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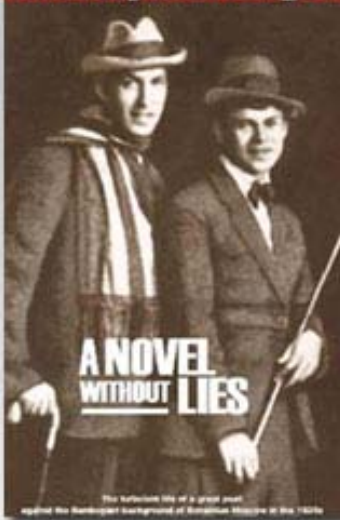
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# Technology-enhanced Learning for Cultural Heritage

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**Abstract.** This paper demonstrates an approach for technology-enhanced learning, combining analysis, collaborative work, mobile learning (m-learning for short), discussion, and learning-by-authoring approaches in order to achieve more active participation of the learners during the reception of knowledge and to stimulate their creative thinking. The learners visit famous churches, monasteries, museums, etc., where they can see samples of Bulgarian Iconography supported by m-learning. They rely on the GUIDE@HAND platform containing personalized collections presenting location, historical data, pictures, etc. Multimedia and other information resources are delivered through the *Virtual Encyclopaedia of the East-Christian Art* digital library (BIDL)—a web-based environment for registration, documentation, access and exploration of Bulgarian iconographical artefacts. The main goal of the learners is to create their own learning material/project by analysing the available resources. The presented use case also involves collaborative work and discussion approaches in order to attract learners and support their more active participation in the learning process.

**Keywords:** Use Case Scenario, Technology-enhanced Learning, Learning-by-Authoring, m-Learning, Cultural Heritage, East Christian Iconographical Art.

## 1 Introduction

Current technology-enhanced learning points to the investigation and the deployment of workable learning methods and scenarios for creative thinking, learning-by-doing and learning-by-authoring, engaging learners in more active participation during the reception of knowledge. Creativity is described as “a fundamental dimension of human activity” in [1]. The main questions asked are: How can learners’ creativity be activated and stimulated? What learning methods can be used in order to attract learners for more active participation in the learning process? What tasks can be interesting

and attractive and can stimulate learners' desire to work? Is it possible to change the role of the learner to become the author of easily acceptable and comprehensive learning material?

Workable solutions of these problems are essential in education in Fine Art, and particularly education in East Christian iconographical art. Moreover, arts learners have to work every moment on their professional development in the direction of creativity.

Having in mind the learners' needs and their features in the last team projects we started a long-term consideration of use cases in a scenario for technology-enhanced learning on East Christian iconographical art and culture. Our aim is to demonstrate creative learning-by-doing through active learners' authoring of specific learning materials, using multimedia and information resources delivered through the *Virtual Encyclopaedia of the East-Christian Art* digital library (BIDL) [2]—a web-based environment for registration, documentation, access and exploration of Bulgarian iconographical artefacts. The specific learning resources are united in a project with the main creators – the learners themselves – aided by their mentor/advisor. The project includes several analyses of different thematically related problems (for example, theological meaning of the Iconography of Christ, art critical analysis of the development of Christ's image in the different iconographical schools in Bulgaria, study of the main iconographic techniques used in the historical territories of Bulgaria for the depiction of Christ, etc.), discussed and refined during the discussion of the analysis between the project participants. Similar approaches with implementation of methods of creative discussion on learners' thematic presentation for collaborative learning are described in [3][4].

Moreover, the learners can visit famous churches, monasteries, museums, etc., where they can see samples of the observed iconographical artworks supported by m-learning. M-learning or mobile learning [5] is a special type of e-learning which applies mobile devices (mobile phones, tablets or PDAs) in education. Mobile devices offer new possibilities in delivering learning materials and supporting the learners. They can provide m-learning content anywhere and at any time due to their portability. Since the devices are equipped with a built-in positioning system the learner may receive the learning material at the right place. We apply mobile learning to deliver information at the real location of the icons. They can use the GUIDE@HAND platform [6], where the preselected m-learning collections show multimedia and information digital resources (e.g., pictures of icons, panorama pictures, detailed descriptions, data sheets, etc.), delivered through the BIDL.

This paper discusses a real learning situation (a use case) of creative learning-by-authoring in Bulgarian iconography, combining collaborative work, creative thinking, m-learning and discussion approaches.

## **2 The Involved Platforms**

The *Virtual Encyclopaedia of the East-Christian Art* digital library is an Internet-based environment, a place where iconographical objects of different kinds and ori-

gins were documented, classified, and “exhibited” in order to be widely accessible to both professional researchers and the wide audience. Rare specimens, private collections, icons from difficult-to-access storages, distant churches, chapels, and monasteries, objects in a risky environment or unstable conditions, etc. are appearing for new e-exposition. The library provides services for registration, documentation, access and exploration of a practically unlimited number of Orthodox iconographical artefacts and knowledge and the end users can use this rich knowledge base through its interactive preview, complex search and selection of objects and groups. A complete description of the rich BIDL functionality is made in [2]. Until now, the library was used in several cross-media, ubiquitous and technology-enhanced learning applications [7][8]. At present, media objects and resources from BIDL are used as input data for a learning analysis and synthesis in several projects.

*GUIDE@HAND* [6] is an audio tourist guide mobile application providing tools and interactive services for mobile exploration of cultural places and objects. The aim of the guided walks offered by the application is to enable the visitors to change their perception of new or well-known locations, objects and motives and explore the past and present of an area in an entertaining and exploring way. It can be used as a multilingual interdisciplinary guide both in the open air and inside buildings. The Global Positioning System (GPS) is used to exactly determine the location of the traveller. *GUIDE@HAND* is developed by a team from the Institute for Computer Science and Control, Hungarian Academy of Sciences (MTA SZTAKI).

The application can be applied to educational purposes as well. Here we just mention some examples related to m-learning. The first member of interactive thematic walks developed by MTA SZTAKI is based on the novel *Rooftops at Dawn* by a celebrated Hungarian author, Géza Ottlik. The experience guides the user through the city as the story unfolds on location. Between parts of the story archive videos, photographs, articles collected in theme based multimedia galleries help evoke the era, Budapest in the 1930s. The walk can be used in studying literature and history.

*Mobilis* is one of the newest educational-tourism attractions of the Hungarian town Győr. *Mobilis-Győr* is the first and only thematic scientific playhouse in Europe which concentrates on vehicles and traffic and it combines the exciting sides of natural science and technology. MTA SZTAKI designed and implemented a Web page and mobile application for *Mobilis* in order to help young people in their professional orientation in an interactive and entertaining way. The content consists of six modules introducing different professions. Several game schemes (multiple choice, matching pairs, outline map, logic games, etc.) were implemented which can be easily uploaded with content for a specific game.

In the last years MTA SZTAKI and IMI—BAS started a joint project aiming to provide opportunities to use the *GUIDE@HAND* application in presenting Bulgarian cultural and historical heritage objects, delivered by BIDL [9], Fig. 1. We created the *BOOK@HAND* BIDL application as a new member of the *GUIDE@HAND* application family this year. As a result of the project, the BIDL content editor tool allows the users to create personalised collections of selected iconographical objects. It helps the users to save, edit, or delete these collections on the Web. Furthermore, each collection has a unique QR code, which can be used to generate an export file of the

selected collection. The BOOK@HAND mobile application can read this QR code, and then download the collection. The mobile application stores locally the downloaded collections and presents the downloaded icons and the related descriptions.



Fig. 1. Observation of an iconographical masterpiece from the Museum of wood-carving and iconography art, Tryavna, Bulgaria by using the BOOK@HAND platform

### 3 Development of the Use Case Scenario

The learning scenarios for the system design describe typical or important ways of use of the system. They are designed to give to all the partners in the project (both technical partners and content providers) a shared understanding on the purpose of the system and the ways it will be of use in practice.

The scenario outlined below follows the base methodology of developing use cases presented in [10]. It went through the following stages [7]:

- *Stage 1:* Determining the needed functionality of the use case scenario and all ontological and gnoseological assumptions, the methodological approach, basic requirements, specification phases of development, etc.
- *Stage 2:* Description of a real learning situation of creative learning-by-doing through active learners' authoring of specific learning materials, using multimedia and information resources (media objects, descriptions, glossaries), delivered by the chosen knowledge repository, viz., the *Virtual Encyclopaedia of the East-Christian Art* digital library; learning methods, situations and context of use. Special attention is paid to the learning content in the areas of cultural heritage and in particular in the area of East Christian iconographical culture and art and the learner's features and needs [8][11]. m-learning collections are created that can be used on the location of the real artworks.
- *Stage 3:* Presentation of the general formulation of the scenario with a clear definition of the objectives, basic types of the resources, user groups, activities, requirements, preferences, motivation, needed and/or required information services along

the learning process according to the various users, other required functionalities and information processes to be achieved [8].

- *Stage 4*: Formalization of the scenario and presentation of the functionality required by the users via a combination of activities that can be carried out by the platforms. For each activity the following information is defined: input and output data, user group performing the activity, steps leading to the accomplishment of the activity, information structures and tools needed for the development, and maintenance of resources supporting the activity.
- *Stage 5*: Development of the scenario and definition of a minimal and extended variant.
- *Stage 6*: Determining the basic requirements to the multimedia, semantic and learning resources supporting the use case scenario.

## 4 Use Case Scenario Features

### **Overall objective.**

The overall objective of this scenario is to describe the basic ways of exploitation (called activities) of the two software platforms (viz. BIDL and GUIDE@HAND) for technology-enhanced learning by various types of users in order to provide services for creative learning-by-doing through active learners' authoring of specific learning materials.

### **Methodology.**

The main learning goal of the use case scenario is the project development. Examples of learning sub-goals in the scenario are: the learner has to analyse a character, the learner has to find iconographic objects, the learner has to track an iconographic technique, the learner has to develop an iconographic object, the learner has to compare iconographic objects according to the iconographic technique used, etc. In order to achieve the main goal the following theoretical and experimental methods are used: comparison and differentiation, analysis, and interactive methods including group work, discussion and debate.

### **Users.**

According to the scenario, the main user groups are the developers of various resources and the consumers of those learning resources (i.e., academic users, researchers in the target learning domain, non-academic users). Academic users and researchers as the major learners can also be authors of learning resources. These users should normally possess a medium or high level of knowledge in the target learning domain or should plan to use the platforms to reach a high level in this domain. They actively search and use the digital resources found to accomplish their learning goals (examples, development of thematic projects, term projects, graduation works, preparation of analysis and analytic searches of various problems in the area, performing formal TEL education, etc.).

### **Basic resources.**

The basic types of resources managed or provided by the platforms are: primary annotated digital resources, semantically annotated digital resources, learning resource, semantic resources (ontologies), and profiles of users. Their essences are described in detail in [8].

## **5 Learning Situation (Use Case)**

**Title:** Development of the project *The Iconography of Christ in the Historical territories of Bulgaria*.

**Learning domain:** East-Christian culture and art.

**Primary source of digital objects for the learning domain:** the *Virtual Encyclopaedia of the East-Christian Art* digital library.

**m-Learning tool:** the BOOK@HAND BIDL mobile application.

**Users:** developers of learning resources and users of the learning resources.

**General scenario situation:** Professor Ivanov is a lecturer at the National Art School. He is delivering a course on Iconography for students of different classes of the Wall Painting and Art History departments and students of the Faculty of Theology of Sofia University. To all his students he has given the task to prepare a project on the Iconography of Christ in the historical territories of Bulgaria. This project involves a division of the students into several teams according to their interests: Theology team, Art Critics team, Art Technique team, and Artistic team. Prof. Ivanov assigns to the different workgroups the following particular tasks:

1. make an analysis of the theological meaning of the iconography of Christ (the Theology team);
2. make an art critical analysis of the chronological development of the iconography of Christ in the different iconographical schools in Bulgaria (the Art Critics team);
3. examine the main iconographic techniques used in the best Bulgarian examples of iconography of Christ (the Art Technique team);
4. make an icon of Christ or a part of a mural painting depicting one of Christ's feasts (the Artistic team).

To prepare their analyses, the participants in the teams perform various specific tasks assigned by Professor Ivanov, for example:

*Sample task for the Arts Critics team:* Make an art critical analysis of the development in time of the iconographic image of Jesus Christ in the various iconographical schools on Bulgarian land.

Steps to perform in the BIDL:

1. Select a minimum of six iconographic object containing the image of Jesus Christ in a one-figure composition (Note: The right choice requires selecting iconographic objects with the character or Jesus Christ Pantocrator, or Blessing Christ, or Jesus Christ enthroned, or St. Veronica, etc.).
2. Arrange the iconographic objects in groups by school of iconography.

3. If a school of iconography's group contains objects by an eminent author and founder of the school, place these high on the list. Among the objects designated for art critical analysis there should be at least one by a prominent author/school founder, if available.
4. Ensure that the iconographic objects designated for art critical analysis are currently in good condition.
5. Ensure that at least one primitive iconographic object and at least one Renaissance iconographic object are included in the iconographic objects designated for art critical analysis.

In writing the art critical analysis compare the selected iconographic objects by contrasting clothing, gesture/s, the character proportions, object/s, the presence of other character/s and/or symbol/s, backgrounds, other element/s (e.g., clouds, etc.) in the iconography of the image of Christ. Look for changes in the iconography of these components, for example, appearance or lack of components (objects, symbols, characters, etc.), changes in the background, clothing, etc., in the selected set of samples.

*Sample task for the Art Technique team:* Find iconographic artefacts/objects containing the image of Jesus Christ in order to compare their specifics from a technological point of view.

In a similar way the students in the Theology team perform the specific tasks assigned to them.

Every team prepares a multimedia demonstration (multimedia presentation, film) for a collaborative discussion forum on the basis of the text version of the analysis. At a special working meeting a representative of each team demonstrates the theses and results of the analysis to the other teams through the multimedia demonstration. The listeners from the other teams and Prof. Ivanov, who have previously become familiar with the text version, actively follow the demonstration and formulate questions, comments, ideas to discuss. On the basis of the discussions and presentations a specific task for the artistic team to draw an iconographic object is collectively chosen. After the working meeting each team prepares a final version of its analysis, consistent with the discussed issues. The Artistic team performs the task of drawing an iconographic object, using the learning materials produced by their colleagues from the Art Critics, Theology and Technique of Iconography teams.

Every team can make not only a virtual (in BIDL), but a real artwork observation, too. Learners visit famous churches, monasteries, museums, etc., with masterpieces of the Bulgarian Iconography by using the BOOK@HAND BIDL application containing collections. Every m-learning collection has its topic, goals, key places, m-learning tasks, etc. and can be downloaded to the mobile platform from the BIDL Web page. A demo is accessed on-line at [12] and presented at [9].

Professor Ivanov evaluates each team according to:

- completeness, adequacy and correctness of the text material (choice of collection, choice of base characteristic/s of the iconographic objects to use when implementing the analysis, adequacy of the findings and conclusion of the analysis);
- attractiveness of the multimedia presentation of the theses and results of the analysis;



- questions/comments, their meaning and correctness, creative ideas and thinking.

## 6 Conclusions and Future Work

Nowadays, the work continues on the refinement of the implementation of the presented use case and the development of necessary functionality in the mentioned platforms – BIDL and GUIDE@HAND. In fact the scenario implicitly poses the specific requirements for the different software components, supporting considerably the design of such a service-oriented architecture, as well as determining the functional specifications of the services provided by the platforms, the needed information services, methods and operations on the different levels of exploitation, the users and their activities, etc. On the basis of the use case scenario one could plan the testing and the evaluation of the platforms and their components, as well as the functionality and the multiple reusability of the selected project approach. In the future, we would like to add geographical coordinates to the icons presented in BIDL and extend the BOOK@HAND BIDL application with predefined guided walks to visit famous churches, monasteries, museums, etc. where the icons can be found.

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