About Developing Curriculum Driven Modeling of Degree Program Content

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Abstract: Processing of large amount of information in complex data structures in virtual classrooms motivated research activities in application of modeling methods during recent years. Considering one of them, the authors of this paper studied the possibilities and difficulties of introduction of model based distance learning in the higher education practice. They surveyed some important issues and methodological elements of virtual classrooms in comparison with demands for teaching procedures, programs, and materials. The main objective was to reveal specific circumstances that allow definition of objects appropriate for this special modeling. The paper is organized as follows. It starts with an introduction to virtual teaching procedures in Internet environment. Following this, local and global views of virtuality are discussed and main advantages of virtual education are noticed. Then an application purposed evaluation of the cited course model is given. Finally, possibilites for implementation of virtual classroom in higher education practice are concluded.

Keywords: Distance education, virtual classroom, Internet based higher education

1 Introduction

In the past decade, distance learning utilized advanced communication tools in computer systems as media, knowledge technology, Internet, and human-computer interaction. Conventional distance learning systems use books, pictures, moving pictures. Internet brought new resources as transfer of teaching materials between computers, hypertext in programmed presentations, e-mail and chat. The question that what is the next step in the development is answered in [2] as a demand for advanced description of distance learning related things as teaching programs, student schedules, teaching materials, etc. The next question is that why modeling is the solution for problems in distance learning. Some of the main problems are about review of huge amount information, quick change of teaching

programs and materials, shortage of time teacher and student side, demand of students for individually configured and scheduled programs, etc.

Application of modeling makes utilization of advances in virtual technology possible. Virtual higher education is considered not only as a possible solution for problems of advanced distance learning but also as solution for problems of campus style higher education. The authors of [1] and [2] propose a modeling method and model structure for virtual classroom. A special purpose of the method proposed in [1] and [2] is higher education of engineers. The proposed modeling is considered as a chance to connect virtual environment of CAD/CAM/CAE systems with virtual classroom environments to establish and integrate virtual laboratories. This aspect has not been studied during the survey reported in this paper.

The above cited modeling consider several fundamental findings by other authors. Virtual classroom is considered as a place of teaching to fulfill special learning demands [4]. Application and methodology of multimedia platforms in e-learning is very important as means for better explanation and understanding [5]. Development of virtual education is highly relies upon field experiences with e-learning [6]. Implementation issues and experiences of e-learning technologies in higher education require special consideration [7]. Virtual classroom also can be considered as a system for teaching in an unlimited area using powerful computer networks [8] and one of the tools for reform in higher education [9].

The paper is organized as follows. It starts with an introduction to virtual teaching procedures in Internet environment. Following this, local and global views of virtuality are discussed and main advantages of virtual education are noticed. Then an application purposed evaluation of the cited course model is given. Finally, possibilites for implementation of virtual classroom in higher education practice are concluded.

2 Procedures

As a bridge between theory and practice, virtual classroom, entities must be understandable for teachers, students, and personnel in offices. Considering roles and tasks of participants, new information technology must be fitted into an existing teaching environment without substantial disturbance in the on-going education.

To achieve a modeling understandable for participants of teaching and learning processes, existing definitions and structures including accreditation must be implemented. A proven and successful method for definition of application oriented model entities is application of features as building blocks for model construction. In [2] an extensive application of the feature principle is introduced.

Predefined classroom features can be defined, elaborated, and applied for modification of virtual classroom modules to create module instance for custom teaching programs.

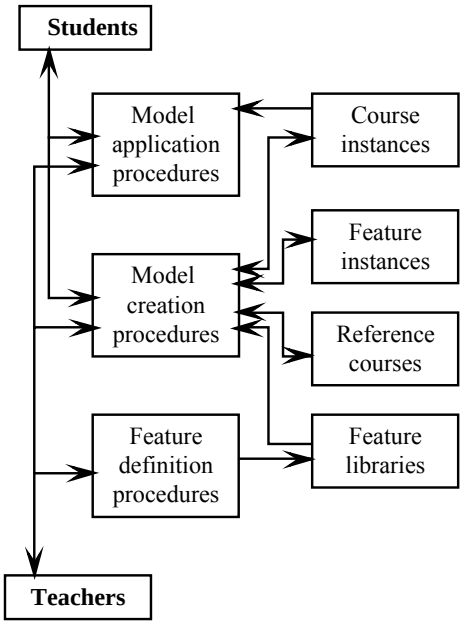

Figure 1
Features for course model

The feature-based scenario of modeling is outlined in Figure 1. Features are defined then applied at creation of courses. Reference course acts as a predefined structure of entities for a typical course. At the same time, predefined features, as course entities are stored in feature libraries. Modeling procedures create reference or instance course structures, feature instances, and modify courses by using of feature instances. Model application procedures execute course instance models and support virtual classroom activities.

Implementation of the above outlined method is possible when reference course and feature definitions can cover the information content and flow of practice. In this case, advanced theory and methodology by teachers is utilized by an efficient system.

3 Local and Outside Concerns

An essential issue in computer based education environments is handling of conflicts. For this purpose, local and global virtuality was introduced in [2]. Virtuality was defined on two levels of a teaching and learning system (Figures 2 and 3). On level one virtuality refers for a system in the virtual world of an actual computer system. Level two of the virtuality is for a system that applies resources from teachers at different geographical sites. Latter is important because same quality of teaching and learning cannot be offered for students in many different topics by the same higher education institute. Mobility of students and teachers is still very important. However, it is impossible to handle all demands by mobility.

Global virtuality can be implemented when information for appropriate accreditation can be acquired. In this case, flexible involving of outside teaching resources is allowed by the accreditation. One of the problems solved by the above-explained method is that continued utilization of teaching after mobility at the same institute is often impossible. A mixed application of the virtual university and mobility at the second level of virtuality seems as best solution.

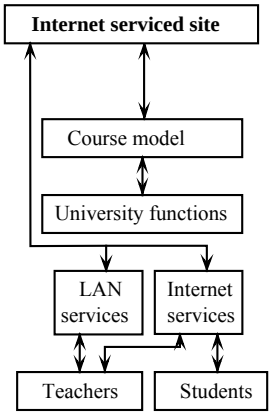

Figure 2
Local virtuality

Local virtuality (Figure 2) means teaching resources are accessible from a single Internet site. University functions are governed by course [3]. Course model consists of instances of generic resources. Student communicates with the system using Internet services. Exchange of information within virtual classroom is handled by local network. Teachers initialize interactive sessions from remote points.

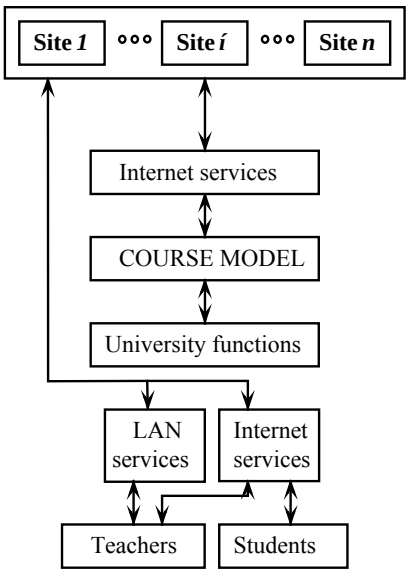

Figure 3
Global virtuality

4 Application Related Issues

A concept for essential communication structure in virtual classroom systems proposed in [1]. The authors of that paper established a simple model structure with main components and attached essential communications to them. Teachers, students, and people in outside sites communicate classroom model, course instance model, and outside world model, respectively. The structure is completed by relationship definitions (Figure 4).

Relationships describe connections revealed between course entities or their attributes. Classroom, course instance and outside world descriptions are connected with teachers, students and outside sites, respectively. The communication medium is the Internet. Attributes of local demand and decision originated virtual classroom entities are defined. The main benefit can be achieved by student profile based instancing of courses. In other words, a course feature instance is elaborated for a student request. In this vase, the request comes from both individual demands and prerequisites and other specifications by accredited courses. When it is allowed, a student may have multiple course instances.

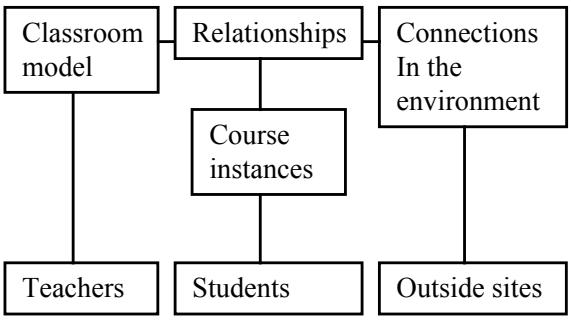

Figure 4
A quick glance to course modeling

Course feature instance can be a complex structure or even a single topic [3]. Topic feature as a basic unit of course features consists of concept, method, implementation, equipment, and opinion entities associated with teaching material and publication entities. Assessments are modeled as submitted works, on line exams, and conventional exams.

Services are offered by the virtual classroom for students. Teaching procedures rely upon services. Main categories of services are virtual lecture seminar or laboratory, teaching material service, off line and live consultation, submission in writing as assignments, interactive learning and programmed training.

Curriculum cannot be fully served by knowledge representations included in the course model. Referred knowledge sources are applied by communication with the outside world (Figure 5). Strength of virtual classroom is its ability to organize outside teaching resources in Internet based course programs. It is impossible to reproduce the knowledge and experience generated in the ever-changing world of industrial related practice including research and development.

Contradicting aspects of flexible course profiles and constraints must be harmonized in an efficient virtual teaching. Constraints in the classroom model are relationships of entities and their attributes, fixed entities and links. Constraints may be defined by any participants of the higher education system considering decided hierarchy. Legislation and government act through higher education related laws, etc. Constraints by accreditation are activated for degrees. Internal measures within an institution must be considered. Main participants of the teaching are teachers. They define requirements within modules for high level of purposeful education. Prospective or actual employers of students may also define constraints. Finally, students define what they would learn within a restricted area. The above sequence also represents a hierarchy.

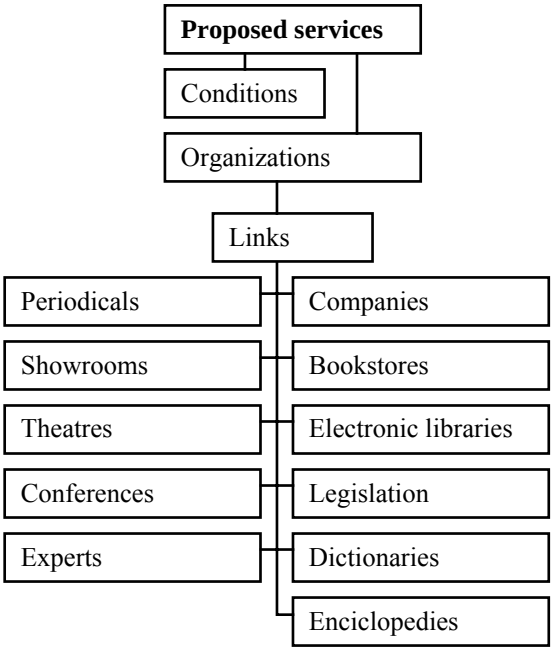

Figure 5
Connections in the environment

In [1] the authors proposed a new structure of interrelated components of a virtual classroom. They placed main emphasis to curriculum to describe content, provides conceptual structure and time for degree programs. Other groups of components make description of teaching processes, credits, students, and virtual laboratories possible (Figure 6). The result is grounded both theoretically and methodologically.

Virtual classroom is developed for a well-elaborated curriculum and it is modified by changes of developing curriculum. Curriculum is defined in the literature as an organized learning experience. It describes content of a degree program, provides conceptual structure and time frame to get that degree. At definition of curriculum, specifics of virtual classroom must be taken into account. Curriculum is considered as consisting of courses. Similarly to curriculum, a course can be defined as an organized learning experience in an area of the education. Curriculum involves a constrained choice of modules, blocks and topics. As for its structure, course is a sequence or network of modules. A module consists of blocks. A block involves topics. Core studies contain basic and essential knowledge in the form of modules or blocks. These can be build into courses or can exist individually upon student requests. Teaching procedures are lectures, seminars, consultations, assignments, and assessments. Other implementation based teaching procedures can be defined in classrooms. Credit information

involves degrees and certificates defined by requirements as well as financial conditions information. Students are featured by course, credit and fee related information. Virtual laboratory consists of software modules, arrangements of the objects and results of student work as assignments and degree works.

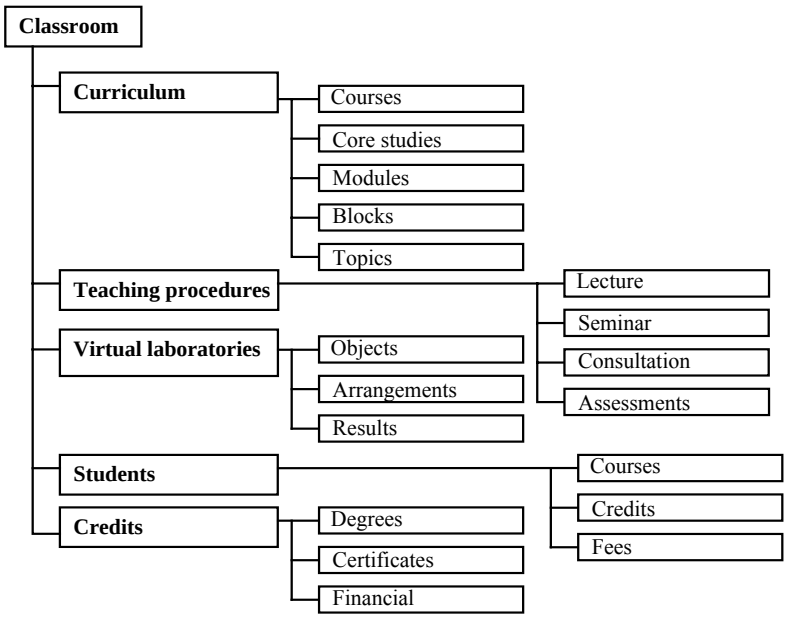

Figure 6
Classroom model entites

5 Implementation in Practice

The authors of [2] consider virtual classroom as an extension to existing modeling and Internet portal software products in the form of virtual classroom modeling extension (VCME). VCME utilizes functions of modeling, virtual university and Internet software. A solution for affordable implementation of virtual classroom modeling was proposed.

An example for potential applications of the proposed virtual classroom is teaching of principles, methods, and practice of engineering modeling. An engineer communicates modeling procedures to create model entities such as form feature entities for model of a mechanical part. The resulted model is developed and applied by other engineers applying other modeling procedures. Engineers are in interactive graphics dialogue with modeling procedures. Modeling systems have open surface for their development in application environments. At the same

time, some existing and utilizable elements of CAD/CAM systems as tutorials serve educational purposes. These systems include modules for Internet communication for group work and other contact with engineers in the outside world. Product model entities are connected by using of relationships between entities and their parameters as it is proposed for virtual classroom entities. Effect of a change of a model entity is experienced in a comprehensive integrated structure of entities.

In the case of engineering application, implementation of a virtual classroom is considered as an extension to existing modeling and Internet portal software products. An affordable system development, work of students in an environment similar to as in the industry can be achieved. An industrial engineering modeling system consists of a set of modeling procedures, a model database, a user interface, tutorials, Internet based group work procedures and application programming interface (API). API serves development of extension to the system by new programs written in own development environment of the modeling system or by using of other development tool set. Other program products for the engineering purposed virtual classroom environment are configurable virtual classroom software and Internet portal software tools. A thorough study of this application of virtual classroom is planned in the future.

A virtual classroom concept is introduced in [1]. This concept involves application of managers for main virtual classroom functional tasks (Figure 7). At the same time, courses model is proposed in this concept as a structure of modules and topics of the teaching program. Virtual university involves a set of managers for different functional tasks. Course manager handles modules of the teaching program. A module involves topics. Enrollment manager works with credits of student work if it is needed. Fees are administrated by this manager too. Communication manager's tasks related to communication tools amongst teachers and students. Teaching material manager downloads materials, offers on line video service, sends materials by E-mail automatically, and gives links to outside sources of materials. Support and license manager establishes connection with producers of modeling systems and administrates licenses. Data security and related tasks are coordinated by the data security manager. Installations use mainly configurable and open architecture professional software for managing purposes. The most important ones are Internet tools and the related applications.

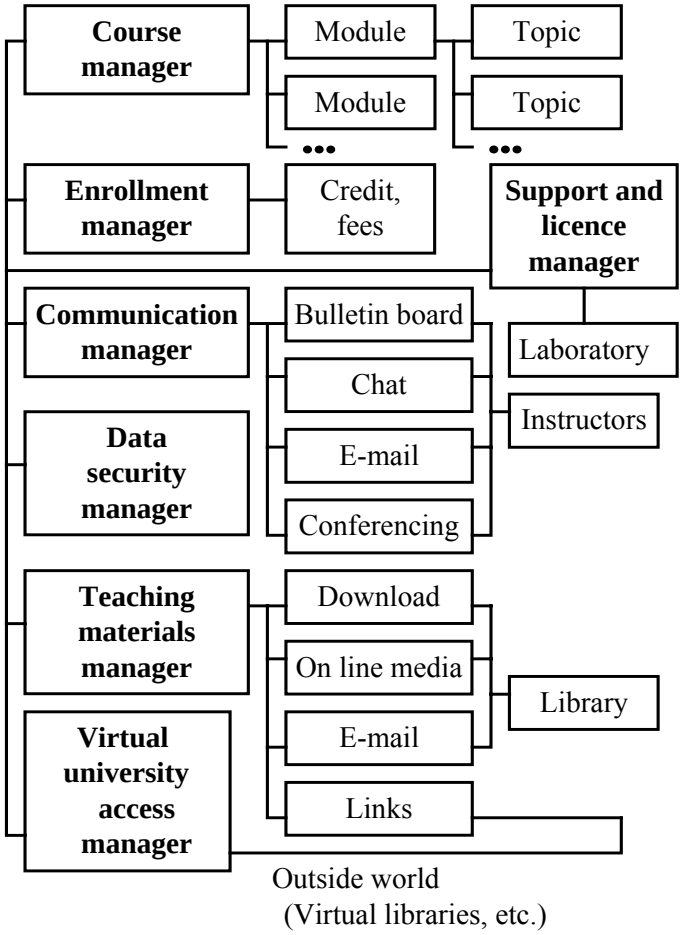

Figure 7
Managers and managed functions

As a final consideration, Essential methods for virtual classroom modeling are summarized. Virtual and Internet methods are applied (Figure 8). In other words, the columns of the proposed method are classroom model and Internet communication. Virtual methods are applied for creation and handling classroom features as building blocks, Modification of classroom descriptions by features, and creating relationships between features. Internet methods serve special browsing, application services as database, service providing for customers, and searches by general and special purpose engines.

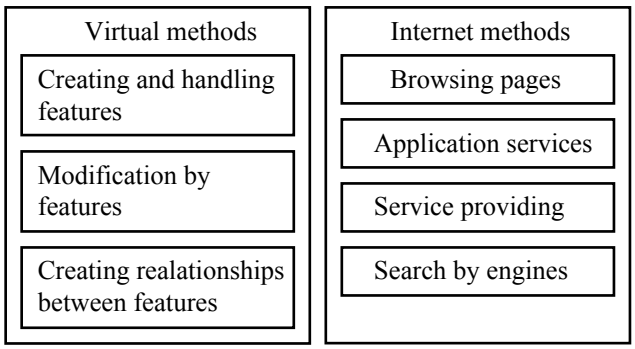

Figure 8
Methods for classroom modeling

Conclusions

The authors of this paper give an application-purposed survey of an early-proposed virtual classroom modeling. They studied conditions and circumstances of application of virtual classrooms in higher education practice and stated some relevant results for evaluation of cited characteristics of that classroom modeling. Among others, structure of the virtual classroom for practice, definition of classroom entities for real world teaching content, managing of virtual classroom, covering purposes of a conventional higher education environment, and a critical evaluation of a proposed set of classroom entities have been evaluated. As a conclusion, virtual classroom is a prospective tool to enhance and organize both campus based and distance education. Nevertheless, high amount of practical considerations is necessary to include for successful virtual classrooms.

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