TOWARDS PERSONALIZED TRAINING OF ELECTRIC POWER GENERATION OPERATORS

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Abstract: This paper presents an approach to personalize the training of operators of power electricity generation. Although the approach is described in the context of electric power generation, it can be adapted to other cognitive training environments. The training courses are personalized on the basis of job position and the operator's training history. The personalized training is complemented with the certification of labor competences.

1 INTRODUCTION

The Web offers the perfect technology and environment for personalized learning where learners can be uniquely identified, content can be specifically presented, and progress can be individually monitored, supported, and assessed. (Martinez 2001).

2 COMPLEX DOMAIN LEARNING

What one regards as simple or complex is somewhat dependent on the individual making the judgment [Adelsberger 2008]. Besides individual differences in terms of prior knowledge and experience, however, there are some particular characteristics of complex domain problem and problem-solving skills associated with the situation. A complex cognitive skill is one that consists of multiple constituent skills; some of them involve thoughtful processing.

Multiple measures and reflective treatment can be found in many work situations and problems in the operation and maintenance of equipment for generating electricity.

2.1 Cognitive and Psychomotor Learning

Currently, electric power generation operators (like other operators of complex equipment as airplanes, helicopters, etc.), are trained, first, with theoretical courses to gain cognitive knowledge. Then, to acquire psychomotor experience they are sent to power plant simulators and after that they practice in the actual power plants supervised by a human tutor, the trainees become real operators. The psychomotor training is by definition personalized.

In this paper we describe the personalization of cognitive knowledge courses for power generation plant operators.

3 INTELLIGENT ENVIRONMENT ARCHITECTURE FOR PERSONALIZED TRAINING

Our proposed architecture of an intelligent environment is based on dynamic course generating systems proposed by [Brusilovsky 2003]. The intelligent environment is composed of four main components (see Figure 1): the domain knowledge module, the tutor, the operator model, and the Learning Management System (LMS).

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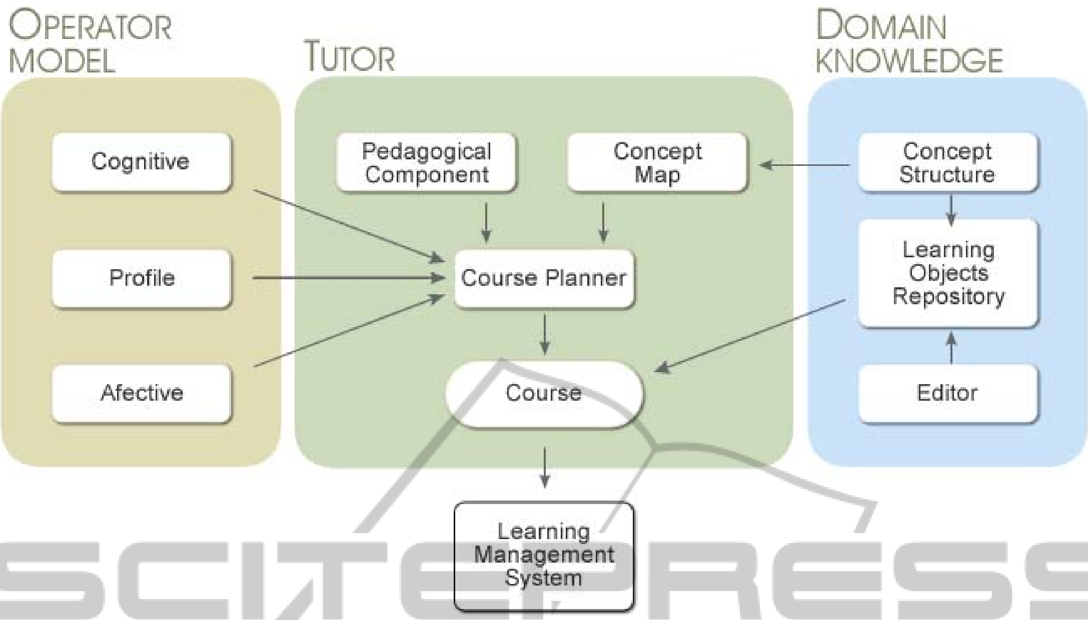

Figure 1: Architecture of the intelligent environment.

4 THE DOMAIN KNOWLEDGE MODULE

The domain knowledge module has three main components: the concept structure map, the editor and the repository of learning objects.

4.1 The Concept Structure Map

The concept structure contains the concept/topic structure of the subject knowledge to be taught. It is possible to organize the domain concepts/topics into a set of smaller, possibly interrelated AND/OR graphs, representing relatively independent sub-areas of the knowledge, different views, or different levels of granularity. It is represented as an AND/OR graph, where nodes represent the concepts domain or elements of knowledge, such as electrical topics, components of control board, rules, procedures and so on; and arcs represent relationships between concepts, such as a prerequisite for learning a concept or a sequence. Every node is associated with a set of teaching and testing materials labeled as Reusable Learning Object (RLO), which instantiate different ways to teach the concept/topic (e.g. introduce, explain, give an example, and give a simulation, exercise, or test).

For the training of power plant operators, the concept structure map is made based on the structural decomposition of the generation process into unit, structure (boiler, condenser, turbine, generator, etc.), systems (air-gas, water-steam, fuel-oil, etc.), equipment (PI Control, etc.) and component (pump, valve, pipe, thermometer, etc.).

4.2 Editor

The editor contains tools for edition of teaching and testing materials based on learning objects. Each material is labeled as Reusable Learning Object (RLO) or Shared Content Object (SCO) according with the SCORM (Sharable Content Object Reference Model) terminology [ADL 2001].

Only for the generation process, CFE has a collection of more than 400 instructional courses developed in house during the last 10 years.

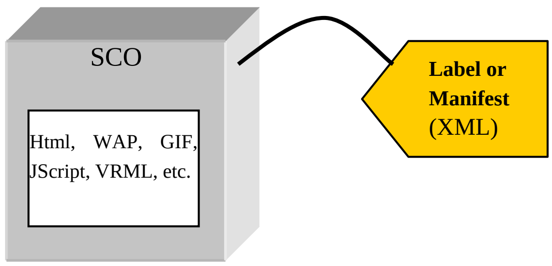

Figure 2: SCORM complaint learning objects (SLO).

The editor allows the repository manager to take learning content, generate a SCORM 2004 compliant label o manifest and to compress all together in a zip file (see Figure 2). The result is a SCORM compliant Learning Object (SLO) that can be managed by any SCORM compliant LMS.

The SCORM compliant manifest contains metadata for the classification and recovery of the SLO. The classification categories have been extended to satisfy the needs of CFE, some were inspired from concept structure map.

The SLO is a set of items to structure a course, workshop, or other aggregation of learning resources, the organization of the SLO is as shown in Figure 3.

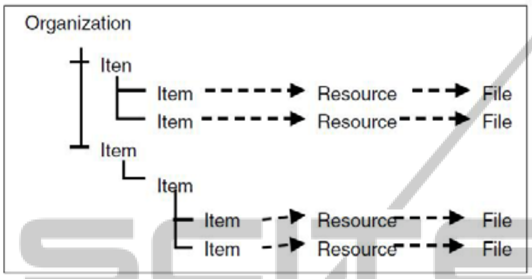

Figure 3: The organization of a SLO.

4.3 Learning Object Repository

The Domain Knowledge module has a Learning Object Repository (LOR). The LOR is a central database in which learning content (SLO) is stored and managed. The Repository main component is the database.

The repository is implemented using a relational database management system and an abstraction model of the database using a semantic network is shown in Figure 4.

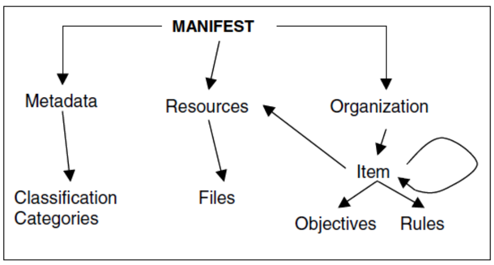

Figure 4: The semantic network for the database structure.

Other authors [Gascueña 2005] use ontologies to model the database but in this case a semantic net is simpler and is a closer representation of the relational database.

5 THE COURSE PLANNER MODULE

First we present the basic approach and then the competences are integrated.

5.1 Basic Course Planner

Figure 5 shows a semantic network that represents the data used personalized courses.

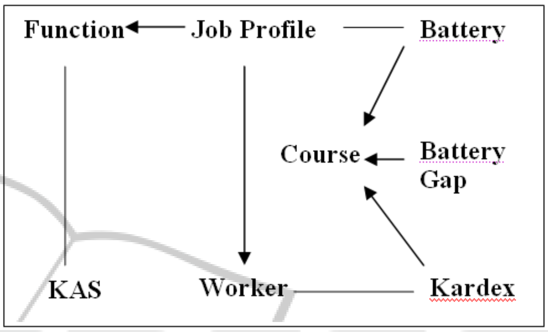

Figure 5: Data used to personalized courses.

5.2 Integration of Competences

The objective is that the traditional training model supports to the employees' labor skills certification without affecting the training contractual rights.

The approach followed to integrate the labor skills concept with personalized training is centered in the concept of thematic content that the training course programs will have to include to support the employee in the labor skills certification process.

The idea is to establish and achieve thematic consistency between the elements of the labor skills norms of the key functions and the specialty courses of the employee position profiles.

The integration process includes the set of specialties (SP1, SP2,... SPn) obtained from the position profiles of the productive organizational functions and the configuration of specialties based on skills or competences (c1, c2, … cn) achieved by correlating the thematic content of the skills norm with the content of the specialties courses and adapting them or creating new contents to impact the competence certification.

In this fashion, a specialty is a group of competences, Sp1 = C1 + C2 +. + Cn, (see Figure 6). The specialties can be classified in more than one specialization level, where the highest level contains the lower levels.

As an example of a competence oriented analysis the design of a master degree curriculum in power plant operation is briefly described. Table 1 shows a 5 semester master in engineering curriculum where the courses in shady background represent competence oriented courses with thematic contents

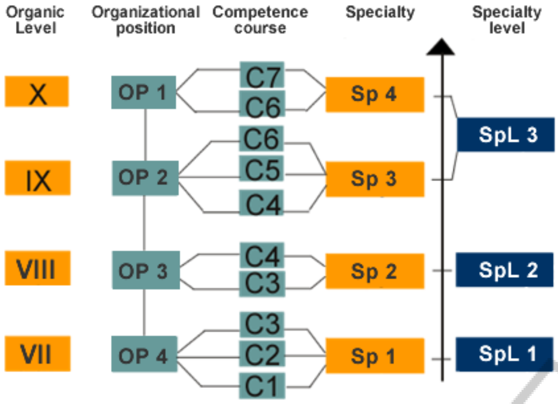

Figure 6: Competence oriented specialty courses.

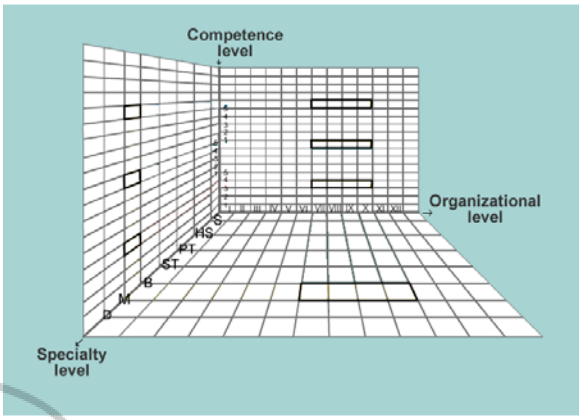

Figure 7: The training classifying dimensions.

matched to the thematic contents of labor skills. The first generation of 15 employees graduated at the end of the spring of 2008.

In Figure 7 the dimensions used in CFE to classify the training levels are shown. The training levels include the organic positions levels of the employees, the competence or skills levels and the levels of specialty to have the appropriate qualification to his position profile, competences and specialties.

6 CONCLUSIONS

This paper described an approach to personalize the training of operators of power electricity generation. Although the approach is applied in the context of electric power generation, it can be adapted to other cognitive training environments. The training courses are personalized on the basis of job position and the operator‘s training history. The personalized training is complemented with the certification of labor competences.

Table 1: Competence oriented master in power plant operation specialty courses.

1	2	3	4	5
		Thesis Seminar	Thesis Seminar	Thesis Seminar Project
	Thesis Seminar	Diagnosis Evaluation	Goal Negotiatin	Controllrs Simulatin
Agent Operation	Recovry Strategs	Energy Balance	Tactic Projects	Performn Measurm
Thermo Economic	Performn Tests	Fuel Consumpt	Problem Identificat	Plant Modificati
Thermo Fluids	Combusti Start Up	Maintenan Planning	Performan Evaluation	Correctiv Actions
Communc Techniqs	Tests Coordinati	Maintenan Execution	Informatin Managem	Preventiv Actions
Knowlede Managem	Tests Planning	Maintenan Results	Informatin Systems	Failure Analysis

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