

# Personal Work Space and Content Analysis Functionality in a Cultural Heritage Digital Library

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**Abstract.** The paper presents a different vision for personalization of the user's stay in a cultural heritage digital library that models services for personalized content marking, commenting and analyzing that doesn't require strict user profile, but aims at adjusting the user's individual needs. The solution is borrowed from real work and studying of traditional written content sources (incl. books, manuals), where the user mainly performs activities such as underlining the important parts of the content, writing notes and inferences, selecting and marking zones of their interest in pictures, etc. In the paper a special attention is paid to the ability to execute learning analysis allowing different ways for the user to experience the digital library content with more creative settings.

**Keywords:** Multimedia Digital Library, Services, Personalization, Learning Analysis

## 1 Introduction

A tendency from the last few years points towards the use of cultural heritage digital libraries (CHDLs) not only as a source and demonstration of digital objects, but as environments for active knowledge perception and studying. This tendency determines the development of new methods and techniques for personalization of the users' stay in the library and adjustment according the user's individual needs.

Most often the personalization techniques in CHDLs includes the selection and recommendation of information resources, system interfaces and the means of navigation according to the personal characteristics of the user (demographic status, goals, tasks, skills, motivation, achievements, interests/disinterest, preferences and requirement, etc.) on one hand and according to the user's behaviour in the environment on the other - a solution specified as personalization according to a user profile. Closely related to this solution are the personalization techniques adverting the ways of delivery and access the content, content adaptation and transformation, grouping, ordering, and reconstructing.

However, the use of user profiling techniques has several advantages as well disadvantages. Good features are the possibility to get to know the users themselves and their personality, to fit the system using rules to user's desirable content and to recommend similar content. But, these good features could also be irritating and intru-

sive for some users and could become unacceptable with time. Moreover, the existing systems have difficulty to specify the difference between temporary and permanent user characteristics and requirements or they don't have them in mind. They also use preliminary established templates for personalization, content adaptation and content delivery avoiding some serious problems such as incompatibility and incorrectness of their usage.

In this paper we try to suggest a different idea for personalization of the users' stay in the library modeling services for personalized content marking, commenting and analyzing that doesn't require a strict user profile, but aims at adjusting the user's individual needs.

The solution is borrowed from real work and studying of traditional sources of content (incl. books, manuals), where the user mainly performs activities such as underlining the important parts of the content, writing notes and inferences, selecting and surrounding zones of their interests in pictures, etc.

A special attention is paid to the ability to execute learning analysis allowing different ways for the user to experience CHDLs content in more creative settings.

The second part of the presented work is in a phase of experimental implementation in the frames of the SINUS project "Semantic Technologies for Web Services and Technology Enhanced Learning". In this project the learning analysis of the Orthodox iconographic art is proposed to be performed by services over the content of the Bulgarian Iconographical Digital Library (BIDL, available at: <http://bidl.math.bas.bg>) [1]. A formal use case scenario of this activity is created [2][6] and an ontological model of the learning method "Analysis" is developed.

Section 2 of the paper discusses the model of services for personalized content marking and commenting also called personal work space or smart personal corner. Section 3 discusses one of the SINUS use cases, demonstrating the learning analysis of the Orthodox iconographic art. Section 4 presents the specification of the ontological structure of the analysis learning method in the SINUS project and its usage in the learning analysis service. Finally, the paper discusses the implementation, future work and plans for extending the research.

## **2 Smart Personal Corner in an Iconographical Digital Library**

The personal work space in the Bulgarian Iconographical Digital Library is now in a process of modeling and is based on a long-term observation of the users' preferences, cognitive goals and needs, aiming to find an optimal functionality solution for the end users.

The functionalities planned to be implemented in the library are:

- Raw digital object (viz. mainly images) sharing, ranking, enclosing, fragment tagging, fragment linking, fragment commenting;
- Iconographical object metadata (or part of them) underlining, outlining, commenting (liking, disliking, sharing), reviewing and tagging;
- Iconographical object (digital object and its descriptive metadata) tagging, commenting, ranking, reviewing, bookmarks and sharing.

The functionality will be developed using mainly the Web and Web 2.0 services and will aim to also link the iconographical digital library with the social network community.

There are some ideas for giving the user the ability to create their own Serious Games using BIDL content and objects, following personal scenarios or directions.

The current BIDL release includes a service for raw digital objects comparison that shows the percent of their similarity. This functionality gives the ability to compare objects in the library (often used by specialists for specifying the objects' iconographic school, author, period, etc.) or to compare objects from the library with external ones (used to prevent inclusion of different version for one object).

During the project "Knowledge Technologies for Creation of Digital Presentation and Significant Repositories of Folklore Heritage" [8] some experimental personalizing services are implemented in the project folklore digital library.

### **3 SINUS Use Case of Learning Analysis of the Orthodox Iconographic Art**

The SINUS learning scenario includes a technology-enhanced learning situation, titled Development of the project "The Iconography of Christ in the Historical Territories of Bulgaria" [6]. The learning domain is East-Christian culture and art and the primary source of digital objects for the learning domain is "Virtual Encyclopaedia of the East-Christian art" multimedia digital library. The target groups of users are learners and developers of learning resources. The general scenario situation is the following: 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 supposes a division of the students into several teams according to their interests - theology, art critics, art technique, and painting. Prof. Ivanov assigns to the different workgroups the following particular tasks: a) Perform an analysis of the theological meaning of the iconography of Christ (the Theology team); b) Perform an art critical analysis of the chronological development of the iconography of Christ in the different iconographical schools in Bulgaria (the Art Critics team); c) Examine the main iconographic techniques used in the best Bulgarian examples of iconography of Christ (the Art Technique team); d) Make an icon of Christ or a part of a mural painting depicting one of the Christ's feasts (the Artistic team). To prepare their analyses, the participants in the teams perform various specific tasks assigned by Professor Ivanov. An example task for the arts critics' team is defined as: "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 for performing the task above:

1. Collect a minimum of 6 iconographical objects containing the image of Jesus Christ in a one-figure composition (Note: The right choice requires selecting iconographical objects with the character or Jesus Christ Pantocrator, or Blessing Christ, or Jesus Christ enthroned, or St. Veronica, etc.).
2. Arrange the iconographical objects in groups (i.e. classify them) 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 iconographical objects designated for art critical analysis are currently in good condition.
5. Ensure that at least one primitive iconographical object and at least one Renaissance iconographical object are included in the iconographical objects designated for art critical analysis.
6. In writing the art critical analysis compare the selected iconographical 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.

For the needs of the SINUS project these activities are provided by learning analysis services executed in the "Virtual Encyclopaedia of the East-Christian art" multimedia digital library. For that purpose several base semantic resources are developed: a base ontology of the East-Christian iconographical art objects [5] (capturing the objects' knowledge in the library), specialized ontologies of the learning domain - East-Christian iconography art [4] and an ontology of the analysis learning method (presented in this paper). A special web service is developed to join these ontological structure and to deliver appropriate knowledge and iconographical objects.

#### **4 Ontological Model of the Analysis Method**

The learning scenarios in the SINUS Project define the main result of the learning process (learning objective) as the analysis of the Iconographic domain and a specific subset of its objects from different points of view (theological, artistic or technological).

The *analysis* is a method which includes a scientific research about particular objects or a whole domain, and aims to collect useful information about their properties, characteristics, and integral parts.

The main purpose of the analysis is finding the most important characteristics about the objects or domain being analyzed, their structure, dependencies, internal and external relationships between their constituents, etc. Those are revealed by:

- main trends in the development in the domain, direction and dynamics of the development;
- discovering the key factors and conditions that directly affect the changes and development in the domain; examining the strength of the degree of their influence upon and the direction of the changes;
- determining the degree of influence of the domain upon other related domains;
- identifying new trends in the development of the domain being analyzed;
- defining current problems, boundaries and limitations in the development of the analyzed domain, as well as problems related with them and possible areas of improvement;
- evaluating the results in the domain's development.

To implement the analysis method service, the SINUS Project expands a practical learning problem into a series of steps, leading to its solution. The steps are defined as a formula [6], which combines actions (skills) from Bloom's Taxonomy [3] with entities from the base ontology of the Bulgarian Iconographic Objects (or additional ontologies that complement it). For example, in step 2 of the artistic team task, the **User** *classifies* iconographic objects accordingly to their iconographic school, i.e. performs an action of grouping objects based on certain criteria.

Using the actions in the "Analysis" learning objective, proposed by Bloom and extending them for the use of the specific learning application, we defined an ontology, the structure of which is shown in figure 1.

The ontology [7] defines the following base classes: **Action, Analysis, Efficiency, Feature, Objective, Purpose, Type** and **User**. The *Action* class is subclassed by: BreakingDown, Choosing, Classifying, Comparing, Correlating, Diagramming, Differentiating, Discriminating, Distinguishing, Focusing, Illustrating, Inferring, Limiting, Outlining, PointingOut, Prioritizing, Recognizing, Separating and Subdividing, used to describe the types of learning goals within the Bloom's Taxonomy. *Efficiency* is extended by the two classes Effective and Ineffective. The *Purpose* class has the following subclasses: Development, Influence, NewTrends, Problems, Results and Trends. A *Type* is further specified by being: AssessmentAnalysis, CombinedAnalysis, ComparativeAnalysis, DiagnosticAnalysis, PartialAnalysis, ProspectiveAnalysis, QualitativeAnalysis, QuantitativeAnalysis and TemporalAnalysis. We have also the three subclasses of *User* – Educator, Learner and LearnersGroup, given that Educator and Learner are disjoint (in the general case the user couldn't have learning purposes and is a simple CHDL content viewer or explorer).

The relations in the ontology are: Analysis *hasAction* Action, Analysis *hasEfficiency* Efficiency, Analysis *hasFeature* Feature, Analysis *hasObjective* Objective, Analysis *hasPurpose* Purpose, Analysis *hasType* Type, Analysis *usedBy* User, LearnersGroup *hasLearner* (inverse of *partOfGroup*) Learner, and Learner *partOfGroup* (inverse of *hasLearner*) LearnersGroup. Analysis itself could also be related to several external entities, for example, it solves Learning Task(s), it could be related to other Learning Method(s), and it leads to achieving of Learning Goal(s).

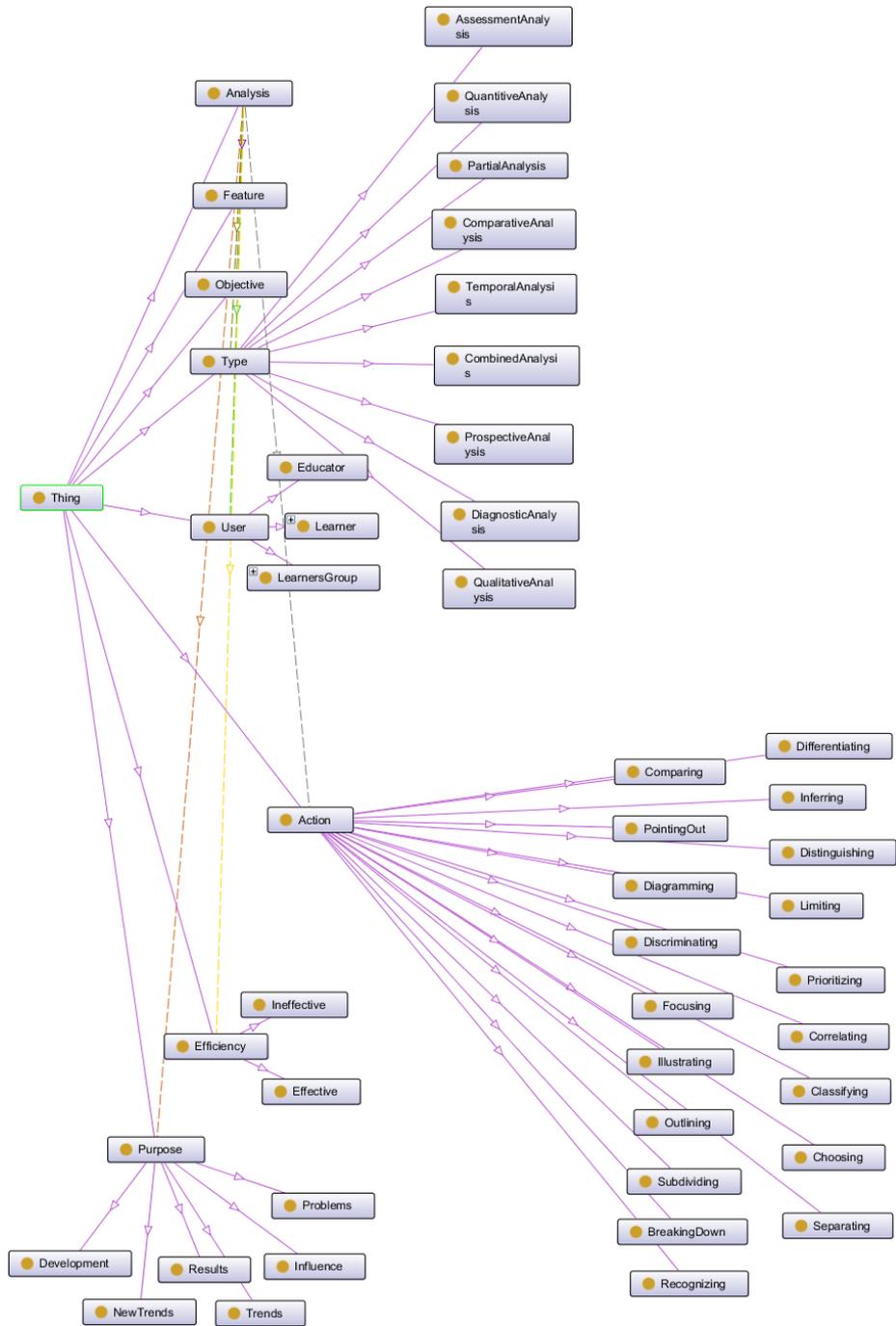


Fig. 1. Classes in the ontological model of the learning method "Analysis"

In the presented ontological model there are no constraints on which actions can be used for the different types of analysis. However, we are currently investigating the possibilities of adding strategies for performing different analysis types as sequences of actions to be carried out with the observed objects. For example, the ComparativeAnalysis method would require a learner to select several resources (Choosing), identify their properties (BreakingDown) and compare them (Comparing), possibly bringing the attention to a certain resource (PointingOut). Such rules provide the basis for describing parts of the learning process formally.

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