ENHANCING CAPABILITIES OF OBJECTS FOR HIGHER UNIVERSITY PROCESSES IN VIRTUAL TEACHING ENVIRONMENTS

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ABSTRACT

Virtual systems in engineering serve lifecycle management of product information and are based on modeling methods. In order to utilize the proven methods of modeling in engineering and establish a higher education system that can be integrated with laboratory systems of virtual engineering easily, the authors surveyed and analyzed some results in model based teaching environment. In this paper, the authors emphasize practice oriented characteristics and features of virtual classroom as important aspects for their implementation in higher education of engineers. After a student demand based definition of course features, virtuality characteristic is discussed locally and globally. Following this, structure, elements and outside connections of classroom model are explained. Finally, application oriented issues are discussed including application of managers for essential groups of functions in course management.

Keywords: *Distance learning in higher education, Virtual classroom, Course modeling, Internet based education, Management of course.*

1. INTRODUCTION

Virtual classroom and various implementations of Internet based higher education organizations have a long history. However, they can not utilize the potential of advanced information technology. Conventional distance learning that uses books, pictures and moving pictures have been replaced mainly by simple Internet based systems that transfer teaching materials between computers, hypertext in programmed presentations, e-mail, and chat. The question that what is the next step in this development is answered in [2] as advanced description of distance learning related objects as teaching programs, student schedules, teaching materials, etc. The next question is that why modeling can be a key solution for problems in distance learning. Some of the main problems are about review of large amount information, quick change of teaching programs and materials, shortage of time at teacher and student, demand by 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 a solution for problems of campus style higher education.

The authors of [1], [2], and [3] proposed a modeling method and model structure for virtual classroom. The authors of this paper discuss some of the related issues. The authors of [1], [2], and [3] also considered several fundamental findings by other authors. Virtual university is considered as a place of teaching to fulfill special learning demands [4], as a system for teaching in an unlimited area using powerful computer networks [5] and one of the tools for reform in higher education [6]. Virtual teaching methods are applied to solve problems at training of High-Tech topics [7]. Some experiences with e-learning are reported by the authors of [8].

A special purpose of the method proposed in [1], [2], and [3] 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.

Frequent and substantial changes of industrial technology require lifetime learning. The time that can be devoted by practicing people for this purpose is very restricted. This requires efficient Internet based solution and substantial computer resources both at classroom and student sides. Companies engaged in development, production or consultation in engineering modeling and other areas are interested in participation of employee at efficient higher education courses. However, they may offer substantial computing and knowledge resources.

In this paper, the authors emphasize practice oriented characteristics and features of virtual classroom as important aspects for their implementation in higher education of engineers. After a student demand based definition of course features, virtuality characteristic is discussed locally and globally. Following this, structure, elements and outside connections of classroom model are explained. Finally, application oriented issues are discussed including application of managers for essential groups of functions in course management.

2. BASIC DEMANDS

In engineering modeling, objects and their relationships are described. This method can be applied in virtual classroom. However, entities must be understandable for teachers, students, and personnel in offices. In other words, the new technology must be fitted into an existing teaching environment without any substantial disturbance in the on-going education.

Modeling is not allowed to be very complicated thing that is not understandable for participants of teaching and learning processes. Instead, 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 are defined, elaborated, and applied for the modification of virtual classroom modules to create module instances for custom teaching programs.

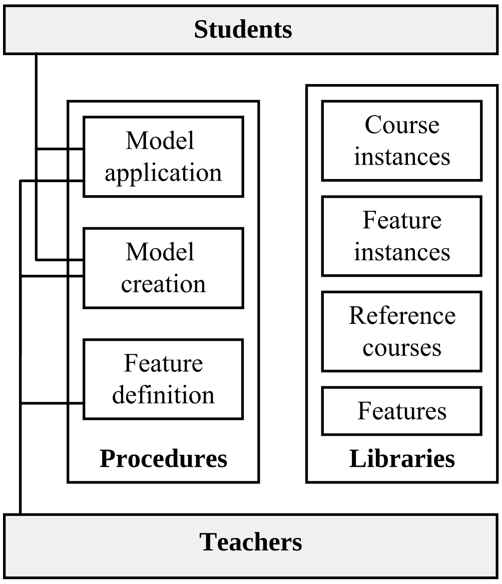

Fig. 1 Definition of course features

Procedures and resources for the feature-based way of course modeling are outlined in Fig. 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 cover the information content and flow of practice. In this case, advanced theory and methodology by teachers is utilized by an efficient system.

3. VIRTUALITY LEVELS

While a virtual higher education organization is within a computer system, it has high number outside connection to involve students and teachers from remote sites. Virtuality has been defined on two levels of a teaching and learning system (Figs. 2 and 3) [2]. On level one, virtuality refers for a system in the virtual world within an actual computer system. Level two of the virtuality is for a system that applies resources from teachers at different geographical sites. Latter is also important because the same quality of teaching and learning cannot be offered for students in many different topics by the same higher education institution. While mobility of students and teachers is still very important, 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, more or less flexibility of involving outside teaching resources is allowed by the accreditation. One of the problems solved by global virtuality 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.

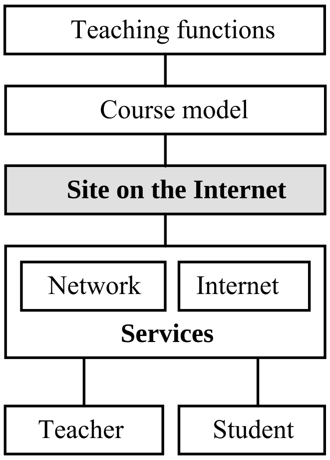

Fig. 2 Locally defined virtuality

Local virtuality (Fig. 2) supposes teaching resources accessible from a single Internet site. University functions are governed by course descriptions [5]. Course model consists of instances of generic resources. Students communicate with the system using Internet services. Exchange of information within virtual classroom is handled by local network. Teachers initialize interactive sessions from remote points.

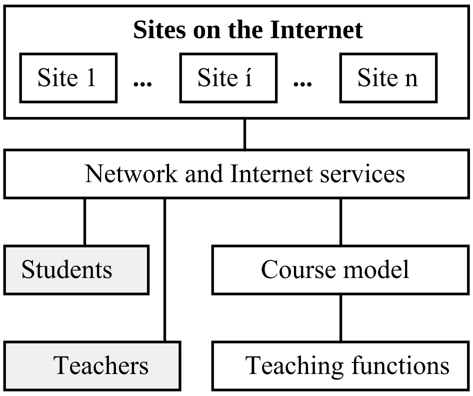

Fig. 3 Globally defined virtuality

4. STRUCTURE OF CLASSROOM MODEL

Predefined course and course element definitions facilitate the definition and selection of courses (Fig. 4.). These entities are available in the modeling system. Generic courses describe a set of similar courses. Course elements are arranged in network to be evaluated to gain course instance. Sometimes simple precedence rules can be used to create instances. It is not allowed to make any modification of instance courses by course modification features that contradict the related generic course definition. In other words, extension of custom tailoring is restricted by higher priority factors included in generic course definitions. At the same time, feature principle is also applied at definition of generic courses and creating course instances.

Classroom objects are to be described by a highly interconnected set of entities. Concept of one of the possible communication structures was published in [3]. The authors established a simple model structure with its main components and attached essential communications to the components. 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 (Fig. 5).

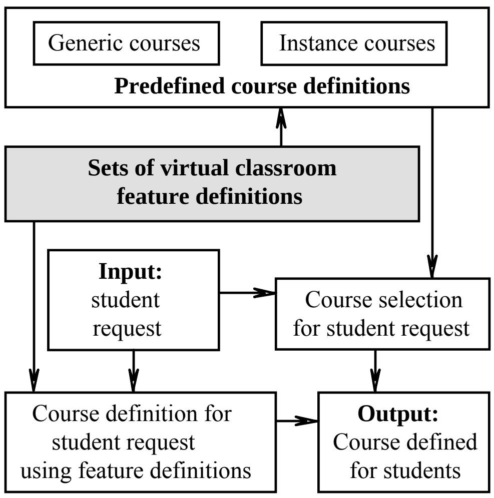

Fig. 4 Basic definition

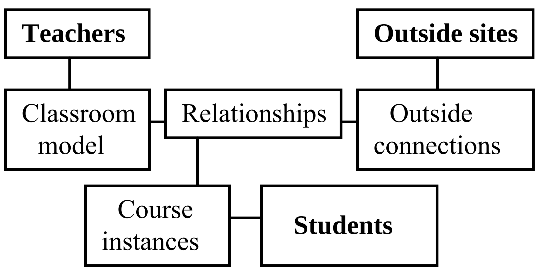

Fig. 5 Outline of the model

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. Local demand and decision-originated attributes of virtual classroom entities are defined as constraints.

The main benefit of modeling 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 case, the request may come from individual demands and prerequisites, and other specifications by accredited courses. When it is allowed, a student may have multiple course instances.

A course feature instance can be defined as a complex structure or even as a single topic. Topic feature serves as basic unit of course feature and 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.

The virtual classroom offers services 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 (Fig 6). Strength of virtual classroom is among others in its ability to organize outside teaching resources in Internet based course programs. It is impossible to reproduce all the necessary knowledge and experience generated in the ever-changing world of industrial related practice within a course.

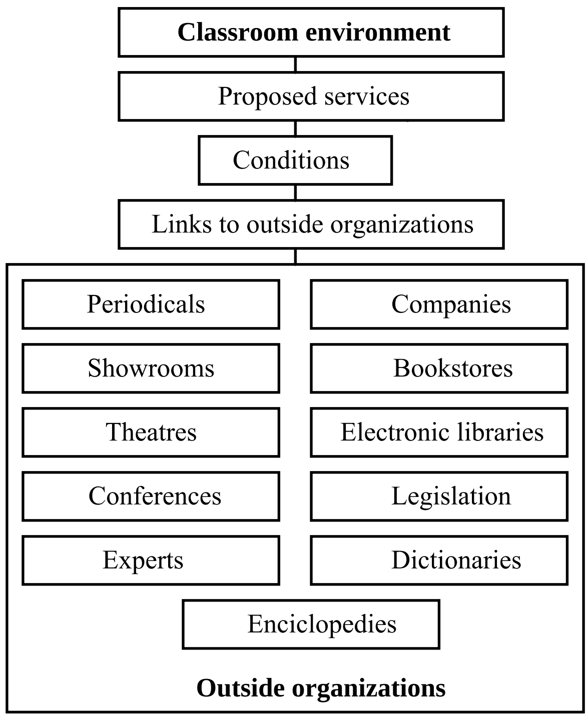

Fig. 6 Outside connections of the model

Contradicting aspects of flexible course profiles and constraints must be harmonized in efficient virtual teaching procedures. 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 a 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.

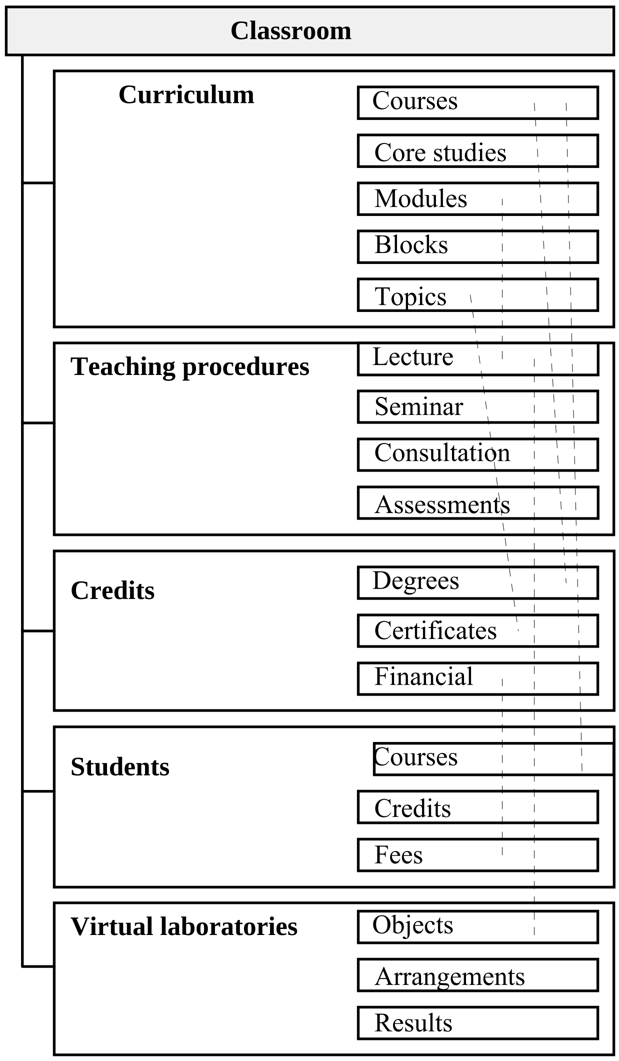

Fig. 7 Groups of classroom entities

In [1] the authors proposed virtual classroom as the starting point of an existing curriculum. Virtual classroom consists of curriculum, teaching procedures, teachers, students, and virtual laboratories. A new structure of interrelated components of a virtual classroom has been established. They placed main emphasis to curriculum to describe content, conceptual structure, and time for degree programs. Other groups of components describe teaching processes, credits, students, and virtual laboratories. Fig. 7 outlines groups of entities in classroom model with several direct connections revealed by the author during an analysis considering possible implementations of the model. A set of relationship definitions may be a solution as it is proposed between attributes of entities in [3]. The result is grounded both theoretically and methodologically.

Virtual classroom is developed for a well-elaborated curriculum then 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 a 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 within an education program. Curriculum involves a constrained choice of modules, blocks and topics. As for its structure, a 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 entities can be applied to compose courses or can exist individually upon student requests.

Teaching procedures are lectures, seminars, consultations, assignments, and assessments. Additional 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.

In [2] a structured course is proposed in which modules can be grouped into tracks. This method facilitates a versatile means of modeling (Fig. 8). Great chance of implementation is assured by application of the feature principle well known from engineering modeling. A course model includes structure of its elements, feature driven construction of modules and associativities between course elements. A track has been introduced as a course element comprising a set of modules for a well-defined purpose. Tracks and modules may be applied in several course instances with no duplication of classroom model entity descriptions. By application of feature driven modeling, a module is considered as a base feature modified by module modification features to create a customized module instance.

In the concept and methodology discussed by the author, a course is a sequence or a network of modules. Block as an entity between module and topics can be introduced when it is demanded by complex structure of a module. A block consists of a group of topics. Authors of [1] decided application of principles, methods, relationships, questions and other practice related entities to describe a topic. This recognized as a method valuable for practicing teachers. Consequently, a topic is processed by using of topic related procedures for handling principles, methods, relationships, examples, questions, materials and instructor activities (Fig. 9). Links can be defined to other topics and outside world objects. Modules are arranged in courses or can be applied individually. Core studies can be defined for basic and essential knowledge as modules or blocks. Finally, a course model offers a reduced choice of possible modules, blocks and topics.

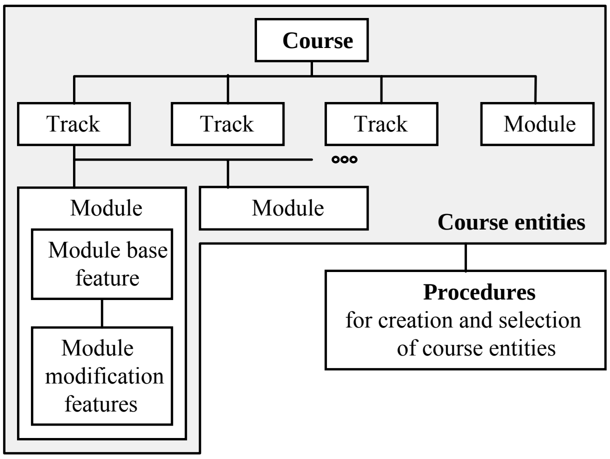

Fig. 8 Main structure of course

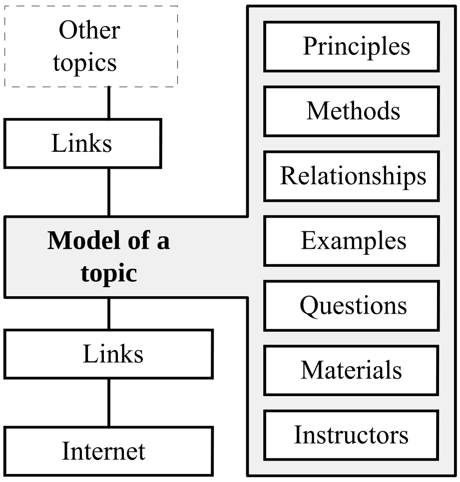

Fig. 9 Structure of a topic

5. VIRTUAL METHODS IN THE PRACTICE

One of the possible approaches in higher education of engineers is implementation of classroom modeling as an extension to a laboratory system for portal based engineering modeling. The authors of [2] proposed a 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.

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. Using of relationships between entities and their parameters as it is proposed for virtual classroom entities connects product model entities. Effect of a change of a model entity is experienced in a comprehensive integrated structure of entities.

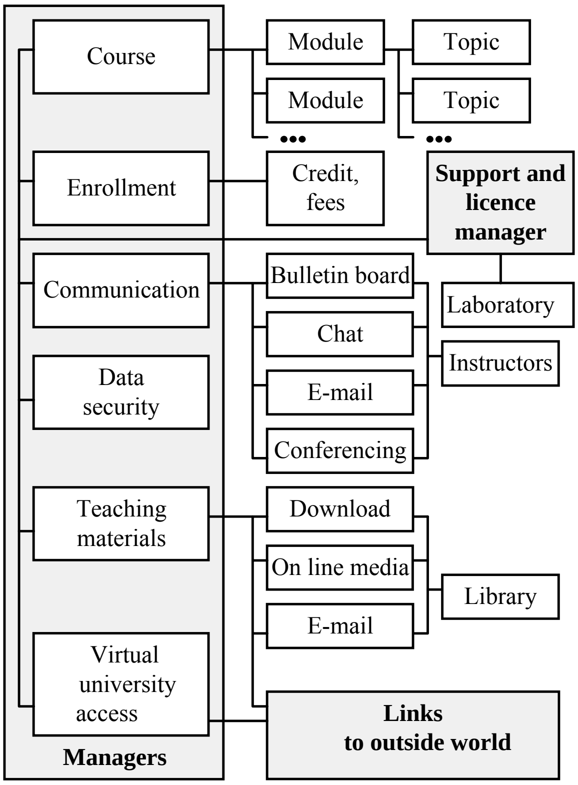

Fig. 10 Course managing functions

At engineering applications implementation of a virtual classroom is considered as an extension to existing modeling and Internet portal software products. An affordable system development and 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 as a tool for the development of extension to an industrial 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 an engineering purposed virtual classroom environment are configurable virtual classroom software and Internet portal software tools. A detailed study of this application of virtual classroom is planned in the future.

Extensive application of course management is introduced in [1]. Using the virtual classroom concept by the authors of [1], resource data, model data, and modeling and other procedures are managed by managers organized for main functional areas in the virtual classroom. For example, course manager handles structure and elements of teaching programs. Virtual classroom involves a set of managers for different functional tasks (Fig 10). The author analyzed application of managers to handle activities around teaching program. A module involves topics for a wide range of teaching content. Enrollment manager works with credits of student work if it is needed. This manager administrates fees, too. Communication manager's tasks are 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. The data security manager coordinates data security and related tasks. Installations use mainly configurable and open architecture professional software for managing purposes. The most important ones are Internet tools and the related applications. Course model is a structure of modules and topics of the teaching program as it is discussed above in this paper.

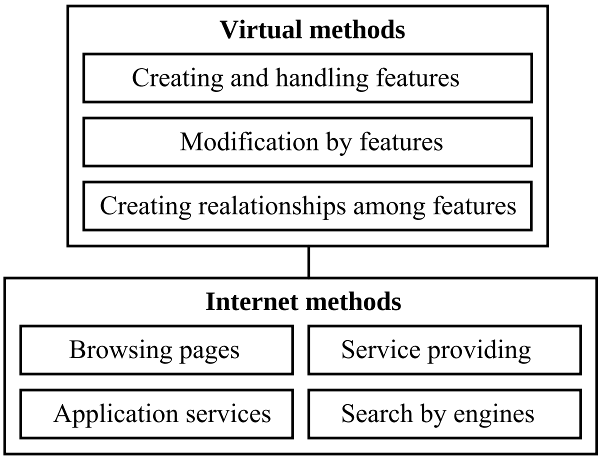

Fig. 11 Basic methods

Essential methods for virtual classroom modeling are summarized (Fig. 11). Virtual and Internet methods are applied. In other words, the base of the proposed method is constituted by 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.

6. CONCLUSIONS

In this paper, virtual classroom is introduced as an application of methods from modeling of interrelated objects. By using of this approach, methods from engineering modeling can be applied at the construction and application of classroom entities. The classroom is built in a structure that involves resources necessary to fulfill student and teacher demands. Virtual higher education organization is basically within a computer system, it has high number outside connection to involve students and teachers from remote sites. The most important characteristic of virtual classroom is its flexibility. In an organized system, unlimited knowledge can be imported from linked sources. This knowledge must be approved by responsible teachers.

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Received May 30, 2008, accepted October 6, 2008

BIOGRAPHIES

József Gáti was born on 21. 04. 1954. He graduated (MSc) in 1968 from the Faculty of Mechanical Engineering at the Technical University of Miskolc. He received his Dr. techn. degree in 1987, and his European Welding Engineer degree in 2000. From 1975 to 2000 he worked for the Bánki Donát Polytechnic as associate professor. From 1987 he worked as Secretary General of that Polytechnic. From 2000 he is associate professor and Chancellor at the Budapest Tech, and Head of Rector's Office as well. He is member of European Committee for Standardization, Hungarian National Delegation of International Institute of Welding, IEEE Hungary Section, John von Neumann Computer Society, and Hungarian Fuzzy Association. He received Bánki Donát Award in 2003, and Zorkóczy Béla Award in 2004, Pattantyús Ábrahám Géza Award in 2008.

Gyula Kártyás was born on 17. 01. 1954. He graduated (BSc) in 1976 from the Faculty of Engineering Pedagogy at the Bánki Donát Polytechnic. He also has a degree (BSc) in mechanical engineering, which was also earned at the Bánki Donát Polytechnic in 1977. He received degree in sociology (MSc) from the ELTE in 1986. Between years 1990 and 2005, he worked for the Bánki Donát Polytechnic as assistant professor. Since 2005, he is an associate professor. From 2000 he serves as Educational Director of the Budapest Tech. He received Bánki Donát Award in 1998.