Key factors for an integrated, multi-learner e-learning environment using the PENTHA ID Model

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Abstract: Today we live in a society characterized by multiple reference points and a dynamic knowledge, continuously subject to reviews and discussions. It is necessary a new model of person, manager of own space and identity. The here presented Instructional Design model uses a socio-cognitive constructivist approach and allows a multi-perspective view of the learning process. It proposes a flexible design that includes rapid prototyping and an educational environment, able to: increase productivity and operability, create conditions for a cooperative dialogue, develops participatory research activities of knowledge, observations and discoveries ("ecological" learning environment), customizing the learning design in a complex and holistic vision of learning / teaching processes. In particular, it examines the conditions that makes a learning environment "adaptive". Finally, the LAMS implementation will be analysed to verify how it supports : a) coaching /tutoring solutions with the finality to adapt the learning path; b) the teacher/author in advanced monitoring and planning activities, and dynamically re-defined course activities; c) the student, in a dynamic, collaborative and synergistic construction of "significant knowledge" in a multi-learner environment.

Keywords: Instructional Design, Interactive Design, PENTHA Model, Knowledge Management

Introduction

Instructional Design is the art and science of creating an instructional environment and educational content that will lead the learner from the condition of not being able to accomplish certain objectives to the position of being able to accomplish those objectives.

In this essay we propose a holistic Instructional Design (ID) model, defined PENTHA Model [dall'Acqua, 2009], an acronym for *Personalization, Environment, Network, Tutoring, Hypermedia, Activity*. It aims to assist the Author / Teacher in defining the complex didactical scenario of an adaptive e-learning process, examines the *conditions* that makes a learning environment "adaptive", *how* those conditions are realized in an integrated multi-learner e-learning environment, and *what* tools and functions must be supported in a LMS project.

The PENTHA model critical elements are:
1) a *social constructivist* didactical approach, with a *cognitive view* influence
2) a *design phase* that aims to produce *storyboard* and *flowchart*, that includes: Learning design (strategies and approaches), Learning Path Control and Intelligent Tutoring Actions
3) a focus on the creation of a **"***Student Relationship Management* "(SRM) [dall'Acqua, 2008], where students:

- are driven and motivated to continuous learning and become protagonists of choices in their learning path ("*fidelity" effect*);
- can behave as learning *stakeholders*, collaborating through pro-active interactions (*personalized learning effect*);
- can change perspective in their study, present a feedback on their "expectations", generating a relationship between student-discipline and research data value ("*studenting*" *effect*).

The PENTHA Model starting point is that technology in e-learning, beyond supporting students and teachers technically and scientifically, becomes crucial for the development and management of relations among the learning community. Besides, some online student aspects, un-percepted in *face-to-face*

learning, can be detected by the teacher, so student needs can be anticipated, dedicating a significant attention to their identity and cognitive characters.
In its formulation, we aim to incorporate several ID theories, because a goal of the model is to combine some of them in a single concept, recognizing the essential aspects of each.

Acronym

The PENTHA acronym describes primarily key factors of the analyzed multi-learner e-learning environment.

Personalization

For e-learning environments, "learning path adaptation" is an important issue to enhance teaching quality. Adaptive learning provides "Subject Matter" content, adapted to the student's actual knowledge and learning style, towards the realization of "self-directed" and personalized learning processes [Koedinger et all, 2006].

Environment

The PENTHA Model proposes a LMS environment, oriented (*constructivist vision)*: to emphasize the knowledge construction in function of the context, meaning real world complexity; to increase reflection and the social negotiation of knowledge

Network

- *of relationships and communications:* Referring to an adaptation process at the user interface level, the PENTHA model intends to describe how to support the user's interactions with the learning platform, and facilitate communication- / collaboration process between learning communities.
- *of competences and knowledge:* Referring to a convergence between learning practices, complex knowledge domain and learning design
- *of technologies:* Referring to a dynamic informatics structure, modifiable in real time

Tutoring

In the PENTHA model perspective, the key to e-learning success is in the ability to provide a complete tutoring concept. The automation of some aspects of the design process, execution and assessment (cognitive tutoring), permits to : manage the reticular nature of knowledge, support the teacher/tutor in his actions, and guide students to complete their courses on the base of their performance, progress and learning styles.

Hypermedia

The key aspects of Hypermedia are that it should provide easy access to information within an interactive environment which can be adapted. The web-like linking of ideas that characterizes hypermedia is more like the functioning of human cognition rather than the traditional linear structure found in much educational programming.

Activity of sequence

The Model assumes that learning activities aim to encourage the construction of learning processes, based on reflection, expressive creativity and design. They stimulate advanced cognitive abilities and skills, with the creation of sequences of activities, dedicated searches, research and analysis.

Didactical scenario

Consequently, the Model identifies five conceptual dimensions of the didactical scenario: Knowledge-, Cognitive-, Didactical-, Semiotic- and Social dimension (see Fig. 1).

Knowledge dimension is a three level structure of abstraction: 1) "Learning Object" (LO), elementary didactical module, which can be used, re-used or referenced during the course session; 2) "Ontology", graphical structure which formally describes an educational domain through the specification of a

terminology of concepts and the identification of relations between them; 3) "Metadata", structured data which describes the characteristics of a resource.
When instructional designers are pedagogical experts but not content experts—and teachers are content- and research experts but not pedagogical experts—the result is a divergence of content and pedagogy. The model considers that research needs to move toward exploration, into the specific forms of pedagogical and content knowledge that effective teacher practitioners and subject matter experts use when teaching specific subject matter content to their students. [Kanuka, 2006]

Cognitive dimension involves [1]: 1) The "cognitive state" of the student, dedicated to represent the students knowledge, at any given time; 2) The "learning preferences" (such as: difficulties, language, learning style, context, typical learning time, interactivity type and level, learning resource type, semantic density, etc.); 3) The "evolution rules" of the cognitive state and learning preferences, obtained: a) confronting the test results at the end of the assessment activities with previous test results; b) observing the used didactical material, the acquired knowledge and skills, in order to determine the degree of receptivity (retention) of the learner to various types of issues/subjects.

Didactical dimension consists in a set of "selection rules", responsible for selecting the appropriate didactical nodes, and a set of "sequence rules", to apply a proper order of the content in question. The defined rules must be able to access the learner's profile, containing didactical preferences or prerequisites for the learner. In doing so, an individual content selection and learning path can be defined. Selection rules define the relations which were jointly responsible to identify the subsequent nodes. The result is a learner specific content graph, referred as *individual content graph*. In the learning process, the learner navigates through the individual content graph by following its sequence. The individual content graph serves as input for a set of sequence rules. The resulting sequence is the *learning path*, explicitly explained in the Syllabus section, a personalized navigation structure of sections and sub-sections, activity types/modes, interactions of tutoring [2], etc..

Semiotic dimension is realized in the specific construction of texts and their hypertext organization, the introduction of multimedia elements in the creation of "communicative situations", and the relationship between production-reception-signification. It opens to a "pragmatic-semantic text interpretation". This dimension is interpreted according to "Semiotic Textology" of J. Petofi [2008], where a text consists of two elements: a text-sense representation and a text-correlation representation. It defines "operations" which have to be performed during the interpretation, the "sequence" of these operations, and the "well formedness" of the results of these operations.

Social dimension is a combination of the above mentioned four dimensions for the use of collaborative tools and the definition/introduction of cooperative activities (external arrows of the PENTHA model – Fig. 1). It presupposes the relevance of collaborative strategies in relation to the learning objectives of the course, and the availability of adequate networking facilities for group interactions, within the virtual learning space. The possibility to create communities of practice (*shared knowledge*), a dynamic, synergistic and collaborative construction of significant knowledge [Novak, 1998].

Approach, strategies and lesson modes

Teachers develop a teaching style based on their points of view about what constitutes good teaching, personal preferences, their abilities, and the standards of their particular discipline. The paradigm shift from teacher-centered to learner-centered learning needs a complex didactical screenplay (scenario): macro project (about operation modes), micro project (about e-content and e-tivity [1] types), and scripts of activity sequences.

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[1] Compare the researches on IWT, University "Roma Tre" (Informatics and Automation Department) and University of Salerno (CRMPA Applied Mathematic Research Center) - Italy

[2] see below paragraph "tutoring modes"

[1] "E-tivity" is a framework to create an online *active learning* and i*nteractive*. This is a model which was proposed and developed by G. Salmon, Open University, UK.

A number of theories (e.g., Bruner, Reigeluth, Scandura) suggests a simple-to-complex sequence. The algo-heuristic theory of Landa prescribes a cumulative strategy. In Gagne's Conditions of Learning theory, a learning sequence is dictated by prerequisite skills and the level of cognitive processing involved. Criterion Referenced Instruction (Mager) allows learners the freedom to select their own learning sequence based upon successful mastery of pre-required lessons. The Component Display Theory (Merrill) also proposes that the learner select own learning sequences based upon the instructional components available [Kearsley, 2009].

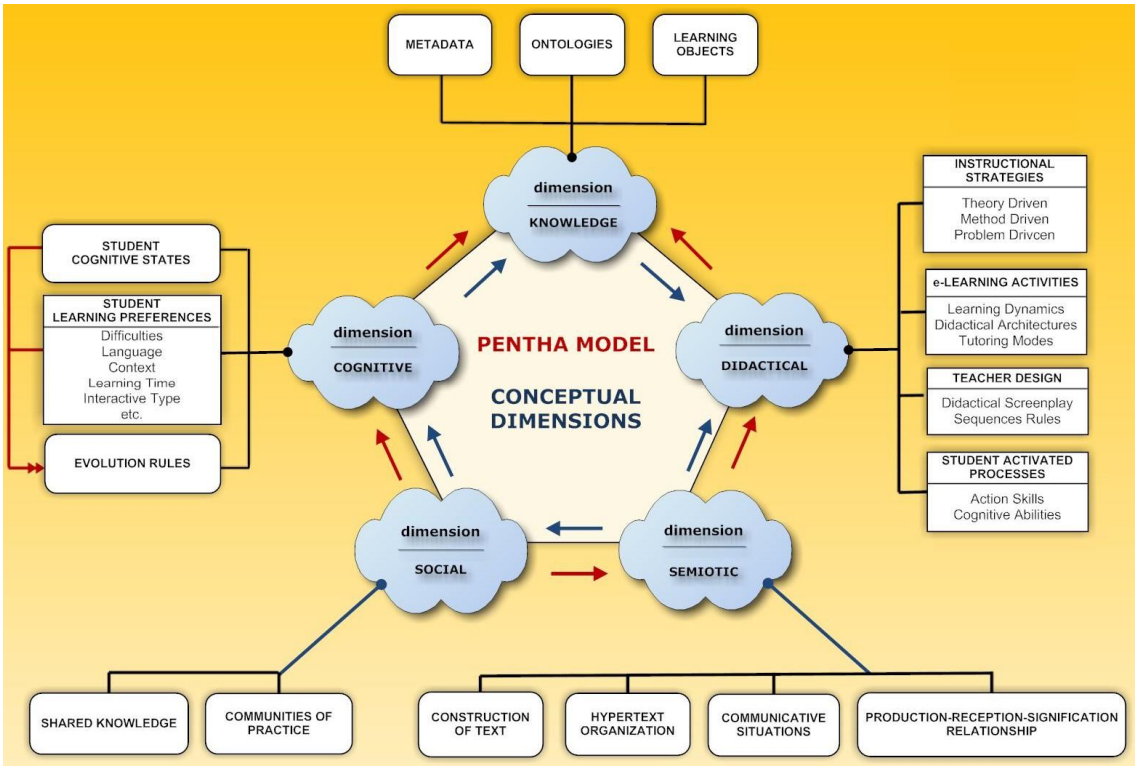

Fig. 1: PENTHA Model scenario

Specifically, we aim to combine:

- the "Teaching Learning Sequences" (TLS) theory, where the Author should decide which learning activities will be used and how they are related to classroom communication [Lijnse and Klaassen, 2004]
- the Reigeluth's "Elaboration Theory", whose purpose is to help students to select the content in order to maximize the achievement of objectives [Reigeluth, 1999: 425-459].

The result is the proposal of a *didactical structure* that describes in a diagram the essential aspects and general processes of teaching/learning achievements, based on the sequential breakdown of contents or tasks to be performed.

In particular, the PENTHA ID model intends to:

- allow a combination of *bottom-up* processes, driven largely by rationale, questions and ideas of the students, and a process (*from above*) structured in a sequence of conceptual development levels in relation among them [Lijnse and Klaassen, 2004].
- facilitate rapid prototyping in the instructional development process
- aid the memorization of "factual" knowledge, through the promotion of mental images
- evaluate a sequence of instructions, as holistic as possible, to foster meaning-making and motivation
- integrate viable approaches to scope and sequence into a coherent design theory

The model follows the rational route, but towards a more creative methodology. It suggests a fundamental didactical *problem-driven* strategy, to solve a practical problem or simulation. In this aspect,

it refers to two ID models: Nelson's Model, where the activities are strongly contextualized within the processes of collaborative learning, and Jonassen's "Constructivist Learning Environment" (CLE), where the problem assumes a fundamental importance [Reigeluth, 1999: 215-239; 241-267]:

- it considers multiple solutions, models of solution or no solutions;
- it assumes different criteria for evaluating solutions;
- it asks students to make judgments on the issue and to explain their positions by expressing personal opinions and beliefs;
- it is motivating, interesting and meaningful.

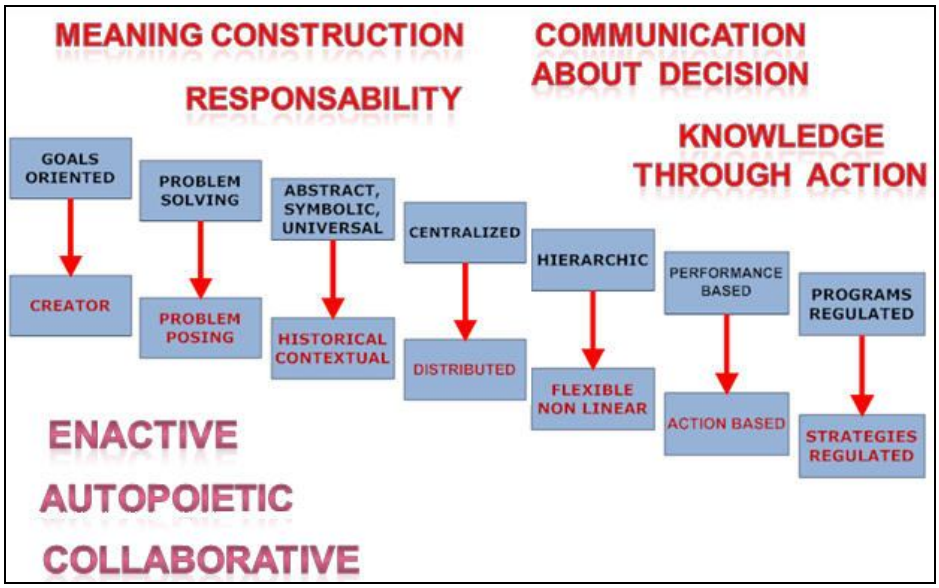

Fig. 2: PENTHA Model learning key factors

According to the above explanations, we assume that students build their own knowledge (*constructivist approach***)** on the basis of what they already know, realizing what they are doing and for what objective (*problem posing)* [Lijnse and Klaassen, 2004]. The lesson modes that activate these processes are: *heuristic lesson*, which allows the capability of dialogue and problem posing; individual-, collective- or guided *problem solving*; *brainstorming*, for comparison, creativity and collective problem posing; *social discussion*, for the problem posing and comparison of opinions and perspectives. Additionally, the following modes are significant: *cooperation /collaboration*, for mutual support and sharing of resources; *simulation* of role playing or phenomena, for the exploration of rules; *project work*, for adductive activity.

Didactical guidelines

According to ID methodology, in the PENTHA model perspective, teachers establish proceedings towards analysis, design, development and evaluation of the learning effect. They design in phases and dynamic structures, deciding on appropriate instructional strategies, planning on own didactical approaches. Subsequently, the Model suggests to follow ten fundamental didactical guidelines [dall'Acqua, 2008]:

1) *Detection and definition of "development areas"*, in function of the epistemological and methodological fundaments of the discipline
2) *Emphasize on the value of didactical activities in function of the student portfolio*
3) *Assessment of existing student competencies and skills*
4) *Activating an "individualized learning"*, adapting the learning design to the personal profile of the student, with the goal to let achieve the same objectives to all students
5) *Definition of objectives,* indicators of : a) *what* the learner should be able to understand at the end of each learning session; b) *abilities* and *skills* to achieve; c) *conditions* within the learner's behavior are

observed, supervised and evaluated. Through objective determination, it will be possible to evaluate the results of training sessions; identify content and didactical methodologies; guide the learner in the learning path, enabling the learner to concentrate efforts towards a well defined own target [Trentin, 2008: chap. 9].

6) *Identifying a strategic and operational development* to achieve teaching of essential "soft skills" as well as domain specific content, also through an inherently social and collaborative methodology
7) *Being aware of interdisciplinary thematic and methods* which the student must experience
8) *Activating a "personalized learning",* being aware of each students expectations and searching his active collaboration, with the goal to achieve his own cognitive excellence. This is because we consider "value creation" in regard to the student a mandatory requirement for his learning success.
9) *Identifying performance indicators,* based on a pedagogical approach. Used to measure the achievement of objectives, to identify areas for improvement and for the alignment of the entire instructional design
10) *Being aware that technological support sustains and doesn't prevent educational activities of tutoring*

The cultural product becomes polycentric because: a) *student satisfaction* is built: it consists in the sensation of seeing expectations achieved or exceeded. This requirement is satisfied by focusing on the student profile, and guiding the learner to decision making processes about his own learning path b) *active teaching style* is used, able to create value for students, anticipating and managing expectations and demonstrate all strategic decisions and tactics, skills and responsibilities in achieving their requirements.
Important considerations, is the measurement of the student satisfaction per se (*direct method*), but also in relation to the satisfaction level of the "class entity" (*indirect method*).

Assessment factors

In particular, for a personalized training, five essential e-assessment factors should be considered**:**

- *Profiling action* : analysis of personal characteristics of students, their needs and expectations.
- *Behavior recording action*: analysis of student behaviors during the learning cycle, the ability to monitor the student during collaborative activities and recognize the completion of tasks from students participating in group assignments
- *Presenting action*: structuring, visualization, storytelling and re-draft of didactical sequences; allow, too, logical-graphics simulations, for exercises, brainstorming and developing ideas
- *Planning action:* enable content management at a high level of abstraction through ontology's maintained in accordance with common standards for knowledge representation, semantic analysis of concept maps for the Human Tutor (H-Tutor) and an Intelligent Automatic Tutor (e-Tutor) (see "Intelligent tutoring function" paragraph), and production of flowcharts for Student
- *Scanning action:* analysis of activities, associated to social- and knowledge networks. It should have the availability and control of multiple resources (network of dispositifs) for the training and management of reticular nature of knowledge, and the type of user interactions like user/Learning Objects (LO), user/user, user /H-Tutor, user /e-Tutor, H-Tutor/e-Tutor, Author/e-Tutor

These factors enable intelligent tutoring actions (see following section), with an extended faculty and granularity for learning path data recording and monitoring, and the management of multiple actors with different roles.

Tutoring modes

Furthermore, seven tutoring modes are identified **[**dall'Acqua, 2009], that may be adopted by the teachers / (human) tutors in their online relationship with the students**:**

- *Modeling*, in which the teacher demonstrates how to perform a task
- *Coaching*, where the teacher actively supports the students, while teaching, motivating, analyzing the students performances, provide feedback, reflection concerning assignments to stimulate, discuss about the models adopted
- *Scaffolding*, which favors the adaptation of the learning path taken, a reflection on the actions developed by the student stimulated by the teacher

- *Fading*, a method for adjusting and adapting the path to the achievements of the student until proof of his capability in full autonomy

With these four tutoring modes we aim to incorporate the "Cognitive apprenticeship" concept [Trentin, 2008: chapt.2], that re-evaluates the learning by "imitation" of an expert, typical in the traditional apprenticeship.

Additionally, we selected:

- *Narrating*, for teaching- and learning aspects.
  a) The basic idea of the teaching aspect is to introduce the topic to attract attention of students and the appreciation of different learning styles and different forms of intelligence. We refer to Gardner's "Multiple Approaches to Understanding" [Gardner, 2006: chapt.18], that focuses on understanding of content, promoting the various intelligences (verbal-linguistic-, logical-mathematical-, visual-spatial-, bodily-kinesthetic-, musical-, interpersonal-, naturalist-, and intrapersonal intelligence) of which human beings are endowed.
  b) The basic idea of the learning aspect is that students are encouraged to verbalize their experiences. We refer to the Narrative Learning Environment (NLE), in which stories are used to support learning. They are characterized by three variables: 1) the role of users in relation to the narrative; 2) the pedagogical approach adopted to exploit the educational potential narrative; 3) a series of technological tools to facilitate the construction or use of "fiction", as well as to amplify its impact [Dettori et all., 2006].
- *Reflecting*, which pushes the students to compare own difficulties with an expert /tutor; and encourages them to perform pull actions [3]. Both action and reflection are essential ingredients in the construction of knowledge. Reflection is the vehicle for critical analysis, problem-solving, synthesis of opposing ideas, evaluation, identifying patterns and creating meanings.
- *Exploring*, which force the students to solve problems with new or alternative solutions. We look at the popular model by D. Kolb: "Experiential Learning", a process where the construction of knowledge occurs through the observation and the transformation of experience [Kolb, 1984].

These tutoring modes are accomplished through the use of educational tools; for manipulation and viewing (i.e. knowledge maps) to facilitate testing of complex phenomena and support of teaching/learning sequences. These actions (on cognitive inspiration) are also intended towards knowledge management, which implies how to react to specific situations in real time. This just enhances the didactical enactive aspect [4] of learning, the formal- and informal, active ("learning by doing", "learning by thinking") and dynamic learning.

Technologies

In consequence, PENTHA Model approach suggests four fundamental types of technologies to be supported [Pedrazzoli & dall'Acqua, 2009]:

- *communication* systems - synchronous (videoconferencing etc.) and asynchronous (forum, blog, del.icio.us, etc..). This would be in accordance with "Networked Collaborative Learning" (NCL), a social e-learning approach, founded on strategies of active and collaborative online learning. Fundamental factors are: technological online media, communicative dynamics (synchronous and asynchronous mode), interaction between actors, online and blended activities [Trentin, 2008]. Design of communicative processes is functional to the development and management of online learning activities
- *sharing resources functionality* - synchronous (screen sharing, electronic whiteboard etc.) and asynchronous (access to shared databases, shared documents etc.) to support group activities (collaborative writing, collaborative document synthesis etc.)

[3] "push" action : tutor drives the learner towards the right way if he is away; "pull" action : the learner asks tutoring, when he needs it; tutor acts on explicit request

[4] "Enactive Knowledge" is information gained through perception-action interaction in the environment (*Bateson theory*)

- tools for *knowledge mapping and simulation* (conceptual maps, flowcharting, etc.). This would be also in accordance to the "Open Learning Environment" (OLE) ID Models [Reigeluth, 1999: 155-140], based on the use of tools for visualization and manipulation in order to facilitate testing of complex phenomena, "authentic" contexts to promote the connection between formal knowledge and everyday experience. Therefore make use of "simulation environments" that allow students to manipulate variables and observe the results.
- tools for the *education workflow engine,* systems dedicated to sequential didactical architecture (for procedural ability learning and corrective feedback), and collaborative activity (for peer learning, peer tutoring, project work, problem based approach).

Furthermore, following features are considered important:

- tools for quantitative *assessment,* tests results etc
- *Graphical interface* to avoid cognitive disorientation during use of the application

Student e-portfolio functionality

PENTHA Model suggests to introduce this functionality, that involves students engaged in self-reflection and "critical thinking". It contains the student curriculum, acquired competences, personal grade book, personal repository of documents, graphical or multimedia elements, selected websites, or other personal items [Buzzetto-More, 2007]. In particular, the components proposed are [dall'Acqua, 2009]:

- *personal online space* to write and publish information (texts, images, audio- video clips) with the scope to monitor and evaluate the personal learning process
- *cooperative-, collaborative writing functionality* to allow other students (if authorized) editing, commenting, adding elements for a community of practice
- *social networking functionality* to allow to compare perspectives and interests among students (and tutors), sharing resources to competence portfolios
- *publishing tools* to distribute content (newsletter, email, alerts, etc.)
- *categorizing-, tagging tools* to create a "competence-tree"
- *research and filter functionality* to allow easy search of information on specific topics to integrate own competences
- *access control functionality* to allow a personal access to specific topic sections for several stakeholder
- *conceptual map functionality* to create node elements into concept maps and to document personal learning paths, showing the performed activities

Intelligent tutoring function

Today, Learning Management Systems are able to support online training with different levels of granularity and formalization. The focus is, in our perspective, on automation of some aspects of the design process, execution and assessment, to interpret and manage the reticular nature of knowledge.
The key to success is in the ability to provide a complete tutoring concept, represented by a combination of an "intelligent automatic tutor" (e-Tutor), covering the majority of the needed tutoring requests, and H-Tutor. Tracing the student's step-by-step solution enables the e-Tutor to provide personalized advice in his problem solving approach.
Prototypically tutors provide immediate feedback on each problem solving action: recognizably correct actions are acknowledged, erroneous actions are flagged. It gives the student maximum opportunity to reason about the current problem state, monitoring and assisting his/her approach, based on the defined "tutoring level" in the Learning Entity profile.
Then, an Intelligent tutoring function is able to support the teacher/tutor in his actions, guide students to complete their courses on the base of their performance, progress and styles of learning, towards the realization of "self-directed" and personalized learning processes [Pedrazzoli, 2009; Koedinger et all, 2006].

An analysis of the LAMS tool implementation to apply the PENTHA ID method

LAMS ("Learning Activity Management Systems") [5] is proposed as a system, primarily dedicated to learning sequences and collaborative activities. It allows to create sequences of activities, in a graphical environment using "drag and drop", facilitating the creation, exchange, re-use and adaptation of these sequences.

Among others, it has a network of dispositifs for supporting synchronous and asynchronous learning, including *Collaborative Web 2.0 functionalities,* and multimedia files connection possibility.
LAMS allows Teachers/Authors to create, re-design (modify) and manage courses dynamically. In particular, the Author can decide to define collaborative activities within a section of a course, associated to a "Learning Group", enabling activities like discussion of files, documents, at course based group level.

Specifications and strengths of the LAMS "course structure" are:

- it is *structured*, allowing to design teaching as a screenplay
- it is *"ecologic"*, allowing "thinking by relations" approaches, creating connections and dependencies between Learning Objects, in an integrated and interdisciplinary mode
- it is *graphically intuitive*
- it is *flexible*, in terms of space and time management
- it is an *effective learning technology* based on cognitive processes, allowing knowledge management on concept maps, enabling deep interaction with knowledge

Students can learn through individual tasks, organized in small work group or whole class.
The LAMS platform support logging/tracking at course module level. Human tutors can use available utilities to analyse/summarize the learners behaviour.

Interesting is RAMS ("Research Activity Management System) an evolution of LAMS, based on "human group e-Research" workflow. LAMS / RAMS are defined as *Education Workflow Engines*, to obtain optimum functions of planning. Both products have tools for quantitative assessment, tests results etc, but lack an extensive and advanced test facility, neither an integrated automatic, global hint support. Scoring is registered in a personal section, that can be used to influence the "learning path" flow. Using this capability, the author can, on a basic level, adapt the "learning approach".

For the student e-portfolio functionality, LAMS includes a personal online space, collaborative writing, social networking, publishing tools and conceptual map functionality; but doesn't include categorizing tools, research and filter functionality and control.

In summary, LAMS offers the conditions for a flexi-learning, works towards a dynamic and collaborative construction of knowledge. Besides, it allows presenting and planning, but not profiling and scanning action. Furthermore, it provides a basic behaviour recording action for learning path monitoring.
LAMS is used as learning sequences aggregator for other LMS platforms. The depth of LAMS integration varies depending on the LMS; the most advanced implementations are those of Moodle, and .LRN, where LAMS sequences are considered "pseudo native" LMS platform components. The more common (simpler) integration mode is to enable access to the external LAMS environment through the "external link" approach. Upcoming integrations (like for the OLAT LMS) is a tight integration solution based on wrapper technology, including the possibility of bidirectional data transfer. This will allow test-, assessment data from the LAMS sequence, to be integrated in the achievement structure of the native LMS platform (example common Grade book etc.).

[5] project of Macquarie University (2005), Sydney, AU [Dalziel, J. , 2008]

Conclusion

The concept of personalization and adaptation is fundamental for the innovation process in e-Learning. In this essay we suggest to adopt an instructional design model, PENTHA Model, a systemic and systematic application of strategies and techniques derived from a combination of cognitive and social constructivist theories.
In our opinion, a strength point of PENTHA ID model is to be able to realize the design phase with the production of a storyboard and flowchart, which includes:

- deciding on the best educational order in which to place the different lessons and sub-components, including the tools to use (*sequencing*)
- developing the strategies to be followed within each lesson, with the emphasis being on retaining motivation and maximizing retention (*student centered learning design*)
- deciding how much control the learner can have over the lesson flow, identifying key decision points in the lesson sequence (l*earning Path Control*)
- proposing *Intelligent tutoring actions*, with an extended faculty and granularity for learning path data recording and monitoring, and the management of multiple actors with different roles

A weakness of the proposed model may be that a teacher could have difficulties to quickly understand how to use it. Furthermore, Artificial Intelligence may be quite effective in some knowledge domains, but less effective in more open ended/contestable knowledge domains. The use of AI heavily depend on the definition of the associated domain rules.
The didactical experience of the writer is in the field of social anthropology, philosophy and logic. The obtained results have encouraged to propose this holistic model. The next step of our research will be an implementation guide for course authors using the PENTHA ID Model.

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