NEW METHODS OF TRAINING AND MONITORING THE FUTURE ENGINEERS

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Abstract: The learning content is the key factor of any online learning framework. The learning delivery content has to comply with specific electronic web technology. Three main case studies served as basis of research studies and development of such materials, all the case studies being presented within a PhD thesis. They are as follows: two Web-based collaborative environmental training course for online courses within the European projects and development of the course Simulation of Manufacturing Systems within the analytic program for postgraduate students "Conception Intégrée des Systemes Technologiques" – Faculty IMST –Politehnica University of Bucharest.

Key words: virtual environment, monitoring, collaborative training environment, human resources.

1. INTRODUCTION

The learning content is the key factor of any online learning framework. The learning delivery content has to comply with specific electronic web technology. The design and development of such material represents an important issue to be analyzed and evaluated in many studies developed by many research units of worldwide universities.

This paper presents the development process for such materials subject to online distance learning. The topic is focused on engineering subjects such as life cycle assessment and simulation of manufacturing systems.

The software used to design and develop the course content is mainly Macromedia Authorware, and as a delivery environment – IBM Lotus LearningSpace 5.0. The materials obtained are subject of analysis, testing and evaluation of online educational systems.

The educational materials served as basis of research studies and development of such materials, all the case studies being presented within a PhD thesis. They are as follows:

1. Development of a Web-based collaborative environmental training course within the *EESI Electronic Environmental Services Ireland project*, during the period 2000-2002, at CIMRU (Computer Integrated Manufacturing Research Unit) within National University of Ireland – Galway.
2. Development of an online course within the *Socrates Minerva FAVIR CP 71 206 – RO – ODL* project during the period 1999–2002, Politehnica University of Bucharest being the main coordinator of the project (http://leo.optimum.pub.ro).
3. Development of the course *Simulation of Production Systems* (2003–2006) within the analytic program for postgraduate students (master students) *"Conception Intégrée des Systemes Technologiques"– Faculty IMST – Politehnica University of Bucharest* (http://sun.cfic.pub.ro/cist/cist.html).

The case studies provided a good support resource for learners being used as online learning applications enabling the self-study of courses. Also, many issues has been monitoring such as design and development process, learning content and course structure, evaluation of learning management systems, pedagogical aspects, importance of usability, delivery environment, and a series of problems that occurs during online training sessions followed by conclusions and recommendation for improvement and further research studies.

Ability to learn and to communicate within different situations, as well as the use of new technologies is an important issue of a modern society. Dialogue is a tool of this type of learning where the words and the action make a whole.

2. E-LEARNING CONTENT AND COURSE STRUCTURE DEDICATED TO ONLINE AND COLLABORATIVE TRANING ENVIRONMENT

Many companies are interested in developing their technical training programs according to the actual trends on the market. Analysis of principles and methodologies for both classic and e-learning content, as well as psychological approaches and learning theories represent the first stage of the design process for web based learning content.

Prior to start establishing the structure of an educational online course, the target objectives of the design phase are to be set-up.

The course structure and the course content aims to fit with these objectives. The main objectives are as follows:

- the learner must be familiar with the terms and the areas where the course topic is applicable;
- the learner must be able to identify the methodology components related to the course content;
- the learner must assimilate practical skills over practical applications;

This must be the course presentation web page consisting of all these details (Table 1).

Table 1

Course presentation issues

Overview	Brief introduction about the course structure and content.
Course Outline	• Goals and objectives • What is to be learned? • Who should take this course? • Which are the skills gained by the learner? • Which are the benefits of taking this course?
Course Details	• Course length and price • Enrolment • Language • Course policies
Course Structure	• Course Syllabus • Course Content

Course Resources	• Documents
	• External links
	• Related courses
	• Learner toolst
	  o Address book
	  o Calendars / Planners

Collaboration Features	• Discussion board (forums)
	• Real time collaboration
	  o Chat between learners
	  o Live sessions
	  o Whiteboards
	  o Documents sharing

Prerequisites	Necessary prerequisites for a learner to be able follow the course.

To comply with the course objectives, a set of three topics shape the backbone of a course structure:
• basic knowledge; general overview of the topic;
• methods and methodologies; theoretical aspects;
• practical applications; aquiring skills.

Also, before taking the course, learners must be well informed about the course content, multimedia facilities and collaboration tools used within the training material.

3. ASPECTS REGARDING THE DESIGN AND DEVELOPMENT PROCESS FOR e-LEARNING CONTENT

Many issues serves to the design and development process of a learning content suitable for online learning such as pedagogical principles and approaches, instructional design methods, esthetics and ergonomics – most of them presented in the related literature – emphasizing the learners' needs both for academic field – graduate and postgraduate students – and corporate training (by enhancing the industry needs for engineers' continuous training).

The course content consists in several modular parts, each part being constituted of a different course components and learning tools such as: tutorials, on-line support materials, hypermedia, drills, simulations, educational games, different interactive tools, tests live sessions and collaborative learning. To implement and to use all these, a model consisting in three phases (planning, design and development) must be created.

A very important issue for the development process is monitoring learners taking online courses. The authoring software, Web technology and learning management systems offer the opportunity to track data about learners, their performance and their progress in accordance to specific norms and e-learning standards.

4. E-LEARNING DELIVERY METHODS AND DEVELOPMENT ENVIRONMENT

Learning is one of the most complex process within an organisation. A complete e-learning solution is comprised of three core components, with the organization and the learner at the heart. The three core components are: infrastructure, content and related services. An e-learning infrastructure, like e-business technologies, is built on classic networking and enterprise infrastructure services and standards, such as Internet Protocol (IP)-based network, web browsers and databases. At the application layer there is a set of technologies that can be integrated to provide an infrastructure framework for delivering the complete suite of e-learning services.

Learning Management System (LMS) is software that automates the administration of training events. An LMS typically incorporates functionality such as:
• managing and allocating learning resources such as registration, classroom and instructor availability, instructional material fulfillment and outline clearly delivery. The database capabilities of the LMS extend to additional functions such as company management, online assessments, personalization, and other resources;
• learning management systems is a vital infrastructure needed to track, record, schedule and deliver corporate learning. They are typically designed for multiple publishers and providers. It usually does not include its own authoring capabilities; instead, it focuses on managing courses created from a variety of other sources.
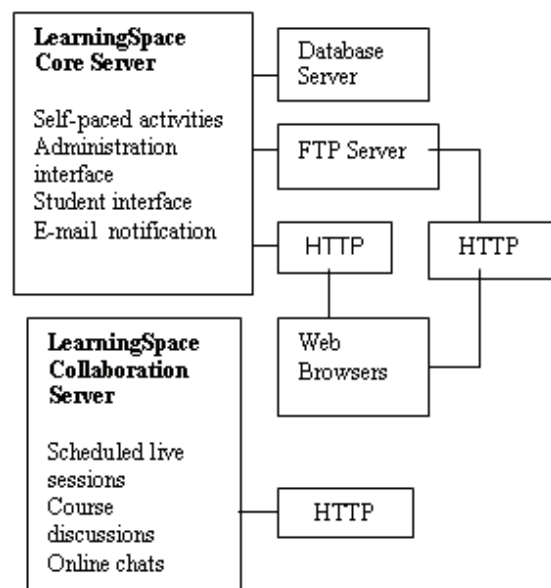

Fig. 1. Learning space servers – Lotus development corporation.

Such a learning management system represents an important component of an educational portal.

Clearly it is important to understand primary usage requirements when selecting between different kinds of LMS. It must be outlined some criteria LMS evaluation such as: functionality, scalability content support and connectivity.

The diagram presented in Fig. 1 shows the two components of LearningSpace servers and how they interact taking into consideration the two working interfaces – Administration Interface and Student Interface.

Administration Interface enables the training administrator (instructor, designer) to perform the following activities:
* add, edit, or delete learner information;
* assign courses to learners;
* add, edit, or delete courses or lessons;
* generate reports on learners and courses;

The Student Interface enables learners to perform the following task:
* access online courses and other learning assignments;
* generate report son their progress and results.

5. ASPECTS REGARDING DATA TRACKING AND COURSE EVALUATION THROUGH THE TRAINING PROCESS

A very important issue in monitoring learners taking online courses is data tracking. The authoring software, Web technology and Learning Management Systems offer the opportunity to track data about the learners, their results and their progress. If a learner takes an online course voluntary, there could not be necessary to track the data, but usually the learner or in the case when training is required for an individual learner or a group of learners, tracking the learner progress it is required.

Data tracking also provide information about benefits of the course, numbers of learners taking the course, popularity of the course, problems that occur during delivery, and then it is very important to understand if the course accomplishes the goal it was designed for. All this is realistic by collecting, organizing and analysing data about the learners and their performance in the course. As benefits of tracking users' performance could be mentioned:
* providing users with feedback as they work through the course;
* establishing virtual meetings or e-seminars to discuss problems occurred;
* assessing the learner results;
* take the data tracking information to have a more effective design of next courseware developed.

5.1. Learner Performance Data

As specified above, learner data performance is the information provided after monitoring the learner progress, performance and behaviour. Usually this data depends upon the level of details required. Data collected could be divided in the following subcategories:

* *assessing data* – consisting in information about how learners assess their progress (the score for each test, the result of a test – pass or failed, the number of attempts at completing a test, time spend in course, success or failure in meeting the course objectives).
* *passing data* – such a data that passed to the course at the start of each session. This data consists in learner's name and ID, a bookmark to designate where the learner stopped in the last session, time spent in the course so far;
* *control navigation data* – this data could be summarized as follows: numbers of times a learner has accessed a lesson or a test, prerequisites to start a lesson or a test, minimum score required to pass a test, maximum time allowed to complete a lesson;
* *course usage data* – consisting in overall usage frequency of the course. Information collected refers to the name of each learner and time spent using the course or individual modules of the course, the numbers of times each learner access the course, the numbers of learners who complete the course.

5.2. Course Evaluation Data

This type of data is used to assess the effectiveness of the course. Having the right information, the course could be improved, or this feedback could be used at the design stage of a new course. Evaluation of effectiveness of a course is an important part of the instructional design process. By tracking the appropriate data, the potential problem areas in the course could be identified and then an early action to correct them is required. A feedback questionnaire for each learner could be a solution to find out the problem areas, or also the some types of data such as the results of each interaction by each learner during the course, the score for each test, learning objectives met of failed could be also important for a good analysis.

5.3. Data Tracking Methods

Some of the most common ways to track data include:
* *file-based tracking* – quick and inexpensive method for small amount of data;
* *e-mail data tracking* – when requirements refer to collect a few basic items of data about the learners and their performance in the course, an email message containing the data could be send to a training manager or administrator within the organization;
* *database data tracking* – appropriate where large amounts of data and extensive reporting requirements. Using a database requires some specialized knowledge and programming expertise;
* *using a learning management system* –as a software application that manages the deployment, management and tracking of e-learning courses. A LMS uses a database to store information about learners and courses.

A clear stipulation of the main objectives from the design stage of the e-learning content leads to best results regarding the course content and structure. The feedback

Table 2

Scaling method

Excellent/ Very important	Very Good/ Important	Good/ Quite important	Fair/ Not so important	Poor/ Don't know
5	**4**	**3**	**2**	**1**

Table 3

Learners' questionnaire results

	Level of importance for learner Scale 1…5	Learner opinion about feature Scale 1…5	Improvement recommended (by learners)	
			YES	**NO**
COURSE CONTENT				
Quality	5	3	60%	40%
Quantity	5	3	70%	30%
Clarity	5	4	70%	30%
Collaboration features	3	4	80%	20%
Self-paced content	4	5	50%	50%
Test and quizzes	3	5	60%	40%
Optional readings	2	2	80%	20%
e-Workshops	2	3	70%	30%
Case studies	4	4	60%	40%
Practical applications	5	3	10%	90%
Interactivity over the course	4	2	10%	90%
Learnability	5	3	40%	60%
Time resource	4	4	80%	20%
COURSE PRESENTATION				
Graphics	4	4	20%	80%
Text fonts and colours	3	4	30%	70%
Colours	3	4	40%	60%
Accuracy	5	3	50%	50%
Layout	4	4	10%	90%
Creativity	3	4	20%	80%
Pictures quality	3	4	20%	80%
COURSE STRUCTURE				
Order of topics	5	4	30%	70%
Related content	4	4	40%	60%
Topics clarity	5	3	40%	60%
Topics fitting with objectives	5	4	20%	80%
Scheduled meetings	3	4	90%	10%
Help	4	4	40%	60%
DELIVERY ENVIRONMENT				
Accessibility	5	5	10%	90%
Operability	5	5	20%	80%
Progress reports	4	4	10%	90%
Security/Logon	2	5	0%	100%

obtained from the learners and their comments are very useful for establishing the improvement procedures for further development activities in accordance to the learners' requirements. There are high initial costs for implementation of distance learning courses.

The administrative services are, generally, more complex than live courses.

6. COURSE CONTENT EVALUATION – METHODOLOGY, TESTING ENVIRONMENT AND RESULTS

The last stage in the instructional design process is the measuring effectiveness stage. The first step of this stage is to evaluate the pilot course developed.
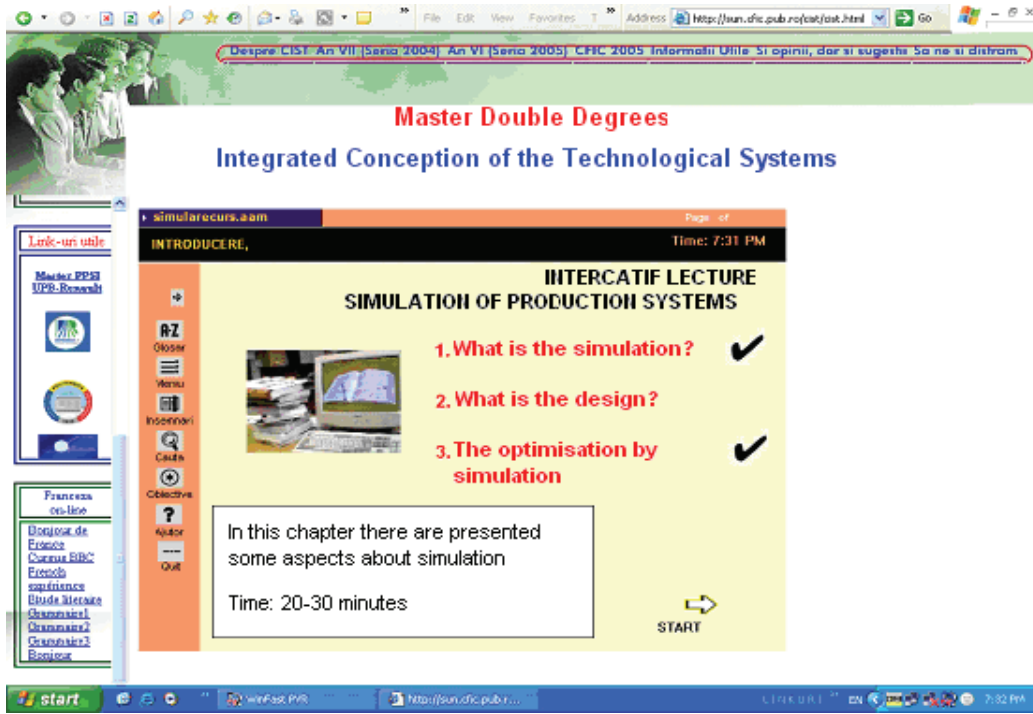
Fig. 2. Screen shot a the web page where the course can be accessed.

The testing environment was a group of 15 postgraduate students (year V) from Machine and Production Systems Department at master courses "Conception Intégrée des Systemes Technologiques", master with double diploma in collaboration with University Bordeaux 1.

The results and the feedback received from learners highlight the level of importance and attitudes of them referring to the topics covered by questions. This information has been analyzed and grouped according to specific topic (course content, structure, presentation, delivery environment).

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As part of testing procedure, it has been considered the scaling method presented in Table 2, the final results being classified in Table 3. The learners provided useful feedback on courseware capabilities, contributing to the further design and development instructional process.

The importance of the questionnaire is a big one. With the questionnaire it could be improved the learning material content, the course design and presentation.
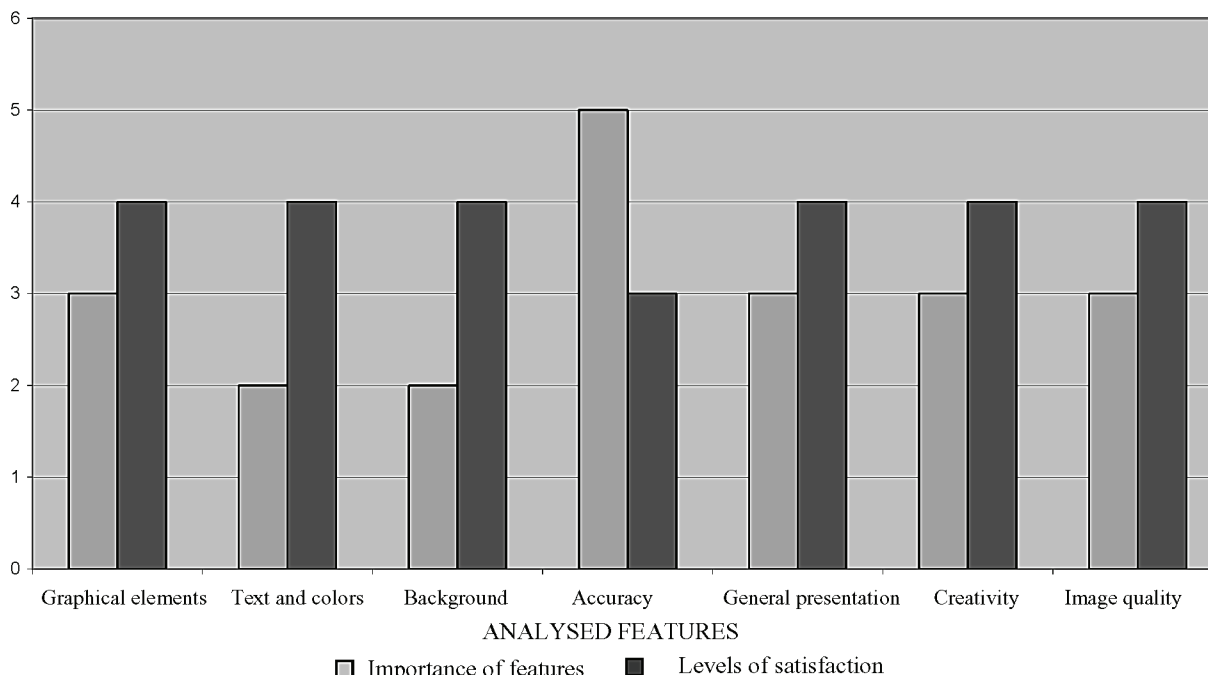

Fig. 3. Statistics of the results obtained from 15 postgraduate students.

There are students that asked another kind of color for the background (Fig. 2), others had asked more practical applications (Fig. 3). There is a various and an important feedback that must be provide for the learning material improvement.

The continuous monitoring of the learning material and virtual environment is one of the most important activities. That means that all the time the course could be changed and improved.

7. CONCLUSIONS

Learning material evaluation tried to asses the effectiveness of the application: to discuss the importance of usability, pedagogical issues and to examine methodologies for assessing each. Usability means that users of an application should be able to use the product easily, can learn it quickly and can use it easily to achieve the tasks that they set out to do. Usability will enable the users to concentrate on the tasks, the learning and not on the tools that they use to carry out the tasks.

Usability and pedagogy are important considerations when testing the online courses. Usability engineering involves *a* range of techniques that can be used for evaluating applications. Research (Pieratti) indicates that several of these methods should be applied when evaluating software, as no one technique will highlight all possible usability issues. Usability techniques can be applied at several stages in the development cycle of software:

- the conceptual design (needs analysis, story boarding and initial interface design);
- prototyping (this includes prototyping of the conceptual design and software prototype);
- pre-launch (alpha and beta versions of the software) and the final release.

The techniques used will depend on the stage of the software development, for example, at the conceptual design stage a user and task observation may be used; at the prototyping stage a paper prototyping technique may be applied; at the pre launch stage walkthroughs may be applied and after the final release walkthroughs heuristic evaluations and usability tests may be used.

The usability engineering techniques applied are described as follows:

- *heuristic evaluation* – This will involve experts assessing the interface against established usability principles.
- *usability tests* – These will involve observing actual users carrying out real tasks with the software and recording their actions and responses
- *interface evaluation* – This will involve usability experts assessing the software against established interface and usability guidelines.
- *pedagogical evaluation* – This will involve assessing the structure of the learning and its appropriateness for online delivery.

This is not a usability-engineering tool but is considered to be an important evaluation for the projects as the applications made are to be used as an online distance-learning environment.

Other aim elearning material is to integrate the experience of each teacher in a potential excellence network. The result of the feedback obtained from the testing process and evaluation activities for the course "Simulation of the Production Systems" shall be used for further development and improvement stages of the course according to the conclusions presented above.

Target groups related to these applications are comprised of undergraduate and postgraduate students manifesting a specific interest for continuous learning within engineering area, gaining the advantage to reach after a modern and trendy career as well as on the academicals research field.

Qualification level of a team is the main issue that assures the success in such situations. Learners will reach the targeted objectives only if the group itself reaches this target. Cooperation and collaboration are the main components of a successful teamwork. Another important aspect of teamwork is how to get and how to offer help.

Finally, it is to be mentioned the necessity of reassessing the role of technology within the educational process and the concernment of applying the modern information systems and technologies.

The benefactors of the learning material could be the fields of the professional /technical formation and the universities.

The objectives are the improvement of the professor's knowledge and pedagogical behaviour.

Students in the last year of study represent the public and the subject is their future professional activity.

Young people must be helped and formed using new technologies and communications techniques to find out as soon as possible a place in the active life and answer at the needs of the companies.

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