

# TOWARDS ENHANCEMENT OF THE QUALITY OF EDUCATION THROUGH INNOVATIVE USE OF DIGITAL CULTURAL ECOSYSTEMS

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## Abstract

This paper presents the activities for development of models for effective use, continuing development, research and delivery of digital cultural resources in digital cultural ecosystems for learning purposes following the grand vision, good practices and achievements of the Digital Research Infrastructure for the Arts and Humanities.

Keywords: Digital Cultural Ecosystems, Education, Learning Analysis, Context-dependent Use, Personalization.

## 1 INTRODUCTION

The paradigm of digital cultural ecosystems appears to respond to the growing willingness to share the wealth of cultural resources and continuous research and study of cultural treasures. These systems virtually assemble various digital collections, archives, virtual museums, digital libraries and cultural heritage sites in order to facilitate the access to their resources, bringing cultural content to new audiences in novel ways. The digital cultural ecosystems (DCE) are meant to connect people, data, processes and things by the shared use of digital platforms. Formally, a digital cultural ecosystem can be huge, covering joint content management systems of one country or a region (similarly to a large forest or lake in the nature), but it can also be small, such as a virtual museum or a private collection of artefacts (the nature analogues: a puddle of water or only a tree). "Digital organisms" "work" through services and tools to satisfy their users. DCEs aggregate heterogeneous resources leaning on interoperability support of its building blocks [1]. The idea is to create a collection of flexible services that can quickly be adapted to the dynamically changing needs. From the users' point of view, an ecosystem refers to enrichment and more convenient use of different communication channels on which they access and publish content. This paper presents the activities for development of models for effective use, continuing development, research and delivery of digital cultural resources in digital cultural ecosystems for learning purposes following the grand vision, good practices and achievements of the Digital Research Infrastructure for the Arts and Humanities. Major digital sources related to European history and culture are fragmented in various repositories, libraries, and collections. This raises the question of how users-learners can access heterogeneous sources. The problem of how to utilize all available knowledge that is distributed over multiple locations and stored on a myriad of digital storage is challenging. The number of cultural artifacts is increasing rapidly and there is also growing demand for simple access and better usability and personalization. We are working on an innovative model for the creation of new knowledge and we address the problems of gathering, processing, analyzing, visualizing massive amount of data targeting education purposes [2][3]. We are developing feasible methods of learning analysis, understanding, interpretation, context-dependent use and sharing of content in ecosystems for digital culture in new ways and through means for fuller delivery of knowledge to digital collections and archives of cultural artefacts.

## 2 METHODOLOGY

The research methodology adopted in the current study includes:

- methods and techniques for scholarly investigations, selection, synthesis, analysis and generalisation of scientific information on achievements, best practices, developments, policies and problems in Europe and Bulgaria related to the objectives of this study—Big Data management;

- concept modelling, methods and techniques for proposal and analysis of ideas for the implementation of major infrastructure components of a technology platform (common architecture, object ontology concerning the study, a national metadata profile, profile of the data and their exchange, including services for data mining, search, context-based use, *etc.*);
- concept modelling, methods and techniques for software design of optimal functional models and architecture for an ecosystem, repository, infrastructure, services, tools, *etc.*, created on the basis of ideas from the preceding item;
- methods/techniques for designing pro-innovative models for efficient use and continuing development of software platforms; specifying working strategies and policies;
- schemes for monitoring and control and for internal evaluation of the performed research.

The research methods and techniques are based on the standard methodology established in Informatics and ICT and assume that the created models, methods and tools will be reusable, flexible and extensible. The research methods and techniques has in mind the high dynamics of the development of the field, of the fundamental and interdisciplinarity research.

### 3 RESULTS

The current section presents an approach aiming to give opportunities for creation of a more effective and engaging DCE content observation involving users in active knowledge perception. Automatic content synthesizing has the potential to offer the required improvements to the learning experience of the users. The actions, which are part of the model, are diverse enough to be interpreted differently in a specific context and can be combined freely to support more personalized systems, ultimately increasing the users' satisfaction with their experience in the DCEs.

#### 3.1 DCE Content Synthesizing for Educational Purposes

The long-term observation of the user's needs and wishes in DCEs gives us the idea to look at synthesis techniques and tools as continuation issues of digital libraries (DL) content analysis [4][5], which could offer new abilities for improved usage of digital cultural assets in DCEs. The content synthesis method includes specific activities to combine objects or/and their elements using various sources, making connections, classify, divide, compare or contrast executed according to selected context or goal. More general, as Bloom claims [6], *the synthesis is creatively or divergently applying of prior knowledge and skills to produce a new or original whole*. To implement the synthesis method (mainly for research/learning purposes), the practical research/learning problem is divided into series of steps, leading to its solution [7]. The steps are defined as a formula, which combines actions with content units. For example, the user combines digital art objects (paintings) accordingly to the personages, *i.e.* he/she performs an action of grouping and ordering objects based on certain criteria. The selection could be further arranged according to the time feature and the user can see/discover the main trends, direction and dynamics in the authors' artwork.

The specific synthesis actions aim to improve the manipulation activities with DCE assets during inferring phase of their observation. The actions are loosely divided in two groups, according to their scope of influence. For reasons of clarity, the model makes use of each action only once, but it is possible (or maybe even advisable) for more complex models to use a different grouping of actions and reusing the same action at different points. The first sub-group refers to actions used for synthesis of information transferred between the participating actors. The administrator, the moderator and the editor negotiate and collaborate together on new concepts for a digital cultural objects (DCOs) collection, while at the same time, part of the moderator's task include facilitating the interaction between the editor and the viewer by initiating the interaction, communicating with both parties and intervening, if necessary, in order to address the user's expected results. In a similar way, some actions are oriented towards synthesis of information derived from the relations between the DCOs collections from their early conceptual stage to the final results offered to the user. At first, the concept and its realisation by the editor should anticipate the user's potential goals. Then the two initial collections are compared and contrasted against each other. If required, information could be incorporated or integrated into the collections, different sections could be combined or substituted, and the collections could be rearranged, reorganised or even fully reconstructed. The end result is a DCOs collection individualized to meet the user's expectations. The second sub-group refers to actions used for synthesis of information within the boundaries of the DCOs collections themselves. Again, those actions can be viewed according to their role in the whole process of the collections' development.

Once the administrator, the moderator and the editor have come to an agreement on the concept, it is formulated and then modelled, designed or devised by the editor. At the same time, the user expresses the desired result of the interaction and plans his/her goals accordingly. The distinction within this grouping is meant to address the professional approach by the creators of DCEs, contrasted with the diverse level of knowledge and experience, which is covered by the users. After the initial concepts and goals are set, the collections are created by composing them from different DCOs, compiling them from already existing collections, or generating parts of it from scratch, and structuring the whole information. At this point the collections are categorised in order to assess the extent to which the proposed result satisfies the user's needs. This, in turn, influences the modification and adaptation of both the collection offered from the DE and the collection created by the user, until a satisfactory result is reached. After the successful end of the interaction, the information from the complete process and the changes made to individualise the collections according to the user's preferences, serves to validate, revise and reinforce the initial concept and to help the user progress in his/her further experience with the DCE.

Moreover, the different needs of the different users have to be considered. For example, the learners and educators demand for essential information and services for developing DE collections in line with pedagogical requirements, viz. the creation of learning projects or learning context-dependant presentations. Other actors (viz. scientists, professionals, tourists, administrators, etc.) could have different needs.

## 4 CONCLUSIONS

Further investigations in the above-discussed domain point to a wide variety of directions:

- Creation of workable methods and tools, aiming to increase and generalize the visitors' experience in the digital culture platforms and development of contextual techniques for personalizing user's work in these platforms.
- Development of multimodal interfaces and intelligent visualisation of complex information relying on enhanced user experience and usability (*incl.* user-centric visualisation and analytics, real-time adaptable and interactive visualisation incl. people with disabilities [8][9], real-time and collaborative 3D visualisation, dynamic clustering of information [10], gamification [11], etc.).

Moreover, the design and improvement of the learner's experience in the changing cases would not be restricted by the available technologies, platforms and tools. The field has great potential for innovations, especially in our world of active imposition of new e-devices. The focus will be also in the research and exploitation of new or emerging technologies (e.g. 3D, augmented and virtual reality, visual computing, smart world, media convergence, social media, etc.) for the development of innovative products, tools, applications, and services for creative digital content production, usage and management. The aim is to transform and customize the valuable parts of mankind's cultural and historical ancestry into digital assets, whose integration and reuse through research-lead methods has high commercial and non-commercial potential for learning and cultural institutions, tourism, creative and media industries.

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