Designing an LMS-ePortfolio Integration and Implementation Model in E-Business Education

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Abstract—Although Learning Management System (LMS) remains the most useful application for delivering online learning, the overall learning experience can be complemented and enhanced by integrating LMS with a learner-centered personalized learning and reflection environment better known as ePortfolio. This paper presents a comprehensive model for a successful integration and implementation of LMS and ePortfolio systems in an e-business education setting. Three integration strategies namely data-data, API-API, and Integration with Tools and three implementation models namely course level, department level and institution level have been identified. ePortfolio as an assessment tool is briefly discussed. This paper is validated in a lab environment in the department of E-Business, Faculty of Organizational Sciences, University of Belgrade, where one experimental system is installed with Moodle LMS and another with Mahara ePortfolio application. The systems were integrated in three different ways. Based on the review done on variety of related studies and practical experiences, the authors have recommended the API-API integration strategy and to start implementation of ePortfolio at course level and progress towards institutional implementation for institutions new to ePortfolio systems. This paper has contributed to the existing literature by developing an LMS-ePortofolio integration and implementation design model for e-business education.

Keywords— Learning Management System, LMS, ePortfolio, E-Business, E-Education, Personal Learning Environment

I. INTRODUCTION

Learning Management System (LMS) has long assumed an important role in educational institutions and corporations. The main objective of LMS is to enhance the teaching/learning process by using the Internet or Intranet for delivering educational activities. LMSs are specialized systems developed for managing educational activities, which include the distribution of educational content, the synchronous and asynchronous communication with students and the assessment of students' skills based on assignments and tests. The department of E-business in the Faculty of Organizational Sciences, University of Belgrade has a very good experience of using LMS in facilitating the teaching/learning process in the department. Nevertheless, in order to provide an enhanced life-long and personalized learning experience, LMS systems must be effectively integrated with other specialized systems. ePortfolio is one of such Personalized Learning Environment (PLE) systems. Although, there has been a growing interest in using an ePortfolio as an alternative method of assessment in an open distance eLearning environments, the use of an ePortfolio as a complementary solution to LMS in E-Business has not been sufficiently researched. The purpose of this study is therefore to explore how the use of an ePortfolio can enhance and complement LMS and empower personalized life-long learning in E-Business. An ePortfolio platform is a repository management system used to create student ePortfolio profiles, store ePortfolio material, and to evaluate on the basis of ePortfolio data with regard to educational needs. A student ePortfolio profile includes academic papers, essays, projects as well as project reports, assignments, audio and video files, creative design works, code snippets, and any materials regarding personal and professional development related to learning objectives. All these materials are called artifacts. Artifacts are the corner stone of ePortfolio and lifeline for creating personalized learning repository. The components of ePortfolio can be summarized as:

(1)ePortfolio Presentation – which enables celebrating learning, personal planning, transition/entry to courses, employment applications, and professional registration

(2) ePortfolio Tools – which enable capturing and storing evidence, reflecting, giving and receiving feedback, planning and setting goals, sharing and collaborating, and presenting to an audience

(3) ePortfolio Repository – which is a local or remote space to store presentation resources and an archive of evidences created using the tools.

The primary purpose of ePortfolio is to collect evidence for summative assessment, to demonstrate achievement, to record progress and to set learning targets as well as to create professional profile for future employability.

However, the increasing prominence and benefits of ePortfolio platforms as a mean for collecting students' achievements and for evaluating their progress also brings its own challenges. The main issue is integration with oth-

er systems and interoperability with similar platforms. For instance, an integration capability of an ePortfolio system with an LMS would allow artifacts created on ePortfolio to be submited on LMS as part of an assessment. On the other hand it is important that the evidence of students' work does not disappear, or becomes unusable, when they move to another institution or when they graduate from their academic institution. In this regard, interoperability specifications supported by both ePortfolio systems and LMS are crutial. Therefore the main motivations to integrate an ePortfolio system into an LMS are (1) to use it as an assessment tool for creating and sharing artifacts, and (2) to keep the ePortfolio platform independent so that it can be accessibel when the user changes educaitonal institution or get employed in businesess.

The rest of this paper is organized as follows: Section II discusses related work with regard to ePortfolio. In section III, we detail the methodology for the integraton of the ePortfolio with LMS and also outline different implementaion strategies. In the section that follows, we discuss the particular integration and implentation strategies of ePortfolio and LMS Systems in the case of E-Business Education. Finally, we conclude with a summary of the main contributions of this work and a perspective of future research.

II. RELATED WORK

Learning Management Systems (LMSs) have an indispensable role in facilitating the online learning/teaching experience. As defined in [1], LMSs are specialized systems developed for managing the distribution of educational content, the synchronous and asynchronous communication with students and the assessment of students' skills based on assignments and online tests facilities. However, with the advancement of online technologies that promote personal learning experiences, it is inevitable to have some ways of integrating those variety of personal learning tools in to the more mature and widely used LMS systems. The importance of such integration is briefly discussed in [2]. One such very important personal learning tools is the ePortfolio - a repository management system used to create student learning profiles, store personal learning achievements, and to evaluate on the basis of ePortfolio data with regard to educational needs [2]. In this section we briefly discuss a number of related studies with regard to integration of ePortfolio with Learning Management Systems and experiences learned from those studies.

ePortfolio as a student-centered learning has been assessed in [3] to find out the positive and negative characteristics of the system and to ascertain productive approaches to creating e-portfolios. At the same time portfolios' prospects in higher education system has been predicted. It has been shown in [4], that ePortfolio as an assessment tool is more effective than standardized assessment tests. Integrating ePortfolio in the teaching/learning process also empowers self-regulated learning strategies in the digital learning environment. Setting goals and planning effective leaning strategies along with mentor feedback can be enhanced if such initiatives are started with proper orientations on the importance of ePortfolio [5]. In another case study [6], the impact of implementing ePortfolio in a capstone course of an online master's program in health care administration was examined. As their result indicates, students enjoyed the ePortfolio process, critically evaluated their academic work and accomplishments, and valued peer-reviewed feedback offered by their peers.

ePortfolio is also used as an alternative assessment and e-assessment tool in an e-learning environment [7]. However, such attempts are not without challenges. The lack of pedagogical convenience and the lack of students' technological literacy are some of the challenges as discussed in [8] .

Equipping graduates with employability skills can also be achieved by embedding such concepts in the ePortfolio practice as studied in [9]. As noted by the authors, associating learning contents with the workspace skills and motivating learners to keep a record of professional ePortfolio profiles right from beginning can reduce the skills gap between the workspace and academic institutions. In another similar study [10], ePortfolio was used as measure for professional insertion of students so as allowing students to build and enhance academic and extra-academic achievements while being part of a lifelong learning approach. ePortfolio helps students to develop digital visibility by capitalizing their academic achievements and skills obtained elsewhere.

Our approach in this study is quite different in that it focuses in examining LMS-ePortfolio integration methods and then outlining a strategy for implementing personalized learning environment in an E-Business education e-learning settings especially targeted to institutions new to ePortfolio.

III. METHODOLOGY

The research question addressed in this study is: how to design a reliable model for the integration and implementation of ePortfolio with Learning Management Systems and find out how effective an ePortfolio would be as a complementary learning tool in E-Business education setup. To address this research question, the methodological framework employed in this study was action research preceded by extensive technological and literature review along with analysis of related case studies. This approach was deemed appropriate since it relates to the practice of learning, teaching, and researching in the E-Business education and as it relates to the authors. This section is categorized into subsections discussing on (A) ePortfolio integration strategies (B) ePortfolio implementation models, and (C) ePortfolio evaluation Methods. Our lab environment for this study was conducted on Mahara open source ePortfolio system integrated with Moodle learning management system. Moodle is an institution-centered learning management system and Mahara is a learner-centered ePort-

folio system. An LMS and an ePortfolio complement one another in an online learning environment. Their seamless integration results in an effective personalized digital learning environment. Here we discuss the methodologies of Mahara based ePortfolio integration with Moodle and related implementation and evaluation models.

A. ePortfolio Integration Strategies

The most common strategies for integrating an ePortfolio system into an LMS are data–data integration, the API integration and the tool integration strategies.

•Data-data integration – this is the simplest and most widely used, but classic form of integration in digital content management systems. This type of integration uses the import-export features of both the LMS and ePortfolio systems. Both systems must support some common formats in order to successfully integrate resources. These systems support two types of common formats: HTML files (generic) and Leap2A files (specific to ePortfolio). LEAP2A is an XML standard for exchanging learning e-portfolio data. As explained in [11], information in LEAP2A is grouped into items, each represented as an Atom entry. Each item has a LEAP2A type or class, and the type affects which literal attributes, relationships or categories that may be associated with the item. Data formatted in Leap2A can provide domain specific semantic data.

•API Integration – This ePortfolio-LMS integration strategy allows client applications to use directly the functions of a learning management system. These APIs foster client application development through data encapsulation and behavior reuse. This clear separation of interfaces specification from their implementation and data formats allows tool vendors to develop new versions without affecting current clients. Moodle LMS has two such APIs – the Repository API for browsing and retrieving files from external repositories and Portfolio API for exporting Moodle content to external repositories. Both of these API are based on Moodle's FileAPI. File API is a set of core interfaces to allow Moodle to manage access control, store and retrieve files. In order to ensure a bidirectional communication between Moodle and Mahara systems it is required to use both APIs to while creating plugins.

•Tool Integration Strategy – This integration is achieved by Learning Tools Interoperability (LTI) which provides a uniform standards-based extension point in LMS allowing remote tools and content to be integrated into LMSs. The information exchanged between the LMS and the external tool includes course information and user identity – which helps ensure that learners can navigate seamlessly from one learning tool to the other without having to log into each one [12]. There are several benefits from using the LTI integration approach. By adhering to a clearly defined interface between the LMS and the learning tool, academic institutions, LMS vendors and tool providers, can decrease costs, increase options for students and instructors when selecting learning applications and also potentiate the use of software as a service.

By utilizing these sets of integration strategies separately or in combination, it is possible to integrate variety of LMSs with a number ePortfolio systems [2]. However, in this study we integrated Moodle LMS with Mahara ePortfolio using the API integration strategy in a lab environment as illustrated in Figure 1. Both systems are widely used and support API integration out of the box. It is also possible to integrate using data-data integration strategy, but we don't recommend it as it requires manual work and is not user friendly as a result. However, LTI Tool integration is very promising and is currently under fast development to be compatible and applicable with LMSs and ePortfolio systems. By integrating Moodle and Mahara using the API Integration, two key advantages are achieved: (1) Single sign-on, and (2) Assignment submission functionality.

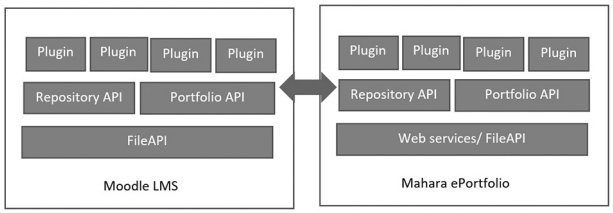

Fig. 1. Mahara – Moodle Integration using API strategy

In the Moodle LMS, the Mahara bidirectional integration support is guaranteed only by the implementation of both Portfolio API and Repository API. The Portfolio API is a core set of interfaces to publish files from Moodle to Mahara repository systems. In this approach, Mahara ePortfolio appears seamlessly as a folder when students want to save content such as a file, snapshots of forums or blogs and assignments.

B. ePortfolio Implementation Models

There are a number of ePortfolio implementation models. However, in this study we have identified three models pertaining to E-Business Education. These are: (1) Implementation at course level, (2) at department level, and (3) implementation at institution or faculty level.

Implementation of ePortfolio at course level is more manageable and its impact and performance can be easily evaluated especially for new institutions. There are a dozen of case studies that implemented ePortfolio at course level. In one case study [13], PebblePad ePortfolio learning was applied to allow students to take ownership of all their learning and achievements throughout a course in a nursing education. This initiative helped students move from didactic model to a student-led focus in their learning experience. In another similar study [14], e-portfolio using Pebble Pad along with Raspberry Pi (RPi), and 3D virtual pathology laboratory was employed in an attempt to improve learning outcomes and increase the chances of employability by aiding in the production of work-ready

graduates in Medical Laboratory Science (MLS) program.

In another case study [15], a strategic plan for digital learning environment was outlined at university level to motivate faculties introduce ePortfolio systems where the culture of using e-learning systems was already there. Such a strategic plan is very helpful in the sense that respective departments or faculties can introduce ePortfolio systems in a gradual manner starting from a pilot project towards full-scale implementation. This shows implementation of ePortfolio at institution level is so complex and may not be effective. However, having a strategic plan inline to the institutions' education goals is very crucial.

This paper introduces a hybrid methodology adopted and modified from the different case studies we reviewed and from the lap environment we setup for this purpose. After outlining the LMS-ePortfolio integration strategy, we followed these six steps to ePortfolio based learning as discussed in [16]:

- Define – First we established the purpose and objectives of the ePortfolio initiative, defined the issues it aims to address, the likely support needs of the learners and the nature of the learning environment. Then we studied which tools, systems or approaches to adopt for the outlined purpose.
- Understand – Clear understanding of what kind of learning outcomes do we require from the ePortfolio initiative and what implications will this have for our practitioners, administrative and technical staff was the second step. Here we make sure, ePortfolio has a great potential as an autonomous and personalized learning environment and provides baseline for life-long learning and future employability.
- Prepare – the third step is to prepare the necessary ground like strategy for access management, ownership of data and identity, assessment of risks and benefits, outlining staff training and support methods, defining accessibility, Intellectual Property Right (IPR), Copyright, and other potential legal issues in relation to ePortfolio usage.
- Engage - Defining an effective strategy for engaging and sustaining the commitment of learners, and those involved in supporting learners' use of e-portfolios is the fourth step. This strategy answers the question, "How are practitioners, personal tutors, administrative, technical and learning support staff, and, potentially, workplace mentors outside the institution engaged in the ePortfolio ecosystem?"
- Implement – Starting implementation of ePortfolio with a lab environment and then with a pilot project is important to take essential lessons. To have an effective ePortfolio implementation, curriculum managers and practitioner teams must be closely involved.
- Review - A range of methodologies to explore the viewpoints of both learners and practitioners should be devised. Creating an evaluation and review methods to show the evidence for the proposed outcomes is the last step in the process of implementing ePortfolio systems.

C.ePortfolio Evaluation Methods

To define effective evaluation methods for ePortfolio, the implementation strategy should always be referenced. The evaluation methods are relative to the purpose and goals of the entity implementing ePortfolio. At the same time it depends on the level of implementation. Be it at course level or institution level, it must have the factors to evaluate the performance of the system in place. In our case, we have designed an evaluation method for both for the course which implemented ePortfolio and the learners' overall practice of utilizing the system efficiently. This evaluation method is explained in detail in the next section in context to E-Business education.

In summary the evaluation method is designed to find out if the ePortfolio implementation is helping in the learning, teaching and assessment process; planning personal/professional goal of users; in transitioning of learners from their institutions to another or from their institutions to the workspaces during job application.

IV. EPORTFOLIO FOR E-BUSINESS EDUCATION

The Department of E-Business, Faculty of Organizational Sciences, University of Belgrade offers a number of business and technology related courses at bachelor, masters and doctorate level. The department has designed and implemented a scalable, reliable and high available private cloud IT infrastructure aimed for scientific work, research and to facilitate technology enhanced teaching/learning process. As a result the department have a long history of using Learning Management System based on Moodle LMS. The courses offered in the department like E-business, Internet Marketing, Internet Technologies, Computer simulation and virtual reality, Cloud Infrastructure and Services, Mobile business technologies, Enterprise networking, E-education, E-government etc. provide an in-depth concepts, principles and practical skills of business and technology. Such multidisciplinary courses have the potential to equip learners with life-long skills and motivate them to continuously learn to remain competitive in their future life.

In this regard an LMS integrated ePortfolio system is highly recommended for the department of E-Business to help learners reflect on their accomplishments, skills and achievements gained throughout their academic journey. Mahara, an open source ePortfolio is a mature systems and have a number of features to create and share variety of artifacts. It is also readily available to be integrated with Moodle LMS at data, API or tool level.

In this study the integration strategy we preferred is the API integration which is supported both by Moodle and Mahara. The implementation model is to start with a lab environment, continue with a pilot project at course level and then to implement a full-scale ePortfolio system at department level which is seamlessly integrated with the existing Moodle LMS in the department of E-Business.

A. Objectives of ePortfolio in E-Business

a) Learning, teaching, and assessment: The first objective is to support the process of learning through reflection, discussion and formative assessment, and providing evidence for summative assessment.

b) Transitioning: The second objective is to provide a richer and more immediate picture of learners' achievements and needs as they progress to a new environment, and supporting them through the process of transition.

c) Personal/Professional development planning: The third objective is support and evidence the pursuit and achievement of personal or professional competences of learners.

d) Applications and Employability: The fourth and final objective in our case is to provide evidence in support of an application for a job or for admission to further study.

B.Evaluation and Feedback Rubric for ePortfolio

An ePortfolio system or combination of tools that supports reflection, collaborative activity and the preparation and presentation of evidence of achievement provides crucial opportunities for learners. However, a reliable evaluation and feedback model should be in place to evaluate students work on ePortfolio. In this study we have modified an ePortfolio rubric adopted from Auburn University [17]. This rubric is used to evaluate learners' performance on creating artifacts and related ePortfolio activities. The key components of the evaluation are as follows:

a) Artifacts - Digital evidence of studnets' learning, experience, achievements and goals [18]. These are the building blocks of everything a student does within the ePortfolio tool. An artifact can be almost any kind of file that describes: academic experiences, Lab or research experiences, Skills or awards, study abroad programs, teaching experiences, internship, work, leadership or volunteer experiences.

b) Design and Arrangements – this evaluates how the student has designed their ePortfolio and arranged their artifact.

c) Reflective Writing Skills – This factor evaluates studnets based on their reflective writng skills

d) Coding/ Technological Skills – This factor evaluates if learners have indepth technological and/or coding skillls.

e) Emotional Intelligence (EQ) – This factor measures, evaluates and gives feedback on the emotional soft skills aspect of leaners.

The above evaluation factors are applied as rating scores: begineer, developing, mature and professional as illustrated in Table 1.

TABLE I. EPORTFOLIO EVALUATION AND FEEDBACK RUBRIC STYLES

Factor	Evaluation Category			
	Beginner	Developing	Mature	Professional
Artifacts				
Arrangements				
Reflective Writing				
Coding/ Technical Skills				
Emotional Quotient (EQ)				

V. CONCLUSION

The indispensable importance of ePortfolio system as an empowering approach in enhancing learners' self-directed learning in the digital learning environment is becoming evident to a number of higher educational institutions [19]. The main challenge is, however, there is no clear strategy for integrating LMS and ePortfolio systems as well as it is quite challenging to implement such integrated systems inline to the goals and objectives of a respective academic institution. This paper assesses a number of case studies and presents a comprehensive model for a successful integration and implementation of LMS and ePortfolio systems in an e-business education setting. The study is validated in a lab environment and the authors have recommended the LMS-ePortfolio API integration strategy and to start implementing at course level and gradually progress from pilot towards institutional deployment. A separate integration and implementation guide is prepared which is not included in this paper. In the future, a course level pilot project will be developed by engaging a selected course.

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