understanding and interpreting process. The overall success of the learning process depends on the quantity and quality of knowledge and conceptual relationships whatever the learner is capable to acquire; therefore we selected three microcontexts from the main text (i.e. productive poet, responsible librarian, influential poet) to improve and extend the linguistic knowledge of the learners. The concordances and quotations of the microcontexts are presented on the three other smartboards in the first row. Finally, the users have a choice to check their knowledge by trying to solve the exercises and answer the questions available as a form of interactive test in another smartboard.

6. Conclusions

As we declared in our previous publications, the main purpose and mission of our three dimensional virtual library model are as follows:

“There is a considerable and increasing need for a kind of efficiently preprocessed, ‘ready-made’ knowledge which is suitable for understanding, learning and/or memorizing the processed content ‘as is’. Which is, in our case, one of the most important cultural heritage of the western civilization – to say nothing of other important ‘side effects’, e.g. the outstanding educational role of the provided literary texts in language learning. During the development and implementation of our virtual library model we have been focusing on a kind of ‘read and learn at once’ strategy which is perfectly supported by the three-dimensional and spatial representation of the provided knowledge (using both verbal and multimedia texts).” [10]

We firmly hope that the virtual library model developed so far along with the excellent and continuously developing features of the 3D environment provided by the MaxWhere Seminar System can guarantee to achieve our goals in the future.

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References

- [1] HANDIS, M. W., Myth and history: Galen and the Alexandrian Library, in *Ancient libraries* ed. by König, J., Oikonomopoulou, K. and Woolf, G., Cambridge [etc.]: Cambridge University Press, cop. (2013) 364–376.
- [2] EL-ABBADI, M., *Life and fate of the ancient Library of Alexandria*, Paris, (1992).
- [3] *Callimachus Greek poet and scholar*, <https://www.britannica.com/biography/Callimachus-Greek-poet-and-scholar> (2020-01-05)
- [4] BERTI, M., COSTA, V., The Ancient Library of Alexandria: A model for Classical Scholarship in the Age of Million Book Libraries, in *CLIR Proceedings of the international symposium on the scaife digital library*, (2009), preprint version. <http://www.perseus.tufts.edu/publications/Berti-CostaAlexandriaKentucky.pdf> (2020-01-05)
- [5] BARNES, R., Cloistered Bookworms in the Chicken-Coop of the Muses: The Ancient Library of Alexandria, in *The Library of Alexandria: Centre of Learning in the Ancient World* ed. by MacLeod, R., London: New York: I. B. Tauris and Co Ltd., (2010), 61–77.
- [6] WITTY, F. J., The Pinakes of Callimachus, *Library Quarterly*, Vol. 28 No. 2 (1958), 132–136.
- [7] BODA, I., BÉNYEI, M., TÓTH, E., New dimensions of an ancient Library: the Library of Alexandria, in *CogInfoCom 2013. Proc. of the 4th IEEE International Conference on Cognitive Infocommunications*, (Budapest, Hungary December 2-5, 2013), 537–542.
- [8] BODA, I., TÓTH, E., BÉNYEI, M., CSONT, I., A three-dimensional virtual library model of the ancient Library of Alexandria, in *ICAI 2014. Proc. of the 9th International Conference on Applied Informatics*, (Eger, Hungary, January 29-February 1, 2014) vol. 1., 103–111.

- [9] *MaxWhere*, <http://www.maxwhere.com/> (2020-01-25); *MaxWhere Store*, <http://store.maxwhere.com/> (2020-01-25)
- [10] BODA, I., TÓTH, E., CSONT, I., NAGY, L. T., Toward a knowledge base of literary content focusing on the ancient Library of Alexandria in the three dimensional space, in *CogInfoCom 2015. Proc. of the 6th IEEE International Conference on Cognitive Infocommunications*, (Győr, Hungary October 19-21, 2015), 251–58.
- [11] BODA, I., TÓTH, E., CSONT, I., NAGY, L. T., Developing a knowledge base of ancient literary texts in virtual space, in *CogInfoCom 2016. Proc. of the 7th IEEE International Conference on Cognitive Infocommunications*, (Wrocław, Poland October 16-18, 2016), 263–270.
- [12] BODA, I., TÓTH, E., CSONT, I., NAGY, L. T., The use of mythological content in virtual learning environment, in *CogInfoCom 2017. Proc. of the 8th IEEE International Conference on Cognitive Infocommunications*, (Debrecen, Hungary September 11-14, 2017), 307–314.
- [13] BODA, I., TÓTH, E., From Callimachus to the Wikipedia: an ancient method for the representation of knowledge in the WWW era, in *CogInfoCom 2018. Proc. of the 9th IEEE International Conference on Cognitive Infocommunications*, (Budapest, Hungary, August 22-24, 2018), 205–210.
- [14] BODA, I., TÓTH, E., Text-based approach to second language learning in the virtual space focusing on Callimachus’ life and works, in *CogInfoCom 2019. Proc. of the 10th IEEE International Conference on Cognitive Infocommunications*, (Naples, Italy, October 23-25, 2019), 439–444.
- [15] *British National Corpus (BNC) – Five minute tour*, <https://www.english-corpora.org/bnc/help/tour.asp>, (2019-07-25)
- [16] *Callimachus – Wikipedia*, <https://en.wikipedia.org/wiki/Callimachus> (2020-01-24)
- [17] MORRISON, A., Callimachus’ muses, in *Brill’s Companion to Callimachus* ed. by Acosta-Hughes, B., Lehnus, L. and Stephens, S. Leiden–Boston: Brill, (2011), 329–348. <https://books.google.hu/books?id=FKa9CwAAQBAJ> (2020-05-28)