Modeling Course for Virtual University by Features

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Abstract:
Environments with large number of interrelated information uses several advanced concepts as computer description of different aspects of modeled objects in the form of feature based models. In this case a set of features is defined then used for the purpose of modification of an initial model to achieve a final model as a description of an instance of a well-defined complex object from a real world environment. Utilization this approach and some relevant methods have been investigated by the authors to establish course modeling in virtual university environments. The main objective is definition generic model entities for courses and instance model entities for student course profiles. Course model entities describe virtual university activities. The modeling can be applied generally but it is being developed for the domain of higher education in virtual technologies. The paper introduces some virtual university related concepts and the approach of the authors to virtual university. Following this feature driven associative model of virtual course developed by the authors is explained. Some issues about the conceptualized application oriented virtual course features are discussed as a contribution to implementation of a virtual classroom model proposed by the authors. Finally, possibilities of integration of the university model with engineering modeling systems are discussed taking into account present day virtual universities and possibilities to communicate with prospective students both in professional design and home computer environments.

1 Introduction

Spending days, weeks even months for attending campus courses is impossible for most of the people engaged in industrial employment as engineers. At the same time, substantial changes in knowledge in some domains, changes in demands by employers

against employees, changes in field of activities of humans and other motivation of humans to improve their knowledge in some of the possible directions resulted a demand lifetime learning for more and more people. This is why distance learning has been expanded in recent years. However, conventional forms of distance learning in higher education have a lot of drawbacks in comparison to campus courses. If students can not attend the campus the campus should be brought to students. This has made possible by development of Internet technology and virtual classroom models as proposed by the authors. Virtual classrooms can be established as special purpose portals. Numerous virtual classrooms and universities offer excellent programs on the Internet. The related amount and complexity of teaching information and classroom activities make design and maintenance of these portals very difficult. At the same time the flexibility of classroom programs demanded by potential students are hard to provide by the existing portals [4]. The authors analyzed the related problems and decided investigations on application of advanced computer modeling together with well proved knowledge technology on the basis of Internet technology for the purpose of virtual classroom.

Internet portals for advanced distance learning are often called as virtual universities. Virtual universities offer services similar as of conventional universities but their purpose is not simply a solution to replace them [3]. Existing virtual universities have been established for different purposes and programs in higher education. The authors would like to contribute to methodology basics of virtual universities by following a model-based approach. Different aspects of a comprehensive virtual university concept and methodology by the authors are included in [1] and [2] as earlier results utilized by the reported research.

Existing virtual classroom methods do not offer direct tools for customization of existing course models. The author’s approach involves description of effects of new components on modified course models. This needs description both of the consequences of modifications and the modified relationships. An obvious solution is feature driven associative modeling. The research reported in this paper is about the above-mentioned approach to virtual classroom in higher education especially in the field of education in engineering. The only solution is taking the advance of computer modeling. Authors decided to establish virtual classroom model by using of advanced concepts as knowledge intensive feature and associativity based modeling for description of virtual classroom objects. It is the main topic of this paper.

The extending field of virtual universities motivated the authors to adapt virtual university principles to teaching an other large group of virtual technologies. The authors propose in the paper a representation that describes virtual university and can be integrated with virtual engineering modeling systems. Internet technologies and proven methods of computer based training are used as a basis of this research.

The paper introduces some virtual university related concepts and the approach of the authors to virtual university. Following this feature driven associative model of virtual course developed by the authors is explained. Some issues about the conceptualized application oriented virtual course features are discussed as a contribution to implementation of a virtual classroom model proposed by the authors. Finally, possibilities of integration of the university model with engineering modeling systems are discussed taking into account present day virtual universities and possibilities to communicate with prospective students both in professional design and home computer environments.

2 Virtual University

Platform-independent Internet software enhances advanced forms of distance learning. This requires substantial computer resources both on university and student sides. Engineers are working in a similar system in their every day company practice so that university activities can be done in the same system as professional engineering activities. Students from the non-professional area can join to this system. Finally, companies engaged in development, production or consult of engineering modeling, in common sense words CAD/CAM systems are interested in participation at higher education systems and may offer substantial computing and knowledge resources. Virtual university offers services similar as of conventional university using this environment for this purpose of campus and distance type of higher education [3].

The outline of the scene of virtual university can be seen on Fig. 1. Teachers are operating virtual university services. Virtual university is installed on a computer system that can provide the necessary services to students through network. Students use local services, e. g. at a company, or services of some providers. The virtual system establishes both off line and on line communication amongst teachers and students.

Virtual universities are extended learning communities and constitute virtual campuses on the basis of advanced communication tools as World Wide Web and telephone systems [7]. Motivated, keen instructors, classroom helpers, etc. share their knowledge with students in a large computer system. Dramatic development of distance communication technologies and virtual technologies are anticipated. The authors think that this is the high time to make research in the above outlined topic.

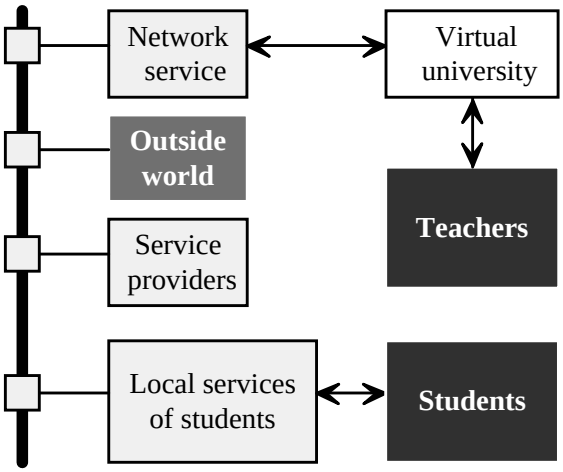

Fig. 1 Essential connections

The VU concept is growing from advanced distance learning [6], [8]. The main resources of a virtual university are published lectures, course materials, assignments for homework, on-line conferencing or consultation and live chats. Materials are browseable and a lot of links are inserted for background information. Virtual systems open new possibilities for the virtual university [5], [4]. Special education versions of modeling procedures can behave as instructor with navigation, correction and explanation features. Advanced commercial modeling systems can be tailored for this purpose. Lectures can be illustrated by live modeling etudes. Virtual laboratory makes it possible for students to login from remote computers within the virtual university. Individual and group work tasks, directed drills and case studies can be made available for students. The engineering model is created and annotated by the student then evaluated and annotated by the teacher. Exam questions can be assigned for solution by the using of modeling procedures. Video materials can be applied to carry records of modeling procedures and can be displayed step by step at learning. Where virtual laboratory can not be accessed on line, special education versions of modeling procedures can be downloaded by students of these special virtual courses.

Multimedia lectures can be applied by hyperstructure to give explanations on different levels of knowledge. More detailed lectures can be chosen by students who are interesting in a given topic.

3 An approach to Model Based Virtual University

In the author's approach for virtual university [1] teachers operate virtual university functions and provide the necessary services to students through computer network. Students use local services, e. g. at a company, or services of some outside providers. Both off line and on line communications are to be operated amongst teachers and students. Virtual university constitutes virtual campus [5]. Motivated, keen instructors, classroom helpers, etc. share their knowledge with students using advanced functions offered by large computer systems. Virtual classroom can be considered as an up-to-date solution for distance learning.

Strongly interrelated information structure about virtual classroom objects to be represented is to be created and handled in computer systems. It is obvious that the only way for handling this information in computer is establishment of a well structured, attributed and related description.

An approach to modeling of the related virtual university activities has been outlined in [1]. Model of a virtual university consists of a set of function entities grouped according to tasks and connected by relationships defined between them. Managers (Fig. 2.) handle function entities. A manager consists of a set of computer procedures for handling creation, modification and application of well-defined function entities. Course manager handles modules of the teaching program. Enrollment manager does credit and fee related affairs. Communication manager supervises communication tools available for teachers and students. Teaching material manager downloads materials, offers on line video service, sends materials as E-mail attachments automatically and establishes links to outside sources of materials. Process manager deals with processes in managing of courses. There are several other managers as it can be seen on the Fig. 1.

The another important problem area is modeling courses (Fig. 2). In the approach by the authors to virtual classroom model structure, a course is a sequence or network of modules. In other words the main structural elements of courses are modules. A module consists of blocks. A block involves topics. A topic consists of topic related procedures for handling principles, methods, relationships, examples, questions, materials and instructor activities. Links can be defined to other topics and outside world objects. Modules are arranged in courses or can be applied individually. Core studies contain basic and essential knowledge. They are modules or blocks. A course offers a choice of modules, blocks and topics.

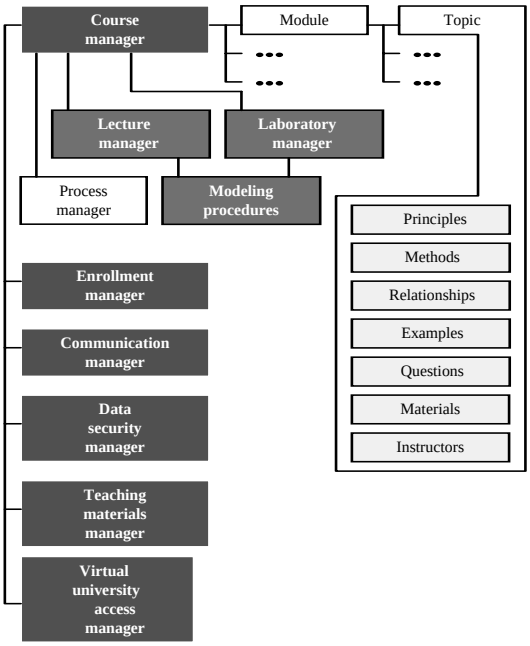

Fig. 2 Functional structure of a virtual university

Background analysis of virtual classroom revealed its components as curriculum, teaching processes, credits, students and virtual laboratories [2] (Fig. 3.). Curriculum as an organized learning experience involves content of a degree program, provides conceptual structure and time frame to get that degree. The course is an organized learning experience in an area of the education. A curriculum can be composed using courses or courses can be defined according to predefined curriculum. Virtual laboratories are composed using software modules, software arrangements for assignments as well as results of student work as assignments and degree works.

Virtual classroom is active in an environment where students, teachers and related humans and objects from the outside world are integrated (Fig. 3.). Classroom model, course instance model and outside world model communicate teachers, students and outside sites through the Internet.

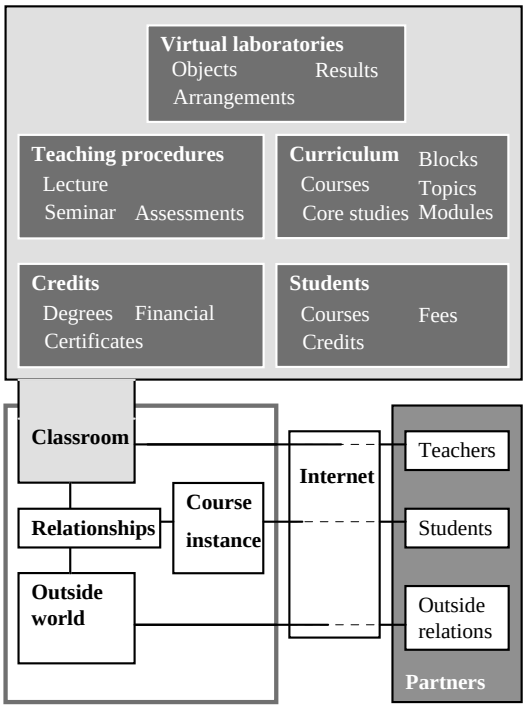

Fig. 3 Virtual classroom and its environment

The above outlined approach to virtual university and virtual classroom constitutes basic considerations for modeling of virtual classroom by the authors.

4 Model of Virtual Course

The course model as proposed by the authors uses structure of its elements, feature driven construction of modules and associativities between course elements. Track has been introduced as a course element comprising a set of modules for a well-defined purpose. Tracks and modules can be involved in different courses as instances. In this case model descriptions are not duplicated.

In the feature driven modeling approach a module is considered as a base feature modified by module modification features to create a customized module instance. Content of a module is defined by the teachers engaged in the related teaching

program and customized on the basis of student demands. Consequently, generic models are applied and used at creation their instances. At the same time types of base and module modification features with basic model related characteristics are defined by course modeling experts. In this context base and module modification feature types are frames final content of which are defined in feature instances.

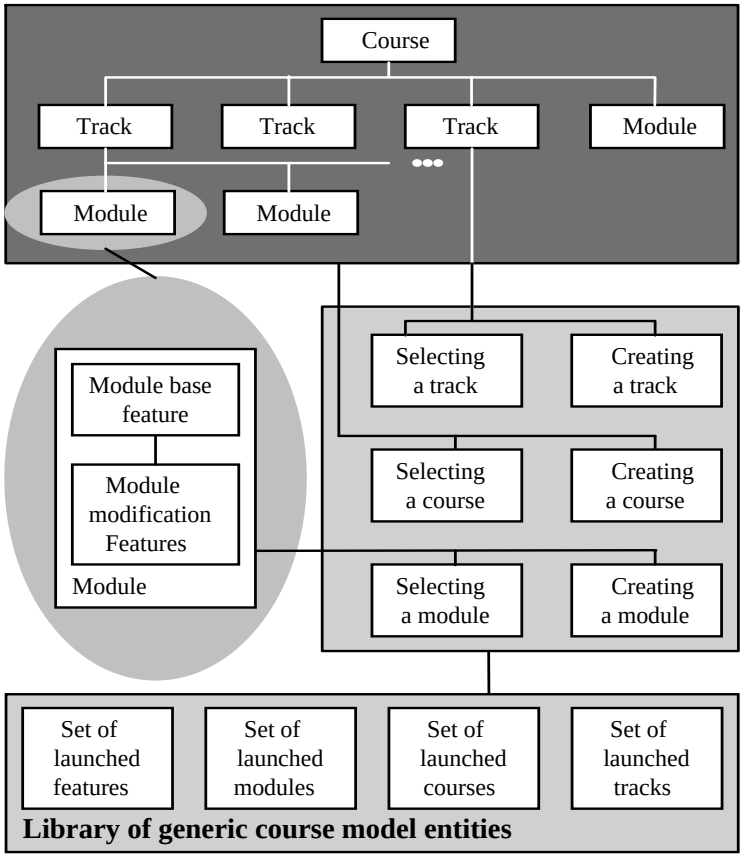

Fig. 4 Construction of feature based course models

Basic construction schema of feature based course models is summarized by Fig. 4. Generic or frame model entities are launched then stored in libraries, as it will be explained in chapter IV of this paper. A course entity is selected then related with track and module entities or customized by appropriate changes. Customization covers selection then adaptation purpose configuration. Track models also created or

configured. Module entities are created by modification of a base feature by appropriate module modification feature entities selected from the choices stored in appropriate libraries.

Predefined classroom features are used for modification of modules to create module instance for customary higher education teaching programs. Fig. 5 summarizes a possible set of classroom features. A module is modified feature by feature if it has necessary places and surfaces to create the modification. In other words information carried by the feature should be accepted by the description structure of the actual module instance. Features have been grouped according to their requirements for place and surface of modification. Structural, contact, assessment, content and handout groups of features have been defined by the authors.

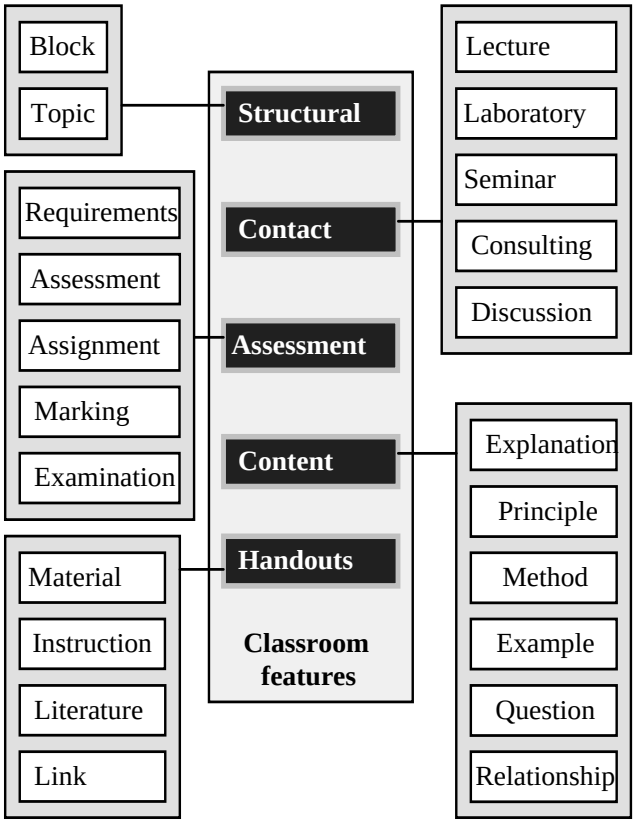

Fig. 5 A possible set of classroom features

Structural feature modifies structure of a module by introducing a new block or topic. Contact features place course elements on the module to establish contact activities between students and teachers. Consulting and discussion are inherently interactive. Lectures, laboratories and seminars can be also interactive. Semi interactive contact features substitutes teacher by using of sets of typical answers and explanations together with effective searching. Content feature contributes to teaching content of the module by purposeful explanations, description of principles and methods, representative examples, putting questions with or without answers and relating things by relationships. Assessment features complete module by description of requirements, composition of assessment, assignment, marking schemas and examinations. Finally handout features include materials, instructions, literatures and links to outside materials.

Surface for a feature can be placed on the module or on one of the existing module modification features according to the group of the feature and the decisions for modifications. Some of the features can modify only the base feature (module) whereas others can also modify previously placed module modification features.

Fig. 6 shows two examples for placing features on modules at initial stage of their creation. Base feature on Fig. 6/a has been defined to provide surfaces for placing of structural, handout and assessment features. *Topic A* modifies base feature as a structural feature. *Topic A* has been defined to provide surfaces for placing of contact and content features. Feature *Lecture B* is placed at the contact feature surface of feature *Topic A*. Fig. 6/b illustrates an alternative solution when feature *Lecture B* is placed at the contact feature surface defined directly on the base feature. Feature *Lecture B* has surface for placing contact features.

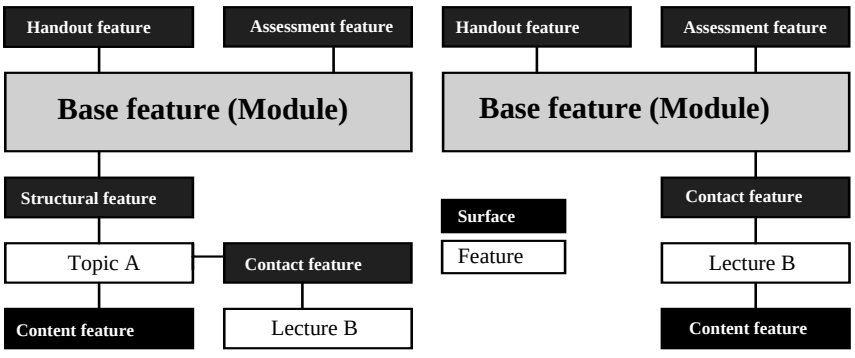

Fig. 6 Placing module modification features

Modules are built into a structure defined for a course or a track. Conventional course plans relate modules each other only by information for other modules that act as preliminary study requirements. However, generally not a complete module but only its some elements are necessary to understand given element of an other module. If the module instance configure omit that element, preliminary requirement is no more exist. To achieve a flexible description and avoid unnecessary preliminary study requirements, modules are integrated by relationship entities defined in a course or a track (Fig. 7). The course or tack model defined by using of this method is brief and consistent without redundancies. Consistency can be checked by an appropriate computer procedure.

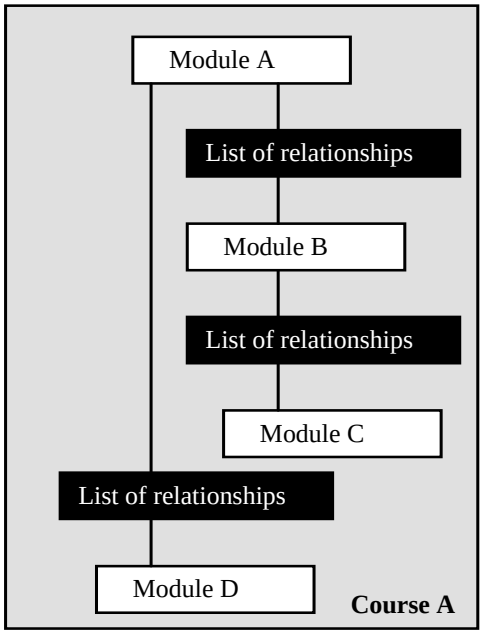

Fig. 7 Integration of modules by relationships

Associativities are also defined within modules. Basically, the structure of modification describes associativities. Other associativities can be defined between features or between any description elements in their content. Similarly, associativities can be defined between the modules and their lower level elements and the outside world in the form of links. Associativity describes dependency while a simple link only points to something. In case of change in an element, the associative elements

change according to the existing associativity definitions. Associativities are often defined for the purpose of saving teacher intent.

5 Application Oriented Virtual Course Features

An absolute free definition of features would require unreal amount of analyses on features to reveal these characteristics. It is impossible to define a complete set of virtual course features that can be applied in all possible courses in all possible fields and purposes of higher education. On the other hand feature-processing procedures must be informed on some basic feature characteristics. The solution in the author's approach is application oriented feature definition in the course model relied upon general feature type definitions (Fig. 8). This method has been proved in engineering modeling at solutions for similar problems.

An other problem to be solved is the high amount of custom feature variants that can be anticipated in the higher education practice. It is impossible to define them as individual features. Instead, configurable generic features are applied. Instance features can be easily configured by adaptation of generic features. Generic entities are also applied on the levels of module, track and course. Modules and features can be suppressed or their parameter values can be changed in order to gain purposefully configured instances of module modification features, modules, tracks and courses.

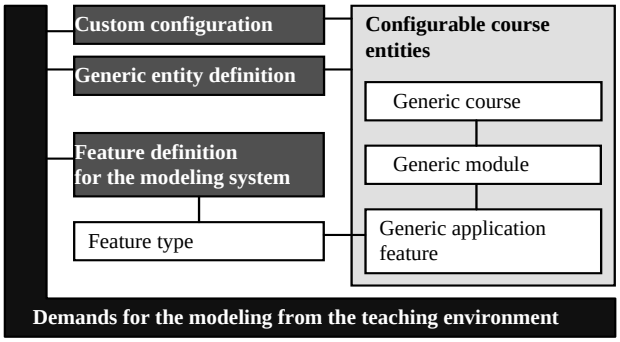

Fig. 8 Concept of configurable course model

It is very important to emphasize that all features on the application level are defined by teachers who do the education program. Also teachers define generic modules and courses. Configuration just simplifies work of a teacher or group of teachers at the definition of flexible customer oriented courses and modules. It would be a bad idea to

define entities on the application level by teachers or researchers other than doing the offered courses and modules. The knowledge and teaching skill are of personal nature. Teachers must describe them for computer models to make the use of computer system at education. One of the main advances of the above outlined application oriented modeling is that teachers can define entities without any advanced skill in course modeling.

6 Teaching Engineering Modeling in Virtual University

Quick development of modeling principles, methods and systems requires frequent training of engineers. Product related training courses at companies are not appropriate to deliver new higher education related topics. Consequently the proposed virtual university concept is most important for further education in the industry, however they can be utilized with equally success in undergraduate and graduate courses. A concept of configurable course model is outlined in Fig. 9.

Modeling tools are organized in comprehensive Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) systems in the present day engineering design practice. Users of modeling procedures use company support through Internet and Internet communication with other users. On the application site on line help, tutorials and manuals are available as knowledge and practice sources (Fig. 10). This environment can be used in virtual university environment as a courtesy of CAD/CAM manufacturers.

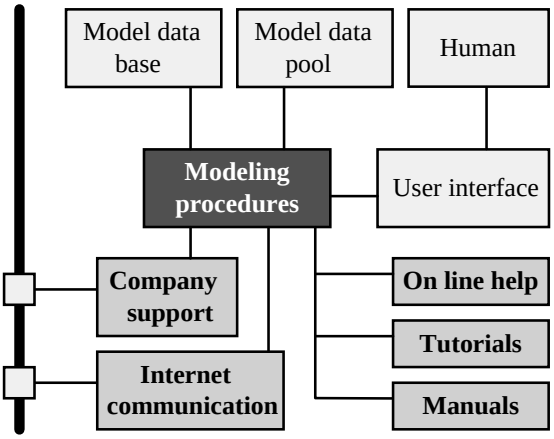

Fig. 9 Concept of configurable course model

Virtual university managers connect laboratory with industrial modeling support and application environments. Industrial application environments offer real world examples and case studies for the virtual university and use training services from the virtual university.

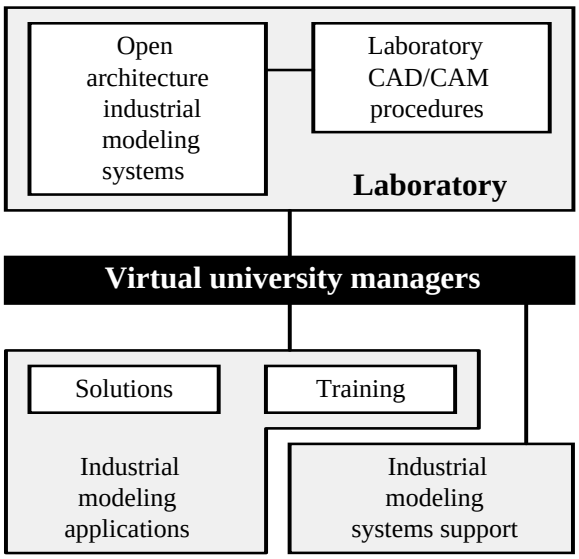

Fig. 10 Concept of configurable course model

7 Conclusions

The authors have proposed a model aimed as a contribution to the dream of virtual university. Using this model an advanced application and utilization of Internet is realized in a manner that opens the system for the teachers to make custom configured course, track, module and module modification feature model entities by the method of configuration instance entities using generic entities.

A concept and an approach have been outlined for a virtual university system in this paper. The purpose is to model a virtual university that is appropriate for teaching virtual technologies for engineering design. The proposed virtual university model consists of functions that are handled by functional managers. Modeling methods are

modeled as topics. Topics are organized in modules and modules are organized in courses. The involved teachers also define generic entities. The same teachers use these entities then for creating instance entities on the basis of student demands. Making and application of course entities are tied closely to teachers to save the personal nature of teaching and outstanding performances of teacher individuals. Wide application of associativities guarantees saving intent of teachers. The proposed course model consists of module entities. Modules are constructed as series of modifications by module modification features. Modules are organized into tracks and courses by relating them using relationships.

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