Concept of Online Distance Learning System on Sustainable Development in the Cross-border Region

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Abstract – The paper contains a description of applications of information and communication technologies for the creation of learning content and methods of its adaptation for distance learning. A concept for an on-line distance learning system of a program for sustainable development of tourism in the cross-border region Bulgaria-Romania has been developed and described. A self-learning approach is presented to business representatives and stakeholders, implementing expert solutions for the provision of tourist services and the development of tourist products. The status and use of the system for the period 2013-2018 is validated.

Keywords – Distance learning, Domain-specific architectures, Business, Self-assessment, Education.

1. Introduction

Distance learning is an important part of lifelong learning and can increase the knowledge and awareness of a significant number of business representatives from different sectors of the industry [1]. The online distance learning system presented in the paper is built according to the requirements set in the project "Increased information of the tourist

cluster for management and protection of the environment MIS-ETC Code: 332, Ref. No. 2 (4i)-2.1-8 [2]. It is in line with the curriculum developed for Sustainable Tourism Development in the Cross-Border Region and is a self-training tool [1], [3], [4]. This is an innovative form that meets the needs for knowledge of the target group (company and stakeholder representatives, implementing expert solutions for travel services and development of tourist products in tourism business organizations and related enterprises, suppliers of food, furniture and other industries in the cross-border region Bulgaria-Romania) [2].

The platform has been developed in Bulgarian and Romanian languages and is designed to meet the needs of applicants from the EUREKA European Cultural Tourism Institute. It represents a well-functioning active platform (distance learning) on the EUREKA website [2], which demonstrates the sustainability of consumer interest and visits from 2013 to present or for 3 years after the end of the project and the site's administrative maintenance contract.

The remainder of this work includes the following: Section 2 surveys some related works. In Section 3 we present the implementation of the software platform. Results from the platform implementation are discussed in Section 4. Finally, we conclude our work in Section 5.

2. Related works

The modern development of information technology provides designers and developers of e-learning materials with numerous and diverse software tools. They range from software presentation packages to advanced authoring environments. The benefits for users are related to the ability to create complex learning resources with specific personalization without requiring authors to have special knowledge in the field of Internet programming.
A study done by Haven & Botterill [5], in 2003 describes results obtained from a project, financed by LTSN HLST (Learning and Teaching Support Network for Hospitality, Leisure, Sport and Tourism), which aims to provide an expanded, systematic review of the current use of the VLEs (Virtual Learning Environment) in hospitality, leisure, sport and tourism sectors. Then a semi-structured questionnaire was used, provided by the LTSN HLST partners in the field of sport and tourism at different institutional levels. The conclusions highlight the motives for the development and implementation of VLEs. VLEs support the process of learning and teaching using instrumental programming environment. VLE should provide an integrated set of tools supporting a compatible data format that facilitates overall training and teaching practice. These tools traditionally include:

- Instruments for communication learner-lecturer and learner-learner;
- Areas for sharing work in separate groups and means of exchanging information;
- Providing learning resources and materials;
- Keeping a learner profile;
- Managing and tracking learners' work - individual and group profiling and statistics;
- Individual and aggregate assessment, as well as distribution of course assignments;
- Other tools to help train the learners such as e-registers and calendars.

With the development of Internet technology, it has become easier to share knowledge and conduct training. The World Network is very helpful in the education system, introducing the concept of e-learning based Learning Management System (LMS). Studies of Alkhalaf et al. [6], Patel et al. [7], Palacios-Marqués et al. [8] and very recently of Mellar et al. [9] show an overview of the architecture of the e-learning based Learning management system (LMS). In general, an LMS contains different components or modules. The Course management module offers opportunities for adding new courses, managing or updating existing ones, personally assigning courses to leading lecturers and other details related to the academic program. The Learners management module supports different forms of enrollment and the way of specific user registration in compulsory or elective courses. The Online exams module is used to automate the process of assessing the learner's knowledge. In the Feedback management module, learners can give ratings for each discipline and opinion for each teacher, but only an authorized person can see this feedback. Patel et al. [7] and Cavus [10] publish detailed comparative analyses of different e-learning based LMS. Each system is classified according to parameters such as technology, features and platform tools. There is a variety of LMSs that serve different purposes. Many of them are based on Moodle technology and contain various features such as course and profile management, security protection, virtual classroom, face to face learning over internet, feedback management, and other common features. But none of the systems analyzed unites the whole set of functionalities, i.e. no LMS is available that contains all of the listed features. Based on the evaluated parameters, Patel et al. [7] offer a new unified cloud-based system that includes all these parameters and other new features.

Gamundani & Rupere [11] and Jain & Chawla [12], and later Riahi [13] and Maskare & S. Sulke [14] describe different approaches for applying cloud technologies to e-learning systems in the form of infrastructure that supports creation of a sustainable e-learning. This is achieved by adding new functionalities to training systems, such as: tracking the state of the system configuration and real-time resource handling; resource allocation on demand and more user-friendly use; help with the development of learning components, including content, services and applications for specific training.

By adopting the definition of Patel et al. [7] and its most recent interpretation by Mellar, R. Peytcheva-Forsyth et al. [9] that E-learning is a method of distance learning through the use of electronic media in which the learner and the lecturer interact through the learning content, stored in the Global Network, we develop the thesis that Semantic web is extension of the current web. Today Semantic web is becoming more and more important. There is a growing need to apply the semantic nature of web to e-learning. Semantic web based e-learning is next generation of e-learning. In their paper, Tiwari et al. [15] present different models of e-learning. The main problem of e-learning is lack of accuracy, time limitation, information overload and cost. There is a need to provide a mechanism for structuring the enormous amount of e-learning resources in order to maintain easier access, multiple usability and personalization. This access should be structured and adapted according to the typology and levels of e-learning: professional certification programs; academic disciplines; lifelong learning courses or those related to the retraining of unemployed professionals.

Kattoua et al. [16] make a critical review of publications on e-learning systems and identify some of the most important influencing factors related to information systems research on origin, characteristics, constraints, and the strengths and weaknesses of systems for web based training.
On the basis of the prepared content analysis of the theoretical formulations published in the last fifteen years [13], [17], [18], [19], the following summaries can be formulated:

- The cost of leading e-learning platforms is too high for the capabilities of Southeast European educational institutions, as well as for NGO educational institutions and small and medium-sized businesses in a number of industries. [1], [18].

- Predominant platforms have specific hardware and server operating system requirements, and others are platform-dependent and require the availability of expensive operating systems [20], [21].

- Most of the existing e-learning platforms do not support e-learning standards and are, therefore, not compatible with each other, making communication between them difficult [6], [22].

- Almost all of the existing platforms do not support two or more interface languages at the same time (this is especially true for small languages). For those platforms that support multiple languages, the interface language is selected either when installing the system or when creating a course, so only the initially selected language is used thereafter. This makes it impossible for a WEB-based course to be developed and presented in several languages at the same time [16], [22].

- Many of the e-learning platforms, due to the fact that they are only used with licenses, have an unchanging structure and organization of work and can hardly be adapted to the specific requirements of the specialized institutions involved in training [23].

- Creating a hierarchy of organizational units (faculty or branch, degree program, department, unit, discipline) in the known platforms is achievable at a very low level [9], [10], [22]. Creating and organizing a more complex hierarchical structure is impossible and this makes it difficult for institutions with a strictly specialized and specific organizational structure to carry out tasks.

- Technologies for developing WEB applications that allow the separation of executable code from the graphical interface enable flexibility of the design, development and maintenance of a new system, and allow it to be modified quickly and smoothly [5], [8], [16], [21]. This is a task for the authors of the training system presented below, fulfilled according to a specific assignment from the users of tourism and related industries in a specific cross-border region [2].

3. Software Platform Implementation

3.1. Infrastructure Architecture

Infrastructure architecture describes the software environment in which the designed system works. It includes an operating system, a WEB server, a database management system, distributed object technologies, communication protocols, server and client technologies, and more (See Fig. 1.). It has five main layers:

Layer 1: the core is the operating system that provides the basic functionality for accessing the hardware resources and the implementation of the basic communication protocols:

- TCP/IP (Transmission Control Protocol and Internet Protocol) – a set of communication protocols on which the Internet and many corporate and local networks are based;
- FTP (File Transfer Protocol) – used to exchange files between computers on the Internet and local networks based on TCP/IP.

Layer 2: describes all the technologies and tools necessary for the operation of the WEB-based distance learning system, namely WEB server, server technologies, database management system. High-level communications protocols are also implemented here:

- HTTP (Hypertext Transfer Protocol) – the main purpose of this protocol is the transfer of information to the global network. It is mainly used as a way to publish and deliver HTML pages;
- IMAP (Internet Message Access Protocol) – performs data transmission between clients and e-mail servers;
- POP3 (Post Office Protocol version 3) – another protocol used to deliver e-mail from the server to the client;
- SMTP (Simple Mail Transfer Protocol) – a high-level protocol used to deliver e-mail from the client to the server;
Layer 3: includes the system core of the learning platform. It provides the basic functionality required for the other components of the system. These can be database operations, preview templates, and more. The use of visualization templates is a modern design technique that allows the separation of the visual part from business logic in the WEB-based products. This approach has the following advantages:

- the technology for developing visualization templates may differ from the technology for business logic development;
- the development process can be divided into stages;
- it allows rapid change and adaptation of the system to different designs;
- it authorizes independent development of the visual part and the business logic of the systems.

It is important to note that some of the communication protocols mentioned in Layer 2 can be implemented in the system kernel. Most often these are those related to email and directory services. In this way, it is easier to integrate the software product.

Layer 4: includes the main subsystems of the e-learning platform.

Layer 5: describes the interaction between the learner and the environment from the point of view of information technologies. It incorporates the technologies and modules for the interaction of the trainer. That includes the WEB-browser, JavaScript modules, most commonly related to achieving greater inter-activity using modern techniques such as AJAX (Asynchronous JavaScript and XML), Flash, and Java applets used in modern systems to create different simulators. For the needs of the training program on Sustainable Development in Tourism, the selected technologies are platform-independent, open-source and free. This independence gives us extra freedom in choosing a hardware platform and operating system. Most conceptual level interest is the 4-th layer of architecture, as it includes subsystems for registration management, administration, content publishing, content visualization, and distance learning system statistics.

3.2. Registration and Access Management

An important step in the development of distance learning systems is the regulation of access to learning content [9], [16], [19].

Part of it may be released for free use. Access to another part needs to be done after registration by users to store statistical information about their behavior. Such examples are the tests, the means for synchronous and asynchronous communication (forum, chat, etc.) where registration is mandatory. On the other hand, the handling of content management and administration modules requires special rights. Based on what has been said, the following levels of access to the system have been defined:

- **Guest** - this is a user who is not registered in the system. These users need to have access to the description of WEB-based courses as well as some sample materials;
- **Trainee** - these users have access to all of the learning content - text, tests, multimedia, communication tools, and more. Every guest can register in the system, whereby he/she acquires the rights of a trainee. The distance learning system can store statistical information about the study materials they read, test results, and their publications. Each registered user will automatically have access to features to change the information in his profile and to change the password;
- **Administrator** - has access to all of the training content as well as modules of the administration subsystems and learning content management.

3.3. Administrative Subsystem

The Administrative Subsystem provides administrators with system management functions. The basic modules of this subsystem are:

- **News management** - This module provides the ability to create news and automatically send them to all registered users in the form of e-mail. Any news can include text, images, and attachments.
- **User management** - Using this module, administrators can change the trainee's user password and delete users. The interface of this module has the type shown in Figure 2.
3.4. Rights Management

This module aims to provide administrators with functions to add or remove new administrators. Here it should be mentioned that the first administrator in the system should have the status of "super user". This means that his/her administrative rights cannot be withdrawn. Once added as an administrator, the user will gain access to the appropriate subsystems and modules on the next logon:

Change of the design: The module provides administrators with the ability to modify site templates. This allows changing the overall appearance of the distance learning system or changing parts of it.

System languages: This module allows for adding / removing, as well as defining the default language. The system allows the user to select a language only if the system messages are translated into the specified language.

System messages: Provides the ability to translate system messages into a language. It is necessary to translate the texts from all the modules, after which the language can be activated.

Settings: The module should provide metadata setup features for the distance learning system, namely description, keywords, page title, logo, and more. This information is important for proper indexing of the system by search engines. The more information the user fills in, the greater the chance is for the system's address to get a higher rating.

3.5. Authoring Subsystem

The main purpose of the Authoring Subsystem is to provide administrators with features for publishing and managing learning content. At the conceptual level, it is necessary to define the structure of the curriculum and the main steps in the publication [21]. Practice shows that learning content should be divided into small resources. They can be classified by type - such as text, tests, multimedia, etc. Additional flexibility is achieved if each resource can be used more than once. Another important part is the menu. In most cases, it is a tree structure in which the teaching material is grouped thematically. Based on what has been said so far, the following steps for publishing learning content can be defined:

Publication of the menu; Publication of the resources; Assigning the resources to menu items. The last step involves "stacking" the resources in the menu items, and one of them can be placed in more than one place. These steps also define the modules that the authoring subsystem must contain:

**Menu management** - This module allows administrators to define the system menu. The basic view of the module may be as shown in Figure 3. As stated above, it should be a tree structure, the depth of which depends on the structure of the curriculum, as well as on the possibilities of the template for visualizing deeper structures.

As can be seen above, the system should allow a structure overview for all system languages, a change in the order of the individual points within one submenu, and a notification to the administrator if he attempts to create a deeper structure of the existing one.

**Publication of the resources** - As a starting point, it is necessary to classify the resources according to the requirements of the assignors and the structure of the educational content [23]. For the purposes of the current project, the following types of resources can be defined:

**Text**: Allows the author to publish formatted text with images. For this purpose, it is necessary to integrate a suitable online editor in order for this activity to be carried out directly in the system. Another important requirement is that the module allows copying of texts from the most widely used...
text editors, while preserving the formatting. This would save a lot of time.

**Files:** This resource allows for the publication of various types of downloadable documents by learners. It would be a good idea to publish more than one document in one resource, since in most cases the structure of the curriculum requires the publication of a series of documents that are thematically related.

**Multimedia:** An important part of the learning content is multimedia, including audio files and videos. Besides the possibility of publishing the files, it is also necessary to provide functionality for online conversion from one format to another. This task is difficult to implement, given the large number of compression algorithms and limited online playback capabilities. It is, therefore, necessary to strictly define the possible publishing formats.

**Frequently Asked Questions:** Allows the publication of the FAQ section. It is necessary to provide the possibility of posting images to the replies, as well as attaching files, if necessary.

**Forum:** This resource should determine the location of the forums in the content structure. The main requirements for the forum are to have a tree structure and the appropriate modules to allow the deletion of publications when irregularities are detected.

**Form “Contact us”:** The resource determines the location of a "contact us" form. This form is used to send short messages to administrators in the form of an email.

**News:** Allows news to be published. News can contain text, images, and attachments, if needed.

**Gallery:** The resource contains images. In the posting process, it is necessary to automatically resize the images if their dimensions are larger than the admissible size. In addition, it is necessary to generate a small version of the published images to be displayed in the gallery.

**Test:** Tests are an important part of the curriculum. Modules need to allow questions of the following types to be published:

- Single choice - one possible answer of five.
- Multiple choice - multiple possible answers of five.
- Fill in a missing word in text.

Each type of question allows the attachment of images for each question and the number of points for each correct answer. Before developing the relevant modules, it is necessary to define strictly the algorithm for the evaluation of the tests. Besides introducing the questions, the system should also provide an opportunity to review the results. It should be done for each user separately and include the following options:

- Visualize the average score of the tests for each user and their number;
- View a list of information about each attempt made. This list should also include time (time and date) information when the test is done and the points collected for each attempt;
- A visualization of any attempt that includes questions and answers. It is necessary to mark the correct answers and responses that the user has given, as well as the success of the learner.

**Assigning the resources** - Once the learning content has been published in the form of resources, it is necessary to associate them with each menu item. One point may contain more than one resource.

### 4. Results and Discussion

Figure 4 depicts the curriculum structure. If there is more than one resource, it is necessary to have functions to change their order. Resource removal is also required. This action does not delete it, but only removes the association. The system was published in 2013 as part of the implementation of the curriculum and a program for the enhancement of the qualification of company and stakeholder representatives, implementing expert solutions for travel services and development of tourist products in tourism business organizations and related enterprises, suppliers of food, furniture and other industries in the cross-border region Bulgaria-Romania [2]. The website on which the content is uploaded is http://sust-tour.webdevc.eu/. The system includes a section for visitors with open access and for trainees - after registration.
A visualization of the content - There are modules, included for visualization of each published resource, i.e. 7 lectures, 7 tests to increase the knowledge and 7 tests to confirm the results achieved, 7 exercises to the main lecture sections with active hyperlinks to additional literature, up-to-date statistical information and legal basis, 5 case studies on sustainable development of the regions in the field of food industry, construction, energy efficiency and cultural tourism. Some of the requirements to the relevant modules are mentioned above.

The following clarifications need to be made:

- The Module for Test visualization takes care not only to generate the test format but also to evaluate the results, visualize the right user responses, and save the results to the database.
- Similarly, the survey module not only visualizes the actual form but also records the results in the database to be able to track, analyze and evaluate the learner’s results.

Statistics - The statistical information subsystem aims to provide administrators with information about:

- the progress of the trainees;
- test results;
- the results of the surveys;
- information about the visits of the trainees.

The installation covers the entire sequence of setting all system components and tests to prove its normal working capacity.

For the reviewed time period of work with the distance learning and self-learning system (April 2013-April 2018), according to Google Analytics data (Fig. 5.), there were 25,133 people - visitors to it, of which 97 have two or more visits, within 31,624 sessions.

The number of trainees is 310 whose average success rate of tests and case studies was 4.18 in the 6-grade system of Bulgaria. The average daily number of visits for the period 2013 – 2018 is approx. 40 and is relatively constant.

Given that the languages in which the training is conducted on the platform are Bulgarian and Romanian, it is interesting to make a cross-section of visitors by countries and regions in the world. The platform has been visited and used by users in 92 countries, with the largest share of: by default, Bulgaria and Romania (93%), the United Kingdom (0.93%), Germany (0.34%), the USA (0.32%), India (0.34%), France, Spain, Russia (0.18% each) and others (Fig. 6.).

Individual interests have been triggered in countries like the Philippines, Hungary, China, Canada, Saudi Arabia, United Arab Emirates, Kenya, South Africa, South Korea, Malaysia, Taiwan (an average of 0.05%, equal to 12 people). Maximum lengths of stay have the visitors from countries such as Lithuania (9:56 min.), Kazakhstan (7:05 min.), Iran (6:46 min.), Oman (6:22 min.), Bosnia and
Herzegovina (6:09 min.), Norway (5:56 min). Taking into account the language barrier, as Rothkrantz mentions [24], the likely interest of visitors is due to the attractive and communicative visualization of the resource design in the platform and the ability to easily and quickly download training content into formats that are convenient for translation.

An advantage of the system is the well-chosen and recognizable name (sust-tour.webdevc.eu) as well as the topicality and the multinational significance of the themes ("Sustainable development" and "Cross-border region"), as well as Bulgaria's reputation as a world tourist destination outside the zones of territorial political conflicts.

5. Conclusion

In summary, we have performed both an experimental and theoretical study of Web-based interaction, which enables the creation of platforms with learning content and methods for its adaptation to the needs of distance learning. Several basic elements of “Concept of Online Distance Learning System on Sustainable Development in the Cross-border Region” have been identified. In correspondence to the requirements and restrictive conditions placed in a specific subject area – business training of specialists of company and stakeholder representatives, implementing expert solutions for travel services and development of tourist products in tourism business organizations and related enterprises, suppliers of food, furniture and other industries in the cross-border region, a human-centered computing platform with information and methodological resources has been created. The experimental results have been successfully interpreted by the complex and in the same time adjustable matrix method, which allows to cover the entire sequence of installation of all system components and to perform tests to prove its normal working capacity.

An analysis of platform-independent technologies (open source and free) has been performed in order to give extra freedom in choosing a hardware platform and operating system to ensure its durability in long-term use. The achievement of the conceptual design is the 4th layer of architecture, as it includes subsystems for registration management, administration, content publishing, attractive content visualization, and detailed statistics of the distance learning and self-learning system.

A validation of the status and usage of the system by visitors and trainees has been shown for the period 2013-2018 through statistical analysis results of ©Google Analytics.

We believe that this work can stimulate conception, design and realization of on-line based distance learning resources in other subject areas for training of business organizations and stakeholders in various sectors of the economy and the non-productive sphere.

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Association “European Institute for cultural tourism EUREKA” has developed an Online Distance Learning System "Sustainable Development of Tourism" for tourist companies in the cross-border region of Dobrich-Constanta. It has been popularized among the members of the cross-border cultural destination "Ist-Pontica" and Cross-border eco-network www.sust-tour.webdevc.eu .
References


