Web-based Application for Presentation of UNESCO Bulgarian Cultural Heritage as a Knowledge-based Tool for E-Learning

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Abstract. The article briefly describes the database "Bulgarian cultural and historical heritage under the protection of UNESCO" and its realization through web based application. The web application follows the approach *Understanding by Design*, a modern pedagogical strategy aiming presentation of additional learning content. The web based application provides additional content in a multimedia environment that encourages the learners to manipulate information and learn through specific experiences upon research. The database and its realization – a web application as a knowledge-based tool for e-learning, were designed and developed in IMI (BAS).

Keywords: Cultural Heritage, Database, Web based application, e-Learning, UNESCO.

1   Introduction

Our motivation for designing, developing and implementing a database to present information about the seven sites of Bulgarian **C**ultural and **H**istorical **H**eritage (CHH for short) under the protection of UNESCO (UNESCO, 2017) is based on the following reasons:Retreat of ethnographic and ethnological knowledge in favor of world cultures, in which the national cultural and historical heritage is minimized and loses affiliation as a starting point and a sign of identity. The growing scale of perception of the world makes unknown our close and inherent in all previous generations (living in our lands) architectural values.

2. The visualization (through television and the Internet) of world architectural sites, which educates historical and systematic thinking in students, reduces the awareness of the value of this heritage in children's perception. Globalization (which as thinking is two-way as it deprives you of a sense of belonging and recognizes the other as your own) ignores the traces of our cultural heritage in our perceptions of the world, while the Bulgarian CHH, as the bearer of our true identity, unites the nation.

3. The possibilities of global connectivity technologies and direct access to all content "rearrange" the learning practices used, and the integration of learning with technology changes the nature of teaching and learning (especially in times of crisis).

The technologies offer a tool for learners to model an environment in which they create shared knowledge artifacts and effective learning strategies. Technologies "carry" knowledge (learning content) presented through different conceptual frameworks. In the network, learners use applications to gain learning experience. Learning is self-management based on interests, and understanding (of the content) allows the experience to self-organize into models and new knowledge (Kovacheva & Dimitrova, 2018).

2   Database Architecture

Data architecture is a key component of any database. It is represented by models or rules that determine which data is collected, how it is stored (as arranged records with identical structure, ready for use or as a set of complete descriptions of complex objects). Therefore, when designing and developing a data architecture, it is important to know: what are the purposes of the data, what is their structure, who collects it and who the users of the knowledge (information) that this data stores are. The structuring of knowledge (stored in developed database) for the monuments-sites of the Bulgarian CHH must correspond to the Standards and means for documentation and protection of sites of the material cultural-historical heritage in the Republic of Bulgaria (Cultural Heritage law 2009/2016 (in Bulgarian)). According to the adopted Bulgarian Standards, a Classification of Monuments has been developed in Bulgaria. In addition, in accordance with UNESCO Criteria (UNESCO criteria, n.d.), the monitoring of UNESCO sites emphasizes their specific characteristics – carriers of information about value, authenticity, shape, material, location, etc.

Each CHH site is complicated, complex, and systematized; formed as a result of interaction between diverse facts related to history, religion, semiotics, architecture, which have their role in creating the specifics of CHH; a representative of the Bulgarian culture and art, storing national history and traditions. All elements in the database are complicated and complex objects. The descriptions of the CHH database elements and their attributes are presented by tree structures. Each object of the CHH database is presented through a conceptual apparatus (terminology) and an interpretive framework, including not only its purpose and "construction", but also the "message" that it "conveys" over the centuries. These accents are key to understanding the value of the Bulgarian immovable cultural and historical heritage. Therefore, the sites-monuments of the CHH are identified as information resources, which are characterized by a permanent identifier "type of resource" (Table 1).

In CHH database eight elements represent information resources for:
- representation of the seven Bulgarian CHH sites under protection of UNESCO;
- "UNESCO" represents the UNESCO organization.

Two modules having a specific function have been added to the database:
- "Dictionary", a terminological resource with specific concepts, aimed at improving the historical, literary and grammatical culture of students;
- "I create", an environment for modelling a new site from the national CHH according to a given conceptual model, creating a "product" (achievement).

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Table 1. Types of information resources and corresponding Bulgarian CHH sites under UNESCO protection

Type of re-source	City	Mona-stery	Church	Tomb	Relief	Organization
Bulgarian CHH DB Object	Ancient city of Nessebar	Rila Monas-tery	1)Boyana Chuch, 2)Rock-Hewn Churches of Ivanovo	1)Thracian Tomb of Kazanlak, 2)Thracian Tomb of Sveshtari	Madara Rider (also Horse-man)	UNESCO

2.1 Organizational Structure of Cultural and Historical Heritage Domain

The representation of knowledge has a long history of development. The idea of graphical representation of knowledge dates back to 1956 as a concept of a semantic network: the first semantic network for use with computers was proposed by Richens (Richens, 1956).

The most appropriate scheme for modelling the organizational structure of the cultural and historical heritage domain is the semantic network. In it, knowledge is organized as an interconnected network of nodes, which presents different units of knowledge (selected by experts) such as sites, attributes (for descriptions of sites and their properties), concepts (concepts for explaining attributes), relationships (between sites, sites and attributes) and an application for the learner ("I create" module based on a conceptual model set in the database).

The hierarchy of nodes in the semantic network begins with the most general class of concepts - domain name (History and Civilization and Man and Society) in the "National and cultural heritage (3rd and 4th grade)", "National and world historical and cultural heritage (5th, 6th, 7th grade)" field of competence. The next, first, layer in the network contains six nodes for each of the six types of sites of the subject classification according to Table 2.

Table 2. Permanent identifiers of the type of resources in the semantic network

First layer (type information resources)					
city	**monastery**	**church**	**tomb**	**relief**	**organization**

As the subject area is divided into specific sub-topics, information about them is passed from layer to layer in the network.

In the second layer, ten nodes present eight information resources (knowledge of the Bulgarian CHH sites under the protection of UNESCO and the world organization) and two functional modules ("Dictionary" and "I create"), see Table 3. The nodes of the subsequent layers of the network store the knowledge for each element (object) of CHH database. Each information resource may or may not contain object(-s) of another type of resource: for example, objects *city* and *monastery* contain object *church*. This organizational structure provides versatility and variability in modelling content for sites.

The module "Dictionary" functions as a traditional data dictionary with concepts (headwords) used in the descriptions of each object type. It's a semantic field that is

sorted in alphabetical order and which develops the linguistic culture of learners through an accessible transition from semantics to semiotics (from meaning to the sign character of language). Explanations of concepts correspond to the literary and linguistic norms, and the terminology of the respective cultural and educational field (Kovacheva S. , Electronic Dictionary as a Tool for Integration of Additional Learning Content, 2015).

The "I create" module, oriented to learning subjects, is a WORD-format document and presents a conceptual model for describing a site of CHH. It has three main functions, defining the key parameters of the digital environment: opportunity to generate learning content with active user participation, online collaboration, and free information exchange. The module allows learners to become active participants in the preparation of new or supplementary information about architectural or historic sites in their homeland and thus they could present regional cultural monuments.

Table 3. Structure of the second layer of the semantic network

Second Layer (eight information resources and two functional modules)		
Organization	**Information resources of Bulgarian CHH**	**Modules**
UNESCO	Ancient city of Nessebar	"Dictionary"
	Rila Monastery	"I create"
	Boyana Chuch	
	Rock-Hewn Churches of Ivanovo	
	Thracian Tomb of Kazanlak	
	Thracian Tomb of Sveshtari	
	Madara Rider (also Horseman)	

2.2 Information Resources – Content and Connections

CHH database is created to meet the following needs: to contain data without any scheme or structure; for access to various data sources; for open access and permanent availability. There are many databases of this type and they may be classified as per the manner they store and extract information: Key-Value databases, Document databases, Graph databases.

As an example, we mention the *Project Pleiades database* (Pleiades). The Pleiades database employs *Uniform Resource Identifiers* to identify (uniquely and permanently) each individual place, location, name and connections in a gazetteer (an index or dictionary of ancient sites). The gazetteer covered a wide scope of the ancient Greek and Roman worlds and expanded to include Celtic, Byzantine, Middle Eastern, early Islamic, and early medieval geography. The alphabetical list of names and the set of thematic layers are not precise and flexible enough to represent the complex, partial, and changing understanding of ancient geography. This is the reason why the content of the Pleiades is organized into three types of "information resources": *places*, *locations* and *names*. In the Pleiades, *places* are conceptual units that qualify as works of human experience. They are not defined by spatial or temporal attributes because they are not objects of cartographic points on the earth surface. The *places* are known only by a

name mentioned by an ancient source, without any surviving material traces or a given archaeological site can be considered as a place for which there may be no data about its name in antiquity. Although some other projects have adopted a similar model, it is still rarely usable.

Each information resource of a certain type of Bulgarian CHH database can contain from zero to "many" resources of the same or another type and this structure of the database provides flexibility in modelling. Information resources may contain reference citations – links that point to primary or secondary literature, external data (in print or online editions), which support or expand the information contained in the database.

Each CHH database resource can be connected to others through easy relationships called "*links*". *Links* are used to create:

- hierarchies, e.g. churches in a monastery (Rila Monastery, Rock-Hewn Churches of Ivanovo), churches in a town (the old town of Nessebar);
- networks, e.g. routes connecting additional information to a certain information resource (*Madara architectural reserve* **to** *the Madara Rider*, *the Valley of the kings* **to** *the Thracian tombs*).

The designed and developed database, as a repository for storage of information resources, has as a starting point the conceptual model based on the "attribute-value" relationship. This model is similar to the "key-value" model, which is considered a high-level description (Rossel & Manna, 2017). The data structure resembles a dictionary. The dictionary contains a collection of records (dictionary entries) composed of many different fields and each contains data.

Metadata is used to describe a database object - a large number of *attributes* defined at several levels in a tree structure that have specific values. The *values* of the attributes are strings (natural language texts), images, short videos, XML files, HTML pages - carriers of educational content (knowledge of each of CHH sites), and in essence we consider the text itself as a database. UTF-8 code was used for the text descriptions.

3   *Understanding by Design* Approach and Its Link with the Database

The pedagogical approach Understanding by Design (Wiggins & McTighe, 2012) is a tool for acquiring a set of competencies and skills that allow personal development and interest in learning. Through technologies, learners develop key competencies for coding and modelling information, which achieves functional literacy. The approach is purposeful: the goal *designs* (defines) the meaning of actions in all (three) stages. When modelling comprehension training, before planning activities (Stage 3), the trainer needs clarity about what the learners need to achieve the desired results (Stage 1) and perform the tasks well (Stage 2). Desired outcomes, criteria and objectives (Stage 1) model the nature of the evidence in the implementation (Stage 2) and the design of training "with" and "from" experience (Stage 3). When designing tasks (Stage 2), appropriate evidence for the desired results is "presented" (Stage 1). After specifying whether the evidence (Stage 2) is in line with the objectives (Stage 1), the design of the activities and tasks is planned (Stage 3).

Designers (trainers) create an environment with "paths" to discover meaning, i.e. the meaning of certain facts and skills.

In order to master the knowledge (**WHAT**) users (learners) need to understand **HOW** and **WHERE** the knowledge about Bulgarian CHH is and **WHY** it is significant. Using the *Understanding by Design* approach aims to develop learning skills and habits, part of the new learning culture, including functional literacy, key competencies, and transversal skills (Kovacheva S. , Presentation of Learning Environment as Knowledge System in a Learning Environment, 2016). Key competencies are based on knowledge, general and specific skills and experience. Designed as an educational result of working with the web application, they are a guide for selection and structuring of the content offered in the CHH database. The *Understanding by Design* approach uses text in a database (both as a resource and as a tool) to explore sites and generate ideas for new sites.

The answers to the basic questions (**"What", "When", "Where", "Why", "How"**) become key "learned mechanisms" (for the learner) for finding connections and evidence in information. In each grade and in each subject, when reviewing and interpreting information, they ask themselves and answers questions about:

- *Points of view and perspectives;*
- *Arguments for an evidence;*
- *Reasons and a result;*
- *Relations and commitment.*

Understanding is a "result" of carefully designed knowledge in discovering the possible meanings of key ideas in the content; a "result" of rethinking and mastering techniques for research and discovery of evidence. The set of evidence validates the knowledge, and the key understandings (links) presuppose a developed ability to transfer. Finding information about the evidence depends on the context and circumstances that "create" the nature of data itself. Understanding is the transfer of knowledge, which implies that the learner researches (examines) a lot of information to establish its validity. They learn "how to learn" and "how to use what they have learned". Effective learning is done through "experience" (by learners) with well-designed "experience" (by trainers).

4   Web-based Application as a Knowledge Transfer Tool and a Learning Resource

The implementation of CHH database in a digital environment is carried out through the web based application "Me and UNESCO", modelled with the *Understanding by Design* approach. The main goal of the web application created is to increase the quality of learning skills in a digital environment:

1. The web application is the basis for improving the student's achievements: their intellectual development and national self-confidence.
2. The web application is a "framework" for improving pedagogical practice.

The web application includes integrated knowledge with an emphasis on the world-famous Bulgarian CHH. It is a tool for studying CHH sites (as integral "sites");

effective integrated environment for active learning and useful transfer of integrated knowledge and skills. **Figure 1** illustrates the presentation of additional learning content for history, civilization, man and society.
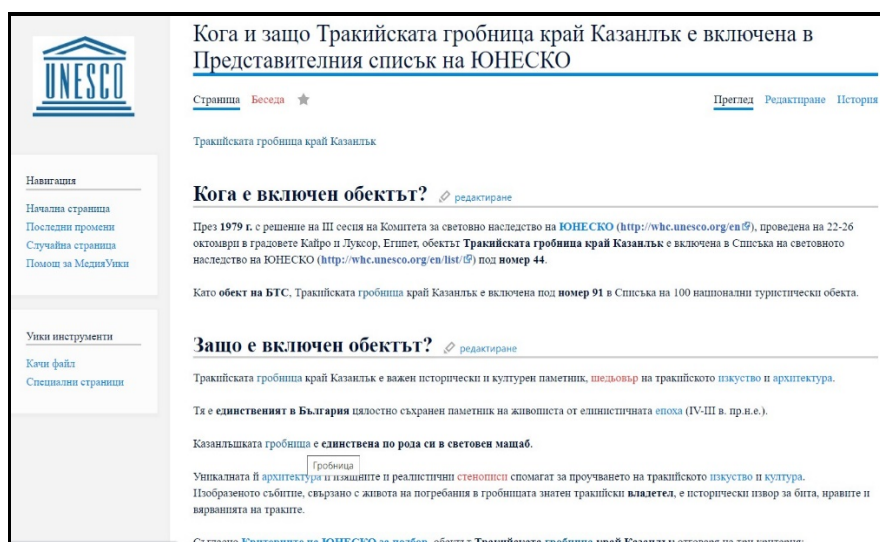

Fig. 1. "Me and UNESCO" – screenshot of the page with the answers of the questions *WHEN* and *WHY a given site is included* and the *link to the Dictionary entry гробница* /tomb/, providing additional learning content

4.1 Web Application Purpose and Tasks

The aim is to meet the need to improve the *quality of knowledge* and build *attitudes towards the value, importance and preservation* of cultural and historical heritage. The goal defines essential indicators for the graphic concept and product design: character, general vision of the web application, content structuring and subordination of individual web pages.

Tasks of the web application, as an ICT tool, are: facilitating the access to knowledge about CHH sites, the educational initiatives to achieve commitment to the cultural heritage and to promote respect and responsibility for its protection through:

- *Inclusion of the multidimensional "cultural heritage"* in each educational level as a rich resource for the development of competences and skills with greater transfer value, summarized as formal educational experience of the learner;
- *promoting the role of cultural heritage* for society as an expression of constantly evolving values and cultural diversity *and building mass awareness* of it;
- *assessing specific aspects of cultural heritage* as a shared source of memory, identity, unity and creativity.

4.2   Characteristics and Conceptual Structure

Interactivity, as a characteristic of modern educational models, supports the *understanding* and development of *key competencies, transversal skills and functional literacy* in learners. These cognitive operations lead to understanding:

- Finding and retrieving information from content;
- Summarizing and interpreting information from content;
- Rationalizing and evaluating information from content,

i.e. *to work with information* from content.

The "Me and UNESCO" web application is a collection of information resources (content) with integrated hyperlinks, implying *learning* (perception and processing of information), and the special "I create" module for the development of various artifacts (products) and for self-assessment and *evaluation* of achievements.

The conceptual structure of the web application, built on the basis of an interdisciplinary approach *Understanding by Design*, unites:

- A database supporting and providing CHH data, with structured knowledge and substantiated statements, interesting facts, hypotheses, events for specific cultural and historical sites, accessible to the public;
- Environment (information), promoting the exchange of knowledge (for learners) and outside the education system, as well as the development, systematization and dissemination of good pedagogical practices (among learners);
- Opportunities for "research" (identification, examination, interpretation and presentation) of "new" cultural-historical sites and connections between them.

4.3   Basic Accents and Desired Results

Content specifics: the Bulgarian cultural and historical sites under the protection of UNESCO, considered in the *Man and Society* and *History and Civilization* school subjects. The disclosure of the *sites* (as a whole) is provided through a database.

The main task of the web application is the "*virtual interaction*" of the students with the CHH sites. The interaction (study of the uniqueness, significance and impact of CHH cultural value) will develop their cultural knowledge and change their social behaviour.

Expected and desired results: formation of educational experience and methodological skills for active acquisition of knowledge, which leads to cognitive, social and emotional development of students.

For this purpose, the starting points for web application design process are: the content as a *resource* and the audience as a *user*, which requires the specification of:

- Key ideas, implied by the principles of the standards for structuring the curricula: *chronological sequence* in the development of the society; forming an *attitude towards Bulgarian history*; connection of the national and the *world history;*
- Key concepts related to ideas and their understanding as a basis for building *system thinking skills;*

- Expected results (achievement) set in learning activity (implementation) and related to the *key competencies and skills of the XXI century* in a separate module using *authentic resources* (for the domain), which increases the quality of learning skills in a digital environment.

The **MediaWiki** multifunctional platform for online collaboration and documentation, useful for collecting, organizing and presenting knowledge, was chosen for project realization. The idea is to present new and / or additional content as a set of hyper-documents combined with multimedia components provided on the Internet. "Me and UNESCO" use the current stable version of MediaWiki (1.32.0), designed for a website with millions of visits.

Main Text Design

It is consistent with the structure, functions and audience of the web application. The titles and subheadings are visually separated, the information is structured in subsections. Each paragraph, as part of the text, has a concluding meaning. Times New Roman font is used for the main text - easy to read (perceive), as the texts, although optimal in volume, are not short. Three colours (black, blue, red) are used, which enhance the emotional perception without distracting from the main content and present: main text, key phrases and specific highlights in the information (such as "*oldest*", "*only*", "*first*"); guidelines (such as "this gives grounds", "it proves that"); concepts in the text (which refer to the "Dictionary" module) and references (links).

Multimedia Resource Design

Video files can be started, stopped and returned for review. They have a clear picture and a short duration so as not to delay their loading. Images add value to content. Users can control their increase / decrease.

Titles, fonts and colour solutions individualize (highlight) each page and segment user interest. Page titles are an important part, summarizing the content of the information resource. They provide systematization through links *in the content*, facilitating selective reading. Subheadings organize relatively independent parts of the information resource. On the one hand, they structure the information, and on the other hand, *through links they renew the interest* of the user.

5   Concluding Remarks

In this article we have shortly presented the database "Bulgarian cultural and historical heritage under the protection of UNESCO" and its realization through web based application. The MediaWiki platform has been selected to support the web application as a software tool for E-learning**,** whose essential advantages are: easy access for students, no installation needed, option as self-study from home, and easy adaptation of the software tools. A digital resource of such kind, which provides a new learning content, represented in text, image and multimedia form, help students not only to obtain new additional knowledge, but also to share experience and create teaching materials.

After loading the information resources for three objects (city, tomb, monastery) and module "Dictionary" in a prototype of the web application, an *approbation* was performed by a "*survey tool*". The main task for the three groups of surveyed users (school

students, university students, educators, randomly selected) is that each participant "plays" individually with the prototype, and then characterizes its parameters. The survey contains a group of questions for *validation and verification of information resources*: the truth of the facts are a guarantee for sustainable knowledge, and the interrelations between them are the basis for successful knowledge transfer. The majority of respondents have positive attitudes towards the use of the web application as a form of learning, contributing to their complex knowledge and future development.

The Bulgarian CHH database information resources are useful for extended training in *general educational subjects*; training in educational subjects in the *field of global, civic and intercultural education*, forming national self-confidence, patriotic spirit and patriotism; expanding and supplementing *content that is present integrated in other educational subjects*. As content, the information resources in the web application meet the requirements for accessibility, non-linearity, interactivity and multimedia, thus retaining attention and enriching the general culture (and not only) of the users.

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