LEARNING DESIGN FOR EFFECTIVE BLENDED LEARNING DELIVERY

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The paper is focused on using Learning Design (LD) to support Blended Learning (BL) and how to integrate it in existing practice. BL categories are analyzed and different kind of components of BL solutions are examined in order to be chosen the appropriate of them that suitable for engineering education. Model of Unit of Learning (UOL) with BL components are developed. The findings in this paper support a project started at Technical University of Sofia R&D Laboratory "E-Learning Technologies" that aimed at developing a Learning Design Tool as a part of a Shareable Content Object Reference Model (SCORM)-compliant e-learning environment.

Keywords: Learning Design, Unit of Learning, Blended Learning

1. INTRODUCTION

Global organizations and universities are increasingly investing in learning programs to achieve business performance improvement and competitive advantage. Technology and learning methodology advancements have presented new opportunities for more efficient and effective implementation of learning programs. Most notably among recent trends are the acceptance of e-learning, and the advent of the Blended Learning concept [1].

IMS LD specification represents various kind of learning, including BL and provides framework of elements the basic of which are: roles, activities, activity structures, learning environments, method that can be used to describe formally the design of any teaching-learning process [2]. A UOL refers to a complete, self-contained unit of education or training, such as a course, a module, a lesson, etc. The creation of a UOL involves the creation of a LD and also the bundling of all its associated resources [3].

A blend as an integrated strategy provides a planned combination of approaches, combining several different delivery methods, such as collaboration software, web-based courses, electronic performance support systems, and knowledge management practices and mixes various event-based activities, including face-to-face classrooms, e-learning, and self-paced learning [4].

BL provides UOLs include components that do not fall into the traditional mold of sequenced content: a FAQ, a glossary, references, resource documents for the learners to work with, etc. Alternately, in a BL environment, the role of learning objects themselves may be different than in a traditional course; the learning objects may simply be instructions for the learner to perform some real-world task in an application other than the learning content.

The paper is focused on using LD to support BL and how to integrate it in existing practice. The findings in this paper supports a project started at the Technical University of Sofia Research & Development Laboratory "E-Learning Technologies" that aimed at developing a Learning Design Module as a part of a SCORM-compliant e-learning environment.

2. NEEDS ANALYSIS AND REQUIREMENT DEFINITIONS

Optimal blends can achieve after identifying the components, categories, delivery methods and models that can be used. The components of BL solutions are divided in two groups: offline components and online components as shown in Table 1.

Table 1 Blended Learning Components

Offline component groups	Online component groups
Workplace learning	Online learning content
Face-to-face tutoring, coaching or mentoring	E-tutoring, e-coaching or e-mentoring
Classroom	Online collaborative learning
Distributable print media	Online knowledge management
Distributable electronic media	The web
Broadcast media	Mobile learning

Within each of these components there is a whole range of different delivery methods that can broken down into three main categories: Offline (face-to-face & work-based), Offline (self-paced), Online & interactive media (summarized in Table 2).

Table 2 Delivery Methods

Offline (face-to-face & work-based)	Offline (self-paced)	Online & interactive media
lectures/presentations, tutorials, workshops, seminars, laboratory practices, simulations, conferences, tutoring, coaching, mentoring, feedback, manager as developer, learning on the job, projects, apprenticeships, placements	books, magazines, newspapers, workbooks, keeping a journal, review/learning logs, audio cassettes, audio CD, videotape, DVD, TV, radio	simple learning resources, interactive generic content, interactive customized content, performance support, simulations, e-tutoring, e-coaching, e-mentoring, feedback, email, bulletin boards, text chat, application sharing, audio conferencing, video conferencing, virtual classrooms, searching knowledge bases, data mining, document and file retrieval, ask an expert, search engines, websites, user groups, PDAs, mobile phones

All of these can be combined to build a variety of different blends. This produces different types of blend, which are classified according to level of complexity. Different categories identified in BL: Component Level, Integrated Level, Collaborative Level, and Extended Level are presented in Table 3.

Table 3 Blended Learning Categories

Blended Learning Categories	
Component - A component blend takes separate delivery channels and strings them together to make a simple blend i.e. the components are separate in the sense of being standalone. They would function effectively on their own if the others did not exist.	**Integrated** - An integrated blend integrates the components into a single mutually supporting structure. Each component is designed with the others in mind including direct design features, style, cross-references, links and dependencies that make the learning experience a single unified whole.
Collaborative - A collaborative blend brings further cohesion to the components and learners by providing face-to-face or electronic tutoring, coaching or mentoring and/or collaborative facilities.	**Expansive** - An expansive blend takes learning beyond the boundaries of the predictable components of formal learning into the workplace, use of offline print resources, use of electronic media, the web and even mobile learning.

Three BL models are identified: Skill-driven learning, Attitude-driven learning, and Competency-driven learning [5].

Skill-driven learning, which combines self-paced learning with instructor or facilitator support to develop specific knowledge and skills. BL that's skill-driven mixes interaction with a facilitator through email, discussion forums, and face-to-face meetings with self-paced learning, such as web-based courses and books.

Attitude-driven learning, which mixes various events and delivery media to develop specific behaviors. This approach blends traditional classroom-based learning with online collaborative learning events. At times, the nature of the content, as well as the desired outcome (developing attitudes and behavior) necessitates the inclusion of collaborative learning that's facilitated through face-to-face sessions or technology-enabled collaborative events. Developers use this approach to teach content that requires learners to try out new behaviors in a risk-free environment. Activities that developers should incorporate into the overall learning experience include discussion forums, webinars, group projects, and online debates that use chat modules.

Competency-driven learning, which blends performance support tools with knowledge management resources and mentoring to develop workplace competencies. The success of knowledge learners depends on how quickly they make decisions in the work place. While part of the decision-making process is guided by common facts and working principles, people also need tacit knowledge that's often retained by experts. Learning that facilitates the transfer of tacit knowledge requires a competency-driven approach. Because people absorb tacit knowledge by observing and interacting with experts on the job, activities may include a blend of online performance support tools with live mentoring.

The analysis of different kinds of BL shows wide variety of possibilities to model BL approaches. One BL model that can be used in process of LD and that is suitable for engineering education has to meet the following requirements:

- BL category: Collaborative category, that presents integrated components in collaborative environment;
- BL components: Offline components - Face-to-face tutoring, Coaching or mentoring, Classroom, Distributable print media, Distributable electronic media, Online components - Online learning content, E-tutoring, e-coaching or e-mentoring, Online collaborative learning, The web, Knowledge management;
- BL delivery methods: The mention above delivery methods are possible according to used components;
- BL model: It has to integrate features from Skill-driven learning and Attitude-driven learning: email, discussion forums, and face-to-face meetings with self-paced learning, such as web-based courses and books, discussion forums, webinars, group projects, and online debates that use chat modules. The developed BL model is presented in Figure 1.

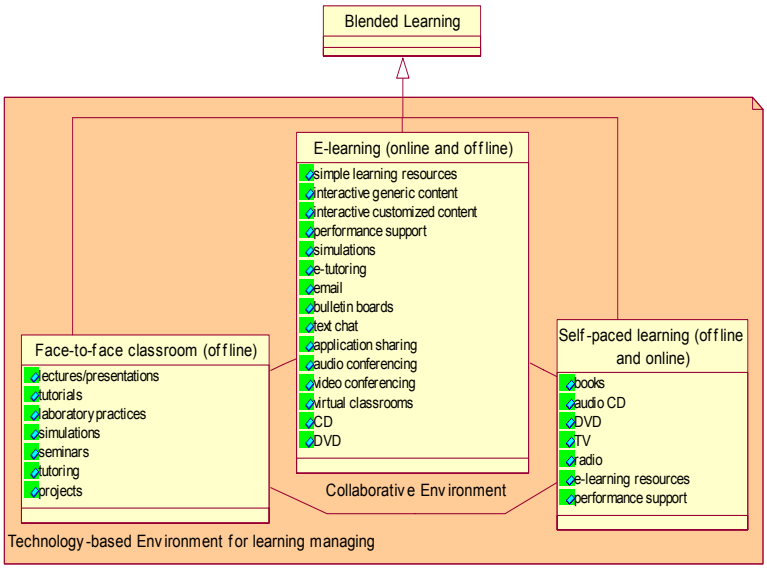

Figure 1 Model of Blended Learning Environment

3. DESIGN OF UOL WITH BL DELIVERY

Designing and developing instruction and learning is a complex process [6]. The five phases are distinguished: analysis, design, development, implementation, and evaluation in process of a UOL creation. The analysis phase involves analyzing a specific educational problem. With a view to the IMS LD specification, in this phase the Author has to answer to the following questions: (1) What are the learning objectives and what are the prerequisites?, (2) What instructional strategy or method to be used?, (3) What learning activities should the learners carry out and what the support activities should the staff perform to support them?, (4) What resources (environment-learning objects and services) should be made available to both learners and staff? In the Design phase, one creates a coherent view how the instructional aspect of the educational problem may be solved. The solution is expressed in the form of an instructional design, devoid of any content. In the development phase the instruction's content is developed. The instructional strategy developed in the design phase acts as a mould for the instruction. After the development phase, a complete piece of instructional material is available for implementation. This requires a software environment that is able to parse the XML code, render it in a user interface and keep track of the state changes of the system. In this paper are examined analysis, design and development LD phases in context of BL delivery.

3.1 Analysis

In this paper the examined UOL is a laboratory practice. The traditional laboratory practice is performed only with delivery methods of component face-to-face classroom. In BL model the laboratory practice integrated methods from three components in order to achieve efficient, effective and attractive learning. In Analysis phase the BL model reflects on Learning objectives, Prerequisites and Activities,

which have to be described according the proposed delivery methods. Here are defined: (1) *Title*: Analysis of U-I transformer scheme. Simulations and direct current sensibility; (2) *Learning objectives*: (A-Main) The learners have to can to perform the theoretical analysis and simulations of U-I transformer scheme after finishing this UOL. (B-Specific) Learners have to can to search, systematize, and analyze catalog information,…; (3) *Prerequisites*: (A-Main) The learners have to posses specific knowledge and skills and the learning environment, including LMS, web tools for searching the catalog information and software for simulation tests is needed. (B-Specific) Learners have to possess knowledge on mathematics, physics, semiconductor devices, LMS and specific installed software is need, …; (4) *Activities*: State the main theoretical points, Work with catalog data for OPA27, Make simulation test of scheme's characteristic I_{OUT} =f(U_{IN}) at R_t=0, etc.

3.2 Design

The design phase concerns the instructional method: describe the role-parts, environments, completion of activity, acts, activity structures, instructional method and finishes with creation of activity table (Table 4). (1) Role-parts: Describe the various role-parts in the sequential order in which they occur.; (2) Environments: If an activity requires particular resources or services, they can be choused, according to BL model.; (3) Completion of activity: Indicates for each activity how it will be completed: leave it up to the user (user-choice) or time limit.; (4) Acts: For each act has to be designed at least one role-part and activity. Act can complete by default or by time limit; (5) Activity structures: Activities should be grouped in an activity structure and the role-part can be linked to this structure rather than to each of the activities within it; (6) Method: Method describes which role what have to do. The method constitutes the role and act columns in Table 4.

Table 4 Activity table

Role	Activity	Environment	Activity completion	Act	Act completion
Assistant	State the main theoretical points	Presentations, tutoring (offline, face-to-face), Forum (online)	Time limit	Act 1	
Learner	Work with catalog data for OPA27	Search engines, websites, text chat (online)	Time limit	Act 2	After previews
Learner	Make simulation test of scheme's characteristic IOUT =f(UIN) at Rt=0	Simulation (offline, face-to-face), Learning instructions, text chat (online)	Time limit	Act 2	After previews
Learner	Make simulation tests of scheme's characteristics IOUT =f(UIN) at R_t=1kΩ, 4kΩ, 5kΩ	Simulations (offline, face-to-face), Learning instructions, text chat (online)	Time limit	Act 2	After previews
Learner	Define scheme's parameters Y21, Rin, Rout through simulation tests	Simulations (offline, face-to-face), Learning instructions, text chat (online)	Time limit	Act 2	After previews
Learner	Prepare a report from laboratory practice	Learning resource, Email, document and file retrieval (online) Book (offline self-paced)	Time limit	Act 3	After previews
Learner	Make a test	Learning resource (online)	Time limit	Act 4	After previews

3.3 Development

In the development phase the content is added to the LD. In a BL environment, the role of learning objects themselves may be different than in a traditional course; the learning objects may simply be instructions for the learner to perform some real-world task in an application other than the learning content. The performance of this task may also require a different scoring paradigm than the standard "learning object reports a score" paradigm; there may need to be a human in the loop or other scoring options may need to be explored. The content is allotted to various elements from Information Model of UOL that is presented in Figure 2. The IMS LD specification takes a generic approach to content by means of two-step referral mechanism. It uses this mechanism primarily to comply with the Content Packaging specification. This approach also fosters reuse of content and helps keep the XML instance document comprehensible. The elements that may contain content are: the *learning objectives* and *prerequisites* elements, and all components, i.e. the various sub-elements of each of the *roles*, *activities* and *environments* elements.

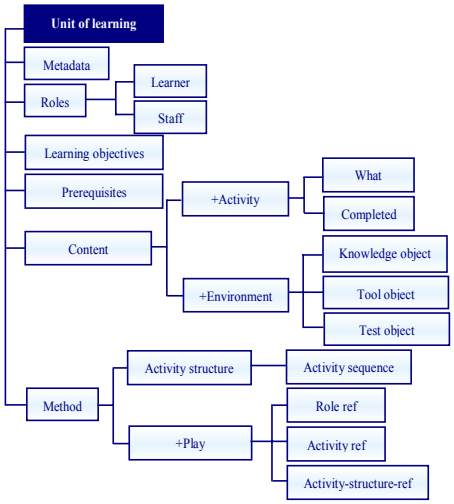

Figure 2 Information Model of UOL

4. CONCLUSIONS

BL provides UOLs including some specific offline and online components that can to be blended depending upon university's needs, available content, budget and time. The blended approach becomes more important to ensure that learning programs are designed to be effective, flexible and cost-conscious. In this paper BL categories have been analyzed and different kind of components and delivery methods of BL solutions have been examined. The model of BL environment suitable for engineering education has been developed. The model of UOL has been proposed that conforms to the LD specification and uses BL technology-based environment.

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