ePortfolio Data Utilization in LMS Learner Model

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Abstract: In this article a research about ePortfolio utilization in eLearning systems is given, utilization opportunities of the ePortfolio data for the adaptive learning system learner model initial data organization are described to partly solve learner model initial data problem. It ensures time and work resource economy as well as quick data acquisition comparing to lasting and tedious learner testing. The result of this work is a more complete description of the learner that is quite important in case of the adaptive system. Learner model is viewed in the lifelong learning context, turning more attention to the adult learning features. The article encourages discussion about general dynamic learner model creation and utilization in the adaptive learning system based on the research about possible ways of learner data acquisition.

1 INTRODUCTION

With the development of information technologies new learning instruments that ensure more qualitative learning process appear. Learning Management Systems (LMS) are purposed to help teacher by offering different types of learning materials and by not attaching learner to certain location and time. The number of researches about adaptive e-Learning system (ALE) utilization for providing learning process is increasing. In these researches the system is able to recognize learner's needs and features, and offer necessary material to the learner in an understandable way, which is more appropriate for acquirement. The changes concern also the learning object – learner. Nowadays necessity for lifelong learning – i.e. learning during the whole lifetime from childhood till old age continuous or periodical – is increasing. The lifelong learning importance also proves the Europeans Commission program "The Lifelong Learning Programme: education and training opportunities for all" that has been realized from year 2007 to 2013 (The Lifelong Learning Programme, 2011).

Learning demands a lot of resources from adults: both material and human resources, but gives back multitudinous values as rise of self-confidence, self-esteem, enlarges trust to associates, satisfaction with life or ability to cope with difficulties, protects from depression and enhances welfare. On the other hand, learning process also has negative features. It can cause anxiety, stress and affect human mental health. Fear or aversion against learning can appear if learning environment reminds individual his previous negative experience about learning process (Field, 2011). One solution for this problem is adaptive learning management system (ALMS) utilization in learning.

This article is oriented to learner data acquisition types. In the learner role is viewed adult, his learning specificity that is described in second section. When acquiring new information, adults are based on their own experience that can be collected in the ePortfolio system. In the third section ePortfolio concept essence and utilization opportunities in the education and LMS are shown. Based on previous research results in the fourth section user model data classification and data life cycle is offered, and data acquisition types are discussed. In the fifth section a research of how data about learner from ePortfolio can be imported to the LMS is described. The last section contains conclusions.

2 SPECIFICITY OF ADULT LEARNING

Adult education is a multidisciplinary process that is oriented to supported and effective learning during the whole lifetime. Its goal is to give knowledge that would improve professional qualification and help to consummate civic, social, moral and culture

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attitudes and skills, and to gain success in all vital spheres (De Goñi, 2006).

There exist numerous opinions about adult education, which are determined by different factors, for instance, differences between Western and Eastern cultures. In the field of pedagogy different education theories are considered (for example, M. Knowles, N. Gruntvig, etc.). Nowadays adult education is very often connected with the concept of "andragogy". Andragogy is science about adult education that describes adult learning essence (Knowles, 1980).

Based on theory of andragogy, scientific researches (Merriam, 2001); (Cercone, 2008), and practical operating in adult learning, it was concluded that adult learner can be described as a person who has the following qualities:

- the ability to take responsibility about the process of self-education;
- the ability to move his/her own education and operate by individual plan (self-direct learning);
- he/she possesses with an accumulated life experience reserves that are abundant source to continue studying;
- he/she has the necessity of learning that is tightly connected with social role change;
- he/she is problem-centered, with the necessity to use obtained knowledge immediately;
- he/she is motivated to learn with internal, not external factors ("self-stimulant person", self-esteem, life quality);
- comprehension about what he/she needs to know;
- learning irregularity (the system can be visited very rarely because of work, family or other obligations).

The adaptive system utilization for ensuring education is connected with computer utilization that is why an important role is played by an adult attitude towards information technology utilization, their computer skills and openness to learn new technologies. There are a lot of researches that describe adult learning problems by learning information technologies (Candy, 2002); (Cercone, 2008). By researching adult learning features, Kathleen Cercone has distinguished attributes utilized in the adult education and for each of them offered an appropriate education model by creating „Recommendations for Online Course Development based on Characteristics of Adult Learners".

The most important adult learning feature is that adult learning is based on their experience that has been collected in different life situations (Brookfield, 1995). Based on this adult learning difference in the offered article the question of how the accumulated experience of an adult that is reflected in ePortfolio can be used to gain e-Learning environment learner model start data is researched.

3 ePORTFOLIO

ePortfolio usage for the improvement of learning process is still a novelty. In this section the essence of ePortolio is viewed, as well as obtainable benefits of its utilization in education and examples of ePortfolio usage with LMS.

3.1 The Essence of ePortfolio

Electronic portfolio or ePortfolio (or digital portfolio) is a digitalized artifact (artifact can be any piece of content) collection that contains demonstrations, resources and achievements of a person, group, community, organization or institution (Lorenzo and Ittelson, 2005). This collection contains text, electronic files, images, multimedia, records and hyperlinks. Artifacts can be also collected from a virtual space and represented in wiki pages, blogspots or ePortfolio views (Bubaš et al., 2011). Artifacts can be adapted so that they can represent certain student uniqueness by ensuring depiction that shows the depth of individual learning (Barrett, 2004). EPortfolio data collection is placed on the Internet and can be organized and managed by the person who created that ePortfolio by indicating access rights to the information.

(Grant, 2005) has focused on ambiguous concept of ePortfolio utilization. ePortfolio type classification is also dissenting. By content and utilization ePortfolio can be divided into the following types: student, teaching, institutional, assessment, learning, developmental, working ePortfolio, etc. (Lorenzo and Ittelson, 2005); (Barrett, 2004). Each of above-mentioned types offers evidences that show appropriate skills and knowledge in an appropriate scope.

3.2 Benefits of ePortfolio

ePortfolio system popularity has recently increased and it is used as an activity in many education institutions. ePortfolio utilization has been widely researched in the education institutions, for instance, learning of portfolio utilization in higher education

(Zubizarreta, 2004). According to (Graf et al., 2012); (Buzzetto-More, 2010), utilization of ePortfolio in the process of education gives students the following: the opportunity to develop organizational skills; realize their skills, abilities and lacks; estimate their own progress; demonstrate how skills have developed over time; promote their own professional choice; develop comprehension about their own studying; improve motivation and involvement into learning process; have effective instrument to prove studying; create dialog with teacher. ePortfolio contains personal information about its owner, his competences, goals, accomplished and planned works, achievements, interests and values, thoughts, statements and comments, test and exam results, about information generation and ownership of some portfolio parts.

For ePortfolio creation envisaged programs are divided into commercial and open source programs. Interesting research has been made in the article (Himpsl and Baumgartner, 2009) where the evaluation criteria of ePortfolio system are described and given twelve most popular system evaluations by taking into account these system goals, administration opportunities, offered activities, publication opportunities and usability. This article gives an overview about such system as: Drupal ED, Elgg, Epsilon, Exabis, Factline, Fronter, Mahara, Movable Type, PebblePad, Sakai, Taskstream, Wordpress. (Sweat-Guy and Buzzetto-More, 2007) compare such ePortfolio systems as Eportfolio, Foliotex, Life Text, TaskStream, TK20, Trueout, Blackboard and Open Source. In the article (Balaban and Bubaš, 2010) an evaluation of Open source ePortfolio system Mahara and Elgg was performed for the benefit of Mahara.

After analyzing literature about ePortfolio utilization in learning process it was concluded that ePortfolio:

- ensures accessibility, portability, rises technological skills, is learning-centered, offers opportunity to find arguments and evidences easier for collecting information about oneself from different aspects (Raybourn and Regan, 2011);
- gives opportunity to describe oneself fully (both internal and external worlds) (Graf et al., 2012);
- ePortfolio applications allows functional integration with different Web 2.0 applications and can be used as a contact for e-Learning activities (Orehovački et al., 2012);
- content a little bit duplicates with data about an individual that are stored in the social network; in some learners it causes disinclination to use ePortfolio system (Griesbaum and Kepp, 2010);
- is self-expression type; helps to find collaborators to share with common interests; ePortfolio is intersection of reflection, documentation and mentoring (Seldin, 1997).

3.3 ePortfolio Usage with LMS Systems

When making a research about ePortfolio utilization opportunities for learner model data acquisition, it was concluded that in the learning process ePortfolio is mostly used only as data storage with a purpose to store learner data and achievement evidences together. Only in a few articles experiments using ePortfolio data for learner model (LM) initialization are viewed. Further some ePortfolio usage examples are mentioned.

ePortfolio utilization with the purpose of reflecting and presenting student works and allow others to estimate these works is viewed in Bubaš, et al. article (2011) where an integration of Moodle learning system, ePortfolio system Mahara and blog posts system WordPress is performed.

(Griesbaum and Kepp, 2010) describe Moodle integration with ePortfolio system Mahara CollabIni at the University of Hildesheim. In this article ePortfolio is used as an instrument to ensure personal information management for all university members with the purpose to facilitate self-presentation opportunities.

(Knight and Bush, 2009) describe Integrated Learning Environment (ILE) where they perform Simulated Professional Learning Environment system integration with LMS (Moodle) and ePortfolio System (Mahara) with united student registration in all systems.

(Guo and Greer, 2006) use ePortfolio artifacts for LM initialization. Scholars choose artifacts as evidences based on the questions asked. A system based on ePortfolio data performs a test by searching appropriate artifacts. At the end of course obtained learning results can be saved in ePortfolio.

4 THE LEARNER MODEL

The basis of an adaptive system is composed of three main components: the domain model, the adaptive model and the learner model. The domain model stores knowledge acquired by a learner that is divided into small parts such as concepts. The adaptive model ensures an appropriate system adaptation function by adapting acquired

information based on learner necessities and features. The learner model (user model or student model) contains data that describe some real person who is a learner in this system. The depiction of the learner data in the system is connected with time dimension by showing certain data values that describe system user in certain point of time or interval.

Based on the previous research (Vagale and Niedrite, 2012b) about in LM found data types, ALE learner model data by their meaning and life length are divided into three groups: *basic data*, *additional data* and *complete data*. Created division helps fully describe the LM data life cycle.

4.1 LM Data Types and their Acquisition

The first time when a user registers in the system, it gains *basic data* about this individual that are unchanged or static, their value during the system utilization stays unchanged or is changing very rarely. Basic data contain learner personal information (login, password, name, surname, email, gender, age, date of birth, native language, nationality, address).

Basic data values are written in LM based on: (a) system administration registration data; (b) user-filled registration form; (c) user data import results from other systems.

LM basic data are not enough for learning system to adapt to certain learner necessities. System also collects *additional data* that highlights individual features of a learner. Additional data characterize learner as a personality (personality data) – his individual features, concentration abilities, personality type, collective work abilities, relationship formation abilities, emotional condition, attitudes, learning style and cognitive types. The additional data can save also information about what a learner must acquire (pedagogical data - programs, topics, course sequence, plan); data that describe an adaptive environment for learning (preference data - language, presentation format, sound value, video speed, web design personalization); data that describe previously obtained experience of a learner in work with computers and software that will be used during learning process (system experience - obtained certificates, skills in e-Learning system utilization) and data that characterize system user working environment (device data - hardware, download speed, screen resolution).

Figure 1 shows the sequence of LM data acquisition based on data type classification that is described in the article (Vagale and Niedrite, 2012b).

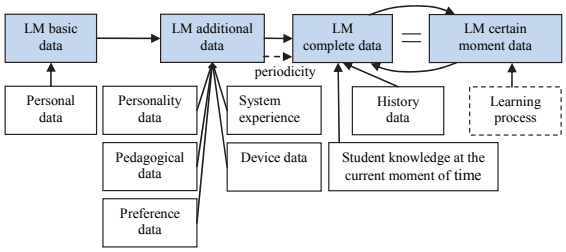

Figure 1: LM data acquisition sequence.

Additional data are dynamic. At the beginning of learning, data that the system will use to ensure the adaption are collected. But over time these data about the person (for instance, learning style, goals, etc.) change that is why in the adaptive system additional data must be periodically updated. This process is shown in Figure 1 with an interrupted bullet from additional data to complete data.

After researching scientific articles about LM additional data acquisition types it was concluded that for LM additional data acquisition can be used in the following scenarios: (a) during the process of registration the system offers to accomplish test or tests to acquire certain data, and a user himself can choose which tests to accomplish; (b) during the process of registration the system offers non-adaptive content, registers user's activities, then with the help of data mining calculates data about the learner, for example, learning styles; (c) additional data are obtained from other systems (registration system, other learning system, social network, ePortfolio) after the process of user registration.

Above-mentioned scenarios are depicted in Figure 2, where from basic data with interrupted lines possible optional transitions to the data acquisition types are depicted: (a) to the data acquisition with the help of tests, (b) to the data acquisition as the result of data processing, where data are taken from other system or (c) LM basic data are taken as complete data and only later by analyzing learning results and registered user activities with the help of data mining algorithm additional data about an individual are gained. In Figure 2 from additional data block goes an interrupted bullet, which indicates that additional data can be restored periodically.

Theoretically, the more additional data about the user the learning system can gain, the more precise is his depiction in this system. However, only by LM and adaptive model mutually interaction good system adaptation ability can be ensured.

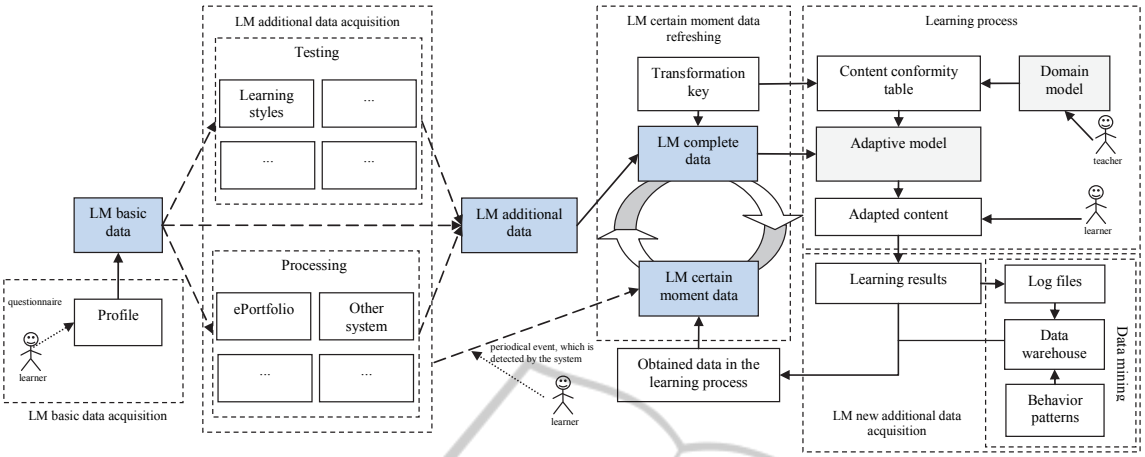

Figure 2: Learner model life cycle.

LM complete data shows how the system interprets real learner in a certain point of time. Complete data includes all information that the system knows about the user in a certain point of time. Complete data includes basic data, additional data, learner knowledge in a certain point of time and activities done during the learning process and results.

4.2 LM Life Cycle and Place in an Adaptive System

ALE learner model modeling process consists of model initialization, updating and data reasoning. More about it is written in the article (Vagale and Niedrite, 2012a). In the Figure 2 the most important processes that occur in adaptive system in connection with the learner model are shown. Processes are depicted in boxes with intermittent borders. The interrupted bullets show dispensable transitions. During the learner model life cycle the following actions occur:

1. At the beginning of LM life cycle basic data and/or additional data about the learner are collected. Additional data are obtained as a result of testing or other system processing. In this step LM initializations occurs and as a result the system "gains" a view of the learner. At the end of initialization LM complete data are obtained.
2. System now has information about the user and with the help of the adaptive model offers him acquired information in the most appropriate way. Adaptive model takes data from LM and by using "Content conformity table" according to LM data offers new information in agreeable way.
3. While learning, a learner interacts with the system. The system saves all learner activities and results them in data base tables or event register.
4. When a learner has ended up with interaction with the system, it performs collected data analysis and processing, for example, by using data mining algorithms or user behavior patterns. Then, an acquisition process of the new additional data that are connected with learner takes place.
5. After new data acquisition the system updates LM by rewriting or adding new LM model data. As a result, LM complete data are obtained that remain actual till the next data updating time.
6. Returning to step 2.

In the case of adult learning, it is important to anticipate LM data periodical refreshing from ePortfolio type system. In this case conflict solving that is connected with the age (i.e., the newest data) and data correction (i.e., data that have higher priority) must be anticipated.

5 DATA ACQUISITION FROM EPORTFOLIO

One of the newest research directions in creation of the learner model is its dynamic modeling where student interaction with the system is continuously supervised and LM data are updated in real time (Graf et al., 2012). However, the question about those human-characterized data that are already collected in other system is still topical. In the general case a person can use more learning system,

ePortfolio systems and also other environments not connected with learning that can store user-characterized data. Acquisition and utilization of these data in adaptive system as LM additional data is topical for modern researchers.

5.1 Data Integration Examples

Possible options of the data acquisition from another system: (a) data migration – data are imported from the other system, in the source system data are deleted, synchronization between both systems does not exist; (b) data integration – between both systems data synchronization exists.

In case of data integration, some problems like data structure, syntax and semantic heterogeneity problems must be solved (Walsh et al., 2011). To solve these problems, data unification or mapping schemes are created. Mapping is a presentment of an association between different system data model identical data (Walsh et al., 2011).

Mapping can be fulfilled automatically by determining conformity between appropriate attributes with identical attribute names or manually when conformity between system data is made by an administrator or a system designer.

For mapping result storage general user models or learner model server are used. (Niedritis et al., 2011) in the article use Generic User Model for this purpose. (Walsh et al., 2011) have described data integration between systems Sakai and Moodle with the help of framework FUMES, and mapping results are stored in the user canonical model. Van Der Sluijs and Houben (2006) use Shared User Model.

For data transferring from one system to other mostly eXtensible Markup Language (XML) is used with standard data protocol that is employed for web services (Walsh et al., 2011).

OWL language is used in the newest researches of data integration problem solving. For instance, (Van Der Sluijs and Houben, 2006) describe the Generic User model that is based on semantic user model interoperability.

5.2 ePortfolio Standards

EPortfolio content can be different, that is why to get data from ePortfolio system they should be standardized (Guo and Greer, 2006). Standardized ePortfolio information model describes what information in general ePortfolio contains and what set of specifications is defined for describing data organization in ePortfolio. Standards that describe information and relationships between them stored in ePortfolio are: IEEE P1484.2.26 – Learner Portfolio Information; JISC CETIS LEAP2A Specification; IMS ePortfolio Specification; CELTS Portfolio information.

Majority of researches are in favour of IMS ePortfolio specification. IMS LIP (Learner Information Package), IMS ePortfolio and LEAP2A comparison is viewed in (Hämäläinen et al., 2011).

5.3 Research

LMS Moodle (Modular Object-Oriented Dynamic Learning Environment) and the newest versions of ePortfolio system Mahara described in the article (Vagale and Niedrite, 2012a) were used in the research. Both of the systems are open source programs; their structure is based on modular principle, and both systems are compatible with each other. In these systems united user authentication is possible. In Mahara system user, group, view, system security, authentication management and new plug-in installation is realized.

It is possible to export from Mahara the following: user personal information, saved user files, short records and descriptions. Mahara supports data export in HTML and LEAP2A formats. Unlike HTML format, LEAP2A saves more complete information taking into account relationships between artifacts. In Mahara system two additional modules, which can be used for determining learning style by Fleming's VARK model and intellectual abilities, were installed. For exporting all user data including learning style and intellectual test results were taken into account.

In Moodle system data that describes learner are stored in data base table *user*. These data are available in user's portfolio. EPortfolio system stores much more information about the user than Moodle. Table 1 demonstrates data comparison, showing what kind of data can be taken from Moodle and Mahara for LM initialization. Colored rows show LM data category names and white ones show these category data. From Moodle user profile almost all data that are necessary for LM basic data can be obtained. These data can be gained also from exported LEAP2A file by using records that describe appropriate artifact type (for example, email corresponds to <mahara:artefacttype="email">). Moodle does not save LM necessary additional data. It collects only user activities. However, exported file can gain data from Mahara that describes learner working experience, skills, goals, interests, certificates and obtained educations. Personal data acquisition is possible from an appropriate data type

record (for instance, personal skills correspond <mahara:type=”personalskill”>). In ePortfolio added plug-in results are gained after installed block type (e.g., learning style corresponds <mahara:blocktype="learningstyles">).

Table 1: Moodle and Mahara data conformity for LM.

Moodle table user	LM data category name	Mahara mahara:artefacttype/ mahara:type
	Personal data	
username	login	-
password	password	-
firstname	name	firstname
lastname	surname	lastname
email	email	emai
-	gender	personalinformation/gender
-	date of birth	personalinformation/dateofbirth
lang	language	-
city	city	town
country	country	country
	Personality data	
-	learning style	blocktype="learningstyles"
-	intelligences	blocktype="multipleintelligences"
-	individual features	-
-	work experience	employmenthistory, occupation
-	goals	personalgoal, academicgoal, careergoal
-	skills	personalskill, academicskill, workskill
-	interests	interest
-	Pedagogical data	-
-	Preference data	-
-	System experience	certification, academicskill pseudo:educationhistory
-	Device data	-
+/-	History data	-
-	Current moment’s knowledge	academic skill

In Table 1, a “-” symbolizes the absence of appropriate data. Near history data, a ”+/-” means that Moodle system collected data will be useful, but they are insufficient for an adaptive system function. Pedagogical data that describe study program, course topic sequence and learning plan saving in Moodle is not foreseen. They will be described by course teacher or adaptive system based on learner plans and goals. Device data that describe working environment of the learner can be determined automatically with the help of software. Preference data that will adapt learning system working environment will be created by the system itself based on collected device data and individual features. Evidence about learner knowledge in certain point of time at the beginning can be taken from academic skill saved in Mahara and later be supplemented with data that will be obtained during the learning process.

6 CONCLUSIONS

A LM life cycle in an adaptive system and learner model data acquisition opportunities were described based on LM data division offered in this article. By researching ePortfolio data utilization opportunities for LM initialization one can conclude that it is possible to make an automatic data selection from the data saved in LEAP2A specification format. Data saved in basic constructions of ePortfolio system can be collected easier and more qualitatively. From data exported from Mahara one can automatically obtain basic data and additional data that describe personality (personality data). Qualitative additional data acquisition has an impact on the ePortfolio system input information completeness and precision and also the kind of additional models used in ePortfolio system. Based on research results one can assert that ePortfolio data can be used for LM automatic initialization. EPortfolio data are continuously updated and supplemented that is why periodical data actualization from ePortfolio system must be foreseen in the adaptive system. It will help to specify the LM, which is especially important in case of adult learning.

Future work is connected with practical realization of the learner model by using data about learner that are available in other systems, for instance, in ePortfolio. On the basis of the obtained data an analysis on the subject of which adaptation type is the most suitable for each data type.

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