

ON THE DIDACTIC PRINCIPLES, MODELS AND E-LEARNING

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Abstract: It is presented a project *BEST* for development of a virtual learning environment, focuses on didactic principles of the e-learning and the following principles: learning is an goal-directed process; learners may define their own learning objectives, monitor and regulate their own learning process; learning is embedded in a social context; collaborative e-learning is more effective, etc. The *BEST* is realized on the basis of famous systems MOODLE and LAMS, and prototypes of *PeU* (Plovdiv electronic University) – *PeU 1.0* and *PeU 2.0*.

Keywords: e-learning, didactic principles, modeling of the learning process, Moodle, LAMS

ACM Classification Keywords: K.3.1 Computer Uses in Education – Distance learning, K.3.1 Computer Uses in Education Collaborative learning, H.5.3 Group and Organization Interfaces – Asynchronous interaction, Web-based interaction

Introduction

The educational process is based on pedagogy – the methods used for teaching and learning, and the ‘teaching objects’ in a course, such as assignments, learning activities, objectives, prerequisites, etc. There are three options for any learning technology when it comes to model didactic approaches: **pedagogy-neutral** (supporting no pedagogy at all), **pedagogy-standard** (supporting a single pedagogy) and **pedagogy-driven** (supporting a diversity of pedagogy). A great part of the contemporary software tools and technologies in the e-learning field can be characterized as **subject-dependent** (reorganized for specific fields and users) and **pedagogically neutral** (they don't support or provide any kind of methodical strategies and more specifically they don't specify ways for interpretation of learning content and objectives that are dependent on other conditions). They are ‘neutral’ especially in relation of the logic of interpreting of the course content while no learning requirements are specified. On the other hand, there are hundreds of different pedagogical models and strategies. As recorded by many authors: learning is different from consuming content learning and the implementation of one pedagogical model/strategy is not the right direction for e-learning researches and standardization. For example, the course may consist entirely of activities without any learning content and thus its transfer to a ‘pedagogy-neutral’ or ‘pedagogy-standard’ system would be difficult.

In this paper is presented a project for development of a virtual learning environment, named **BEST**¹. The *BEST* architecture focuses on the following concepts: learning is an goal-directed process; learners may define their own learning objectives, monitor and regulate their own learning process; learning is embedded in a social context; principles of collaborative learning; assessments and tasks are both product knowledge driven.

Didactic Principles of E-Learning

In nowadays, the e-learning educational paradigm gains more and more popularity, both as an alternative or as an integral part of the traditional learning. In order to become a real alternative of the traditional learning, the e-learning educational paradigm has to adequately implement the principles of traditional learning. Even a short comparison of the main elements of the learning for the two paradigms (Table 1.) shows that those principles should be further developed for the case of e-learning.

¹ Bulgarian Educational Site

Element	Type (in respect to the educational paradigm)	
	Traditional	E-learning
<i>Main objective</i>	Preparation for life and work	Providing of an environment for self-determination and self-realization of the personality
<i>Knowledge</i>	From the past ("school of the memory")	From the future ("school of the thinking")
<i>Learning process</i>	Teaching the learners certain knowledge and skills	Creation of own world model with active work of the learners
<i>Learner</i>	Object of the pedagogical activities (effects)	Subject of the cognitive activity
<i>Type of the relation teacher – learner</i>	Monological	Dialogical
<i>Learner activity</i>	Reproductive, "reactive"	Active, creative

Table 1. Main learning elements for two educational paradigms

The contemporary e-learning courses are purposed mainly not to present the pure scientific knowledge, but to solve vocational training tasks. The main criterion for the choice of the taught knowledge is its applicability to specific professional tasks. As a result, there is a transition in the process of creation of the course learning content – it is not based on the subject principle. In the same time the requirements to the educational methods and forms are significantly changed as well as to the preparation of the teachers for their new role in the teaching/learning process. For example, various individual and group learning activities (working with learning materials and information) become predominant. The nature of the relationship teacher-learner during the learning process is vastly changed together with their typical behavior.

The importance of universal (methodical) knowledge for assessment and prognosis of the future is increasing. The requirements to educational organization methods and forms and in particular to the preparation of the educators for their new role in this process are changed significantly. Individual and group forms of active work with the learning materials and information become predominant. The type of activities performed by educators and learners is vastly changed together with the nature of the relation between them during the learning process. There is a tendency for the learner to become a full-fledge subject during the process of solving learning and professional tasks – with the support and collaboration of the educator.

The e-learning pedagogical technology is based on virtual learning technologies and uses integration of different types of communication. E-learning essence and characteristics together with the wide use of ICT in its implementation and delivering make necessary the formulation of some additional **didactic principles** related to:

- ? *organization* (the content of the learning materials and the organization of the learning process should be built on the basis of the major learners' activities);
- ? *support* (creation of a user-friendly environment for learning process support);
- ? *communication* (openness of the communication forms and tools);
- ? *effectiveness* (optimal combination between the different management forms of the learning activities of the learners, economical suitability);
- ? *modularity* (learning courses represent subject fields and for that reason the curriculum may consist of different courses depending on the individual and group educational necessities);
- ? *interactivity* (indirect personal interactions student-student, student-teacher, etc.);
- ? *individualization* (of the knowledge and grading of specific learners);

- ? *control* (strict regulation and management of the activities using ICT);
- ? *suitability* (avoidance of unnecessary and pedagogically ungrounded use of ICT);
- ? *flexibility* (e.g. choice of time and place for learning);
- ? *openness* (participation of learners with different input level, without interruption of the work; with specific educational needs, etc.).

The experience gained in the implementation of the new educational forms and the changed notions related to the personality and its development allows the formulation of some ***specific didactic principles*** related to the e-learning:

- ? *personality-oriented* nature of the educational curricula (marketing approach, consideration of the educational necessities of the learners);
- ? *practical orientation* of the content and the activities;
- ? *activeness and independence* of the learners as major subjects in the learning process;
- ? *case studies* (the interaction during the learning process has dialogical and case oriented nature due to virtual simulators and communication);
- ? *problem-oriented nature* of the content and dialogical nature of the interaction during the learning process;
- ? *reflexivity* (learners' awareness of the content and the ways to participate in the learning activities, and especially – of their own personal development and acquisitions);
- ? *variety* of the educational curricula – the learning content should reflect multiple viewpoints to the problems and their possible solutions;
- ? principle of the supporting *motivation*;
- ? *module-block principle* in the educational programs and the learning activities.

E+Learning vs. E-Learning

An ***adequate model of the learning process*** according to us should be basis of e-learning – in a wide spectrum of subject fields and with possibilities to apply different pedagogical strategies. The term ***e+learning*** we will use to describe e-learning principles, technologies, means and tools but with potentialities to be applied in a wide spectrum of subject domains and according to different didactic principles and pedagogical strategies. On our point of view, the topic of the day is not the 'e-learning', but the 'e+learning'. According to this approach a virtual course is modeled not only by the learning content (learning materials) but also by tools (for the educator and the learner) and learning activities (examination, consultation, forums, etc.) accompanying the learning process. In the last years a number of projects related to this approach are performed, for example, *EML* [Learning Activities, 2006], *Moodle* [Malikoff, Dougiamas, 2005], *LAMS* [Ghiglione, 2005], *PeU* (Plovdiv electronic University) – ver. 1.0 and 2.0 ([Totkov, Doneva, 1998], [Totkov, Somova, 2002], [Totkov, 2003]), etc.

EML (Educational Modelling Language) is a semantic notation of complete ***units of study*** developed as a mean for expressing various pedagogical models in order to support reuse and interoperability [Koper, 2001]. The modeling is done with use of the ULM [Unified Modeling Language, 2004] and the binding is in an XML schema. A unit of study is the smallest unit providing learning events for learners, satisfying one or more interrelated

learning objectives¹. The unit of study could be a course, a study program, a workshop, a practical, or lesson, that is delivered through online learning, blended learning or hybrid learning.

Moodle is an open source course (and content) management system in which activities are at the heart of the system. *Moodle* was designed on base of social constructivism. Constructionism asserts that learning is particularly effective when constructing something for others to experience. The students could be considered as actively engaged in making meaning. Teaching with that approach looks for what students can analyze, investigate, collaborate, share, build and generate based on what they already know, rather than what facts, skills, and processes they can parrot. *Moodle* has modular design that makes it easy to create new courses, adding content that will engage learners. This modular object-oriented dynamic learning environment possess intuitive interface that makes it easy for teachers to create courses. Teachers and students require only basic early acquired from Internet browser skills to begin learning, which makes last one very simple and user-friendly platform.

LAMS (the Learning Activity Management System) is a software tool for designing, managing, and delivering online collaborative learning activities. The system is based on the concept of LD² theory [Dalziel, 2003]. *LAMS* has an intuitive interface with a visual authoring environment that allows users to create sequences of learning activities with very little effort [LAMS International, 2004]. *LAMS* offers lecturers a structure on which to build their lessons. The person delivering the lesson does not necessarily need to be a subject expert thus making a case for using *LAMS* for cover lessons.

The **PeU** 'pedagogical meta-model' allows courses (by the graph representation of the appropriate learning process) to be created for different didactic methods. This *PeU* feature expresses its key difference from some e-learning systems offering content-centric learning models. In the *PeU* learning models/plans, activities are specified as means of expressing the 'learning flow' including decision-points, sequences, choices, etc. For example, performance in one activity determines the next learning sequence. Plans could be considered as dual specifications, specifying the both – didactic logic and learning content. The last is the merit to call the *PeU* approach 'pedagogically-driven'. Following this approach any pedagogy could be expressed at a sufficiently high level via a graphical specification. This approach allows a diversity of pedagogy used. The high level of abstraction and flexibility makes these models a very powerful tool for expressing very different learning scenarios, including personalized learning.

The BEST Model of e+Learning

It's natural to ask the question – is it possible to create a system combining the advantages of the three abovementioned systems? The present work is concerned with the answer to this question. We will omit the detailed comparison of the systems and will point out only functionalities that are realized in *LAMS*, in *PeU*, or in both (omitting the detailed comparison of the three mentioned systems):

- A) **Both in LAMS and PeU:** models of the learning process, learning management with different interpretations (depending on the user) of one and the same model, etc.;
- B) **In LAMS, but not in PeU:** open source, possibility to include learning activities of communication type (Chat, Forum, etc.) in (linear) order of activities, support of several kinds of weekly schedules; 'simple' design and user friendly interface based on common conceptions and rules, etc.;
- C) **In PeU, but not in LAMS:** not linear structure of a learning course (and of learning materials too) using logical and control structures (*and, or, case, while, join, split*, etc.), and as a result – the system

¹ It can not be broken down to its component parts without losing its semantic and pragmatic meaning and its effectiveness towards the attainment of learning objectives.

² Learning Design

is adaptive to the learners; learning based on concepts (including generation of a learning plan based on a given Concept Map in PeU 1.0); powerful test system based on pedagogical requirements; wide user typology (authors, teachers, managers, local and system administrators, guests); administrative subsystem (including learning process management of student groups with different curriculum), etc.

The *BEST* system is realized on the basis of three of the already mentioned systems (*MOODLE*, *LAMS* and *PeU*). The experiments with the beta-version¹ of the *BEST*, are encouraging, and confirm the correctness of the project decisions. An important element, implemented in *BEST*, is the possibility to **model the learning methods** using a wide spectrum of learning activities (included in the learning process model) and using interpretation and assessment of the results of the learning activities as events that are able to influence the virtual process.

A main objective, resulting from the new approach to the design and creation of e-learning environments, is independence from the application field – studied subject field, learning activities, form and mode of learning, educational necessities of the learners, learning and teaching methods, etc. The environment should provide support of the virtual e-learning process during the whole life cycle – from definition of the learning objectives and construction of electronic courses, accompanied by learning activities (learning, testing, examination, consultation, team work), to grading of the results and the educational quality.

Learning content and its corresponding electronic materials (which are actually static) are just elements of the complex *virtual learning* process, characterized by dynamics and variability, adaptation to specific learners, asynchronous or synchronous inclusion/ exclusion of different users, subjectiveness and objectiveness of the grading and graduating procedures, etc. The *virtual learning object* in principle may not be related to the learning content but may consist only of virtual learning activities (e.g. communication between learners and consultants, forum discussion, etc.). A significant difference between the new approach and the previous works lies in the modeling of the learning process (including the participating subjects and objects) and the interpretation of the different viewpoints (e.g. the viewpoint of a teacher, a learner, a guest and so on). For example the grading of a learner's progress, viewed as an event (a result from virtual learning), can change the consequent development and adapt it to the necessities of the specific learner. The philosophy of the new approach, in short, is in the following: the learning process doesn't consist only of "absorption" of learning content, learners that are not active in the learning process don't learn well; therefore the adequate modeling of the process, in all its completeness and variety, is crucial for the success of the e-learning.

Examples of **elements and models** that are used in the realization of the designed system *BEST*: metadata and ontology for representation of the knowledge in the subject domain; model of the learning process for the studied SD, including models of learning activities, learning materials, learners, teachers, etc.; intelligent support to the process of creation of learning materials and tests (including multimedia tools, automated linguistic processing, test generation, etc.); cooperation during support of learning and teaching, etc. In addition we will create modules for: *learning course generation* (using a specified learning objective, subject field in the terms of the studied concepts, learner model and learning resources in an integrated database and Internet), *Web presentation of learning courses*; *conversion to standard formats* suitable for export to other ELE and conversion of e-books to browse autonomously; *additional information* (multilingual dictionaries, general and specialized explanatory dictionaries, links to virtual libraries and other electronic resources, etc.); support to the work of learners and teachers in the learning process (*software tools* used for example to create and solve problems, to write homeworks, to construct texts and so on).

The main functionalities of the *BEST* could be summarized as follows:

- ? *Modeling of specific learning processes in different subject fields, wide spectrum of learning activities*

¹ The realization of the system will be described separately.

and subjects participating in them;

- ? *Administration and interpretation of created models*, and simultaneous (parallel) dynamic support of virtual learning for multiple users (learners, teachers, administrators, etc.) based on the created learning models and on the subject fields;
- ? Support of dynamic *virtual interaction* between the subjects and the resources of the system, provided by a model of the corresponding learning process and an integrated database;
- ? *Virtual communication* using activities related to the learning content (communication, information exchange, team work, and so on depending on the dynamic model of the learner) using different technologies and tools (forums, e-messages, videoconferences, etc.);
- ? Application of different *pedagogical strategies for learning* (depending on the specific user necessities, and with possibilities for automatic adaptation of the strategies based on a model of the acquired knowledge – before and after the implementation of a specific learning activity), etc.

In particular, *the learners* could choose the set of topics (located in the corresponding SD ontology) independently, could receive e-learning in form and content suitable for them, could be grouped according to similar educational necessities and/or models, or could be grouped for team work, etc.

The BEST Prototype

The BEST prototype is fully integrated with LAMS (as either an activity, course format, web-services, database, etc.), WeLOAD, LAMS repository, etc. Finally BEST provides complete support for the IMS standard (allowing import and export), conditional activities (such as these in PeU 2.0), and groups/roles customization. Along with this there are several implications for BEST on this pathway: 'bricoleur' tooling; UOL¹-style authoring; XML code output; roles/conditions/paths, and goals for LD levels.

Maintain 'bricoleur'² tooling

The pedagogic sense of the word 'bricoleur' was introduced by [Turkle, Papert, 1992] which grew out of an earlier use by [Levi-Strauss, 1962]. The idea here is that there are two fundamentally different ways of approaching a problem. The 'engineer' way involves making careful plans and writing everything down in full detail ahead of time. The 'bricoleur' way is more of an organic process of iterative design and refinement. While each approach is useful, the advantage of software designed with bricolage in mind is that the users can start producing useful results immediately. *BEST* as *Moodle 1.6* based system is an excellent example of software designed for bricolage. A naive (or even technophobic) educator can start doing useful things in *BEST* with five minutes of instruction. There seems however to be no fundamental reason why LD could not support 'bricolage' by altering the LD XML tree while the code was running, similar to the way you can use DHTML to alter web pages that have already been loaded. Consequently, we would favor the development of LD tools that support this work style (preferably, internal to *BEST*, so that an environment familiar to users can be preserved).

Create UOLs from structured sets of resources, activities and services

A *BEST*'s UOL typically involves resources and/or services sequenced or linked to each other in some conditional relation way ([Somova, Totkov, 2004], [Totkov, Somova, Sokolova, 2004]). *BEST* differs from *Moodle* mainly by its richer structure of an UOLs within its courses, but also allowing the option of unstructured elements or components. Likewise, it should also be possible to export an entire *Moodle* course as a UOL. UOLs is an additional type of building block in *BEST*, next to the traditional flat cards, which the educators or course designer would

¹ Unit of learning

² The French word 'bricoleur' is as 'handyman'

have available to construct a wide variety of learning scenarios (non-linear such as this in *PeU 2.0*). The complexity of this kind of design, however, would require a new authoring interface, such as the drag and drop tool developed by *LAMS* and *PeU 2.0*. These movable, swappable cards/units would then be the core objects exchanged in a *BEST* repository (which is LD-compliant).

Generate XML code from *BEST* designs after-the-fact

In *BEST* an 'after-the-fact' tool that builds an XML model after an educator designs and implements a course. This 'capture' a model/scenario after the learning has taken place. As a course progresses, the LD tool (*LAMS*) analyzes the online patterns and produces an XML model. In addition, a manual editor could then add the face-to-face aspects to the model. Currently in *Moodle*, there is a basic process happening like this already. Behind the mask of the zip-backup is a non-documented XML-tree. In *BEST* that tree is reworks in areas such as fully compatible with *LAMS* automated updating of resources. *Moodle* tends more toward what the authors characterize as 'server-centered' rather than 'manifest-centered' as it is in *BEST*, though there are some aspects of *Moodle* that are reminiscent of a manifest-based approach, in particular the XML format used for backups. Backup format in *BEST* is more LD-friendly structure (realized through an XSL transformation). This, however, is a fixated state of a course at one point in time. That has been useful for exchange.

Adding multiple, definable, conditional roles

In *BEST* were implemented some additional definable roles, and it has the capability to incorporate multiple different roles, conditional roles and temporary roles. One goal is to create an intermediary role between educator and student – such as 'tutor' with limited teaching permissions. Mentor role has been defined too. These roles are at the site level, course level, and activity level and allowed possibly of multiple roles within the same course. However, it appears that the LD concept in *LAMS* can go further with 'multiple' roles. We assumed several simultaneous roles in a *BEST* course. Another concept is conditional role. A student would automatically be given a different role when certain conditions are triggered (*PeU 2.0*). This was done by extra fields in user tables to store temporary role flags (during a course) and longitudinal flags (preferred learning style), and even the combination of these flags. That process was easy, but the difficulty would be implementing the engine that evaluates a script against these roles.

Aim for LD Levels A, B, C

At least two points should be considered regarding LD levels. First, LD levels are a distinction for implementers, not users. They are levels of the effort to implement the related functionality, not levels of the complexity of the learning designs that are created with a tool. This can result in situations where one has rather simple learning scenarios (from a educators point of view), but these cannot be implemented on Level A, because, for instance, certain properties are required. Second, when someone decides to start with a Level A implementation, this should be done with Level B and C 'in mind'. The implementation of a *LAMS* sequencing mechanism in terms of 'acts', for instance, will vary considerably depending on whether we plan to extend it in the future with *LAMS* sequencing triggered by properties and conditions (see *PeU*). Furthermore, it looks very likely that Level C (notifications) will be necessary whenever an LD UOL has to be able to communicate with *BEST/LAMS* integrated database (e.g. for Gradebook purposes). There is also a limit as to how much complexity can be reduced when the views and needs of the different educators and learners are considered. For this reason, implementation of all the three levels should be our goal from the outset.

Conclusions

The new approach discussed here changes the traditional e-learning notion, in the center of which is the learning object (material) and puts a focus on the conception of learning represented by activities (that compose the learn-

ing process viewed as a management process). The specific model of a management process includes flow structure of the learning activities (with possibilities to branch, including a possibility for subjective choice), resources for organization and implementation of the learning activities, management and control tools (including assessment of critical for the process events, stages and acquisitions of subjects) and so on. In this models it's possible for results from the implementation of a learning activity to determine consequent development of the process, e.g. to lead to different learning scenarios including adaptation to a specific learner. The paper points to that the integration is not only technological activity but brings up a mater about new 'electronic' pedagogy in LMS/LD complementary systems. In *BEST* social architecture consciously preserves its intuitive structure for designing courses. A post-run capturing of LD-based XML schemas were achieved both into *BEST*-LD compliance and 'bricoleur' design. Multiple roles in a structured UOL, with conditions, concepts, relations and paths, are implemented as new pedagogical modeling approaches.

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