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The Use of Object-Oriented Integrated Information Systems in e-Learning

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Abstract: e-Learning exhibits different trends that reflect not only the development of ICT (mobile technology, resource sharing or cloud solutions) but also changes of student's and tutor's attitudes to the processes of learning and control of acquired knowledge. It also reflects requirements for educational effectiveness and for life-long education. The study presents the concept of object-oriented integrated information systems utilization in e-Learning which is compared with the role of LMS with maximal using of database system. The contribution also includes a conceptual analysis and a case study of possibilities of the concept's implementation using a content management system.

Key words: Application in database, e-Learning, object-oriented, integrated information system, management system, requirements

INTRODUCTION

In recent years, e-Learning has been developing dynamically as its importance is growing in both academic and corporate spheres (Chang, 2016). In the academic sphere it is related to a desired increase in study efficiency and a change in student's attitudes towards higher preference for digital textbooks and other digital learning resources in comparison with printed resources). It is important to respect the dynamics of change in education. Knowledge transmission is related to time and it is liable to continuous updating. LMS have become the extremely important in e-Learning development and offer comprehensive support to education including programming of education processes (Poulova *et al*., 2015). LMS also provide multistage feedback between the tutor and students. Alongside further development of LMS functionalities, among other significant trends in e-Learning belong m-Learning (Simkova *et al*., 2012; Soykan and Uzunboylu, 2015) and the utilization of collectively generated sources (typically wiki sources, (Gokcearslan and Ozcan, 2011). Increasing attention is being paid to different possibilities of personalized learning, especially, the connection of learning styles and adaptive e-Learning systems (Essalmi *et al*., 2015; Truong, 2016). Personalized learning can also use various approaches of artificial intelligence (Rani *et al*., 2015; Truong, 2016; Ozyurt and Ozyurt, 2015). Another trend is an expansion of publicly available sources which includes uploading and sharing high-quality lectures and presentations (e.g., on YouTube) and the utilization of virtual environments for collective and social forms of education (SecLife). On the other hand, even though, the LMS environment widely used for course tutoring, the issues of sharing learning objects across different subjects and between teachers as well as transparent availability of resources after finishing a course in LMS (e.g. in preparing students for a comprehensive and final exams) are not consistently addressed at universities, yet. Forming comprehensive knowledge throughout the whole course of university study would be strongly supported by the creation of larger sectoral structured learning units that would contain neatly interlinked texts, terminology as well as visual, multimedia and presentation information. Following chapters describe an approach to creating larger branch structured learning units by means of object-oriented integrated information systems.

MATERIALS AND METHODS

Concept and potential role of object-oriented integrated information systems in e-Larning: Object-Oriented Integrated Information Systems (OOIIS) may be in relation to e-Learning, called Information Systems (IS) whose basic information structures are represented by learning objects of different nature in particular presentations, study texts, annotated photos and their sets, video files and meta-information about both web and other sources. These learning objects are then integrated into different applications whose primary component is a structured study support (Fig. 1) interconnecting learning objects into compact learning units. The personalized study structure may also be formed from thematic units of one type of learning objects typically thematic photo or video

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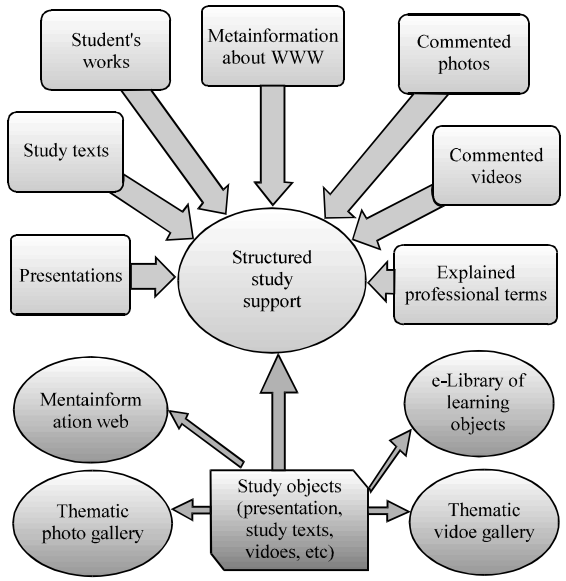

Fig. 1: Linking learning objects into structured study supports and other e-Learning information systems

Table 1: Comparison of selected features of LMS and object-oriented integrated information systems, based on the content management system

Parameters	Details
Property; Unification of the format of information presentation	
LMS	Structured object oriented study support
Only within individual courses	Page and learning objects formats
Property; Sharing learning objects	
LMS	Structured object oriented study support
It is not commonly implemented for sharing between courses	Full sharing without restrictions
Property; More parts of one web page	
LMS	Structured object oriented study support
References to objects	Presentation of objects and references to them
Property; Unification of functionalities	
LMS	Structured object oriented study support
At the level of implemented functionalities of a particular environment	Full unification based on the structure of content management system

galleries (Fig. 1). Free sharing of learning objects which supports targeted searches of study subjects can be done by means of an e-Library of learning objects. Such sharing can be a platform for exchanging learning objects for teachers as well as a comprehensive source for students writing their papers. Selected benefits of the structured learning support in comparison with LMS are clearly summarized in Table 1.

In order to utilize the OOIIS for an academic field of study, a part of it is object-interconnected and supplemented with links to relevant courses in LMS as well as to a specialized wiki and field-specific information necessary to study a particular field. Such an OOIIS offers for the use in specialized academic e-Learning a combination of benefits brought by LMS, object-oriented IS, transparent and annotated links to external sources (e.g., scientific databases, quality external lectures) links to collectively generated sources (specialized wiki). Moreover, all these sources are accessible in one place. There is another fundamental and noteworthy advantage, namely that such an integrated information system is easily administered by providing its users with various rights to access and edit this IS.

RESULTS AND DISCUSSION

Implementation of object-oriented integratedinformation system for e-Learning: Applications for object-oriented IS for e-learning is based on a generic database system Marwin (Borkovcova and Borkovec, 2014) which was applied to the Content Management System (CMS) in order to manage the web content written in the programming language ASP.NET. Database schema shows in Fig. 2.

Marwin as a framework (definition) database includes information from which the resulting application is generated. Marwin thus facilitates applications for data management and their generic display. Marwin can also, be used for the entire CMS. Applications may be physically separated or they may directly involve the application data. The solution with separated framework database allows the operation on its own platform and the client data can thus be used only as a data repository.

It is also, possible to use this database for a large amount of applications that are defined in it. The core of this application allows to process the membership provider in the range of providing basic information about the user and their roles after they login. Marwin (Borkovcova and Borkovec, 2014) also allows complete data management, application menu, printing outputs and it enables to fill in forms with any non-generated elements, including programming forms.

Linking among applications can be strictly three-level architecture or with direct data sources. The resulting core of the framework which can by means of the. NET reflection open any object class can be used as a data source in the final part of the presentation logic with the full use of options provided by object architecture. The disadvantage of this solution is the need to rebuild it in case of modifications to these classes.

The direct connection to data sources means that SQL queries which provide information for generated forms are defined in the database. This option does not meet the requirements of a clean object model. It has several substantial advantages, though:

- It allows direct modifications of the data offered from these sources without modifying the application code

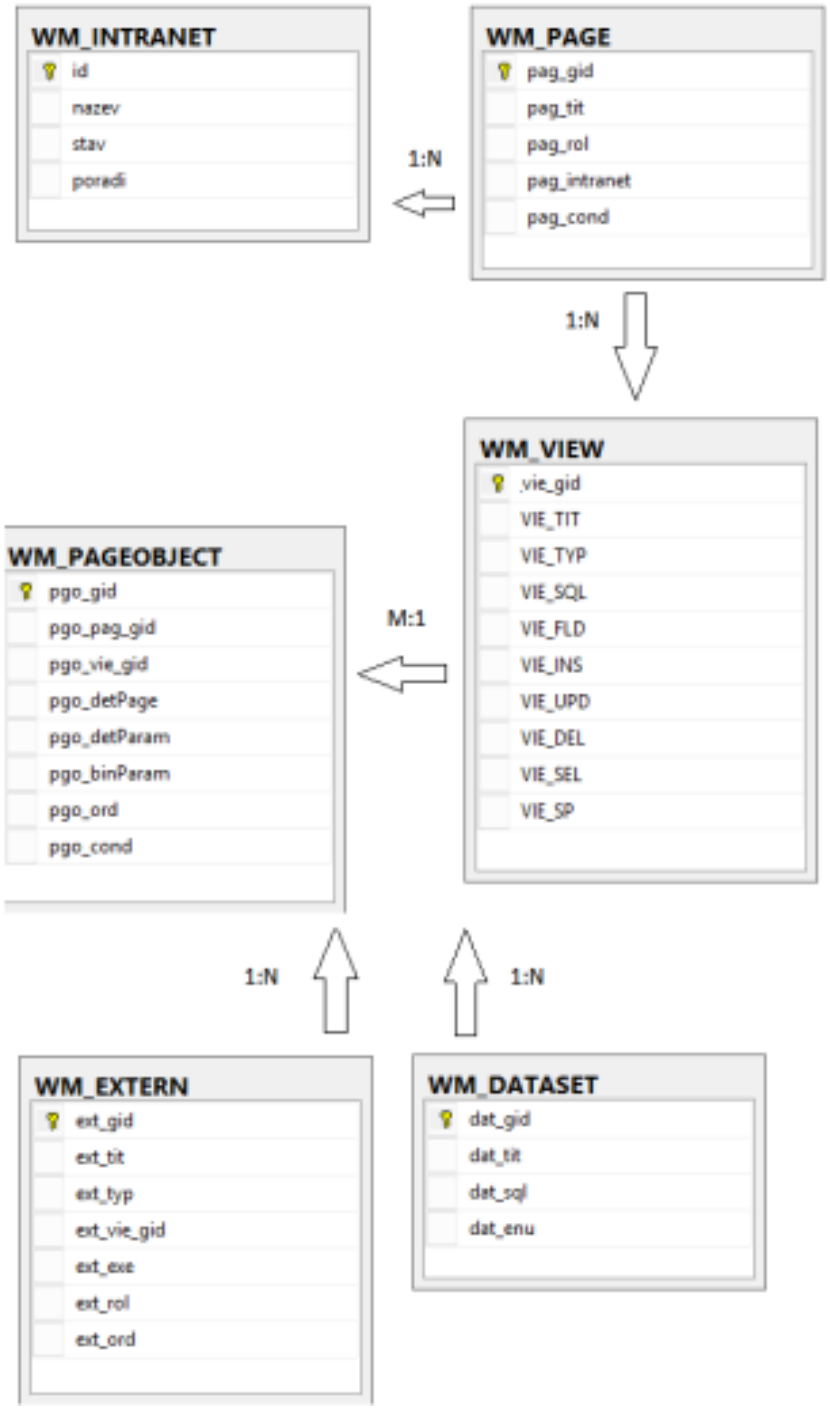

Fig. 2: Database schema of application in Marwin

- For some types of applications it reduces power consumption and allows an optimal use of a particular relational database
- The definition database does not depend on a specific language environment of the core of framework. For example if the core for the client/desktop version is written in. NET it is possible to realize this core for mobile applications in Java, without any modification of definitions in the database

- No particular language environment specialists are required for creating data sources creation

Data sources-table WM-VIEW: In order to facilitate, the basic functionality of framework and user data management it is necessary to concentrate definitions of data resources-database objects and direct SQL queries-in the database. Their definition, including user accesses is concentrated in the table WM-VIEW. This table is used by the core of framework in order to do the following things:

- Adjust the data source according to the user's characteristics and the rights stemming from their role
- Process a data source including specified filters, classification and other requests from the presentation layer
- Open it in the optimal way-in case of lists it is for example advisable to use page numbers
- Return an open data source into the most suitable presentation logic
- In case of details, enable the update of the data source

Generating forms-tables WM-PAGE and WM-PAGE OBJECT, WM-MENU: When taking into account the web form of the core, the basic element of the presentation logic is the website. If a web page is generated it should be able to contain a list (lists) detail (-s) supplementary objects as needed by particular applications. The base of a website definition is a table WM-PAGE which contains information about access roles, page labels and possibly other conditions. The table WM-PAGEOBJECT arranges linking the data generated by the table WM-VIEW to a specific page. The core of framework uses tables WM-PAGE and WM-PAGE OBJECT to display the desired page content. If an application requires a standard menu, the table WM-MENU which enables by means of self-relation to define any menu structure is used. When the menu is used, the core of framework proceeds to generate an application as follows:

- It determines the user and their role
- It generates the menu based on previous information
- It ensures generating the adequate site generation after selecting a menu item

At this point it is possible to generate whatever from the generic basis of a particular application. It is then possible to specify a concrete component solutions, validation issues and the final appearance of the presentation layer by means of an interpretation language. What remains to be done are the elements that cannot be generated (programmed forms or pages) and a system for import and export, mainly for printing.

Ensuring external objects-table WM-EXTERN: For a truly functional IS it is necessary to assume that the standard use of a system of lists and details will not be sufficient. It is therefore necessary to enable generating other objects, freely programmed forms, executive buttons or inserting objects of any kind (e.g., illustrative pictures). At the same time it can also be enabled to add a print manager (see the description of the WM-REPORT table) for the direct output of required data. Therefore, if the data source has any additional facilities, the core of framework must enable their views and executive calls. The implicit location of these elements may be in a common container in a precisely located place of the form.

Printouts-table WM-REPORT: Printing outputs can be done in various ways. It is however, always necessary to ensure the equal access to data sources. It is impossible to tolerate any control of user rights and the implied data ranges at two locations. The WM-REPORT table thus complements the WM-VIEW table that is in cases when the direct output of a framework filtered and sorted list is not enough, directly on a generated form.

There are two ways of using this table within the framework; either the print menu of the application may be automatically generated from the table by means of self-relation for multi-level menu or items may be linked to forms which offer the print option. In order to generate printouts it is good to use a descendant of the detailed form because the inputs of printing parameters are in terms of validation used components used and the presentation layer essentially more or less the same. It is useless and dangerous to redo the code in any way.

The proposal of framework interpreter: The framework interpreter is a set of keywords that allow the developer to influence the appearance of elements of presentation layer directly in the database. It concerns the presentation part of the application as well as the ranges of user's rights and roles.

Not all fields or columns are visible to all users and not all fields can be edited. The first keywords that the interpreter must address are the requirements for visibility and read-only property. Both of them may be based on a particular user's roles and the framework must set specific attributes on visual elements after these roles are

evaluated. It is not about business logic whose functionality ensures the actual performance, the most important thing here is the appropriate setting of the presentation layer. Another important element of the interpreter is the ability to provide connection to the tables from outside sources.

The user would not be able to determine the textual values from the core values and they would be unable to input them. It is appropriate to define a keyword that in a particular field indicates which data are key and which actually appear in the user menu. If the form contains choices from the list of users in more fields it is useless to upload this list of users repeatedly to all of them. It is better to clone the data.

Portal for tourism as object-oriented integrated information system-administration portal and implementation examples: Administration of a tourism portal is done through a secure interface for defining the website data content for tourism management. Such an interface allows editors to define these objects and their relationships. The authors of the solution exploited the possibilities of Marwin generic forms. They added to these forms other necessary features in order to make the management of these interconnected objects clear, simple and reusable.

All administration is currently included in the following items: category, keywords, sources and links. Management of individual categories allows plugging various categories and modules to various pages. Keyword management system allows to define their mutual recursion to individual modules. The technical solution uses not only standard bonds of a relational database server but also the possibilities of Marwin interface as they may be utilized by both the user and editor. The recursive inner (nested) structure of information allow editors of these interrelated objects enters all chains of information only once. The site with multimedia structured instructional texts uses the partial recursion of data sources. Each chapter listed in the menu on the left is separate and it is a kind of root directory of specifically parameterized data recursion.

One of the selected separate sites shows a complex utilization of several technological components. From the perspective of recursive linking of data objects, this subpage behaves as the one previously mentioned. It is also fully manageable in simple records it is not necessary to respect the way of recursion direction and take direction redundancy information. At the same time, this site offers using a documentary server.

This server can provide its users with a standard tree structure of documents for a specific data object. Their interconnection is mutually recursive, so, it is not necessary to connect individual document with various pages more than once or vice versa (i.e., to connect a page with multiple documents). Documentation server is a generic extension of Marwin application which ensures physical storage directly in the database server. In addition to standard file system rights, the system provides an opportunity to use various levels of access to all documents, not only directly on the interface but also while sending links to documents. The entire system is interconnected with Active Directory and the access in terms of authorization corresponds to the common mapping of both roles and network users. Consequently, even external users can be easily added to the user mapper. It is thus ensured that nothing can be separated from the main system and that all objects are safe.

Below the page search filter, there is available further separation of objects-at the time of selection. In case it is necessary to open literature bound to an object, after, pressing the item literature, the user will see a menu of individual items belonging to literature.

Marwin system uses this display and allows to generically view not only lists but also, other linked information. All the above mentioned technical possibilities are utilized to the full extent by all the remaining sub-pages including mutually recursive objects, document management and the application of generics in the background.

CONCLUSION

The conceptual approach to object-oriented integrated information systems which interlink not only objects but also LMS specialized wiki and specialized information from a particular field of study, offers interesting possibilities for their utilization in e-Learning. These options were verified at the Faculty of Informatics and Management, University of Hradec Kralove in the application for an object-oriented IS used in e-Learning. Framework or definition database includes information for generate the resulting application. It may be physically separated or may be using for direct access to application data. Solution with separated framework database allows traffic at its own platform and client's data is used only as a data repository. It is also possible this database use for greater amount of applications that are defined therein. However, associated with it is greater load and applied technologies.

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REFERENCES

Borkovcova, M. and R. Borkovec, 2014. Effective interconnection UML and realized applications use of UML in small companies and development teams. Proceedings of the 24th IBIMA Conference on Crafting Global Competitive Economies: 2020 Vision Strategic Planning and Smart Implementation, November 6-7, 2014, IBIMA, Milan, Italy, ISBN:978-0-9860419-3-8, pp: 1884-1887.

Chang, V., 2016. Review and discussion: e-Learning for academia and industry. Int. J. Inf. Manage., 36: 476-485.

Essalmi, F., L.J.B. Ayed, M. Jemni and S. Graf, 2015. Generalized metrics for the analysis of e-Learning personalization strategies. Comput. Hum. Behav., 48: 310-322.

Gokcearslan, S. and S. Ozcan, 2011. Place of wikis in learning and teaching process. Procedia Soc. Behav. Sci., 28: 481-485.

Ozyurt, O. and H. Ozyurt, 2015. Learning style based individualized adaptive e-Learning environments: Content analysis of the articles published from 2005 to 2014. Comput. Hum. Behav., 52: 349-358.

Poulova, P., I. Simonova and M. Manenova, 2015. Which one or another? Comparative analysis of selected LMS. Procedia Soc. Behav. Sci., 186: 1302-1308.

Rani, M., R. Nayak and O.P. Vyas, 2015. An ontology-based adaptive personalized e-Learning system, assisted by software agents on cloud storage. Knowl. Based Syst., 90: 33-48.

Simkova, M., H. Tomaskova and Z. Nemcova, 2012. Mobile education in tools. Procedia Soc. Behav. Sci., 47: 10-13.

Soykan, E. and H. Uzunboylu, 2015. The review of published articles on mobile learning area in ebsco database. Procedia Soc. Behav. Sci., 182: 710-717.

Truong, H.M., 2016. Integrating learning styles and adaptive e-Learning system: Current developments, problems and opportunities. Comput. Hum. Behav., 55: 1185-1193.