Chapter 2

State of the Art in Curriculum Design

2.1 Introduction

Previous chapter gave brief introduction to curriculum design and mainly described the background and motivation, approach, aim and objectives on doing this project. This chapter briefly describes about the conventional approaches and modern approaches of curriculum design.

2.2 Conventional Approaches to Curriculum Design

Xiang Fu and his colleagues presented their architectural approach of Computer Aided Curriculum Planning and Scheduling System (CACPS) [3] for higher education administrators and students. They had identified the complexity of designing curriculum plan and the problem of deciding which courses to offer and when to offer as the major problems in students and administrators respectively. As a solution to the above problem they propose to automate the process of curriculum plan design and the course offering scheduling within one integrated software framework. CACPS has four major modules. Those are Web Portal, Automated Personal Study Plan Generator (PSPG), and automated multi-year Course Offering Schedule Generator (COSG) and automated Class Scheduling System (CSS). Web portal has used to interact with the user and PSPG has designed to provide optimized multi-year study plan for student and to generate the list of warning according to the quality of the schedule. PSPG mainly design to use back-end database to store curriculum details. Upon request, retrieve curriculum details to design the study plan. Based on the information and the feedback supplied by the PSPG, COSG was designed to refines the current multi-year course offering schedule. CSS was designed to handle the issues of time conflict of classes with student's schedule and issues of timing preferences of faculty members of their classes. This paper has compared CACPS with MMS student scheduling software [4] and Schedule Whiz Academic [7]. Apart from the above two software CACPS is a feedback system which is rely on individual study plan of students to

optimize course offering schedule. Although they presented a better architectural approach with technical challenges, feasibility analysis they planned to use database technology for curriculum design. Since curriculum design is a complex task in is better to use ontology based approach than a databases related approach.

Curriculum Review and Mapping Process Supported by an Electronic Database System [10] mainly addresses the review of Pharmacy Curriculums. Since the paper based curriculum materials are not readily accessible and searchable to the members in different locations they propose an electronic system called Pharmacy Curriculum Management System (PCMS) [10]. PCMS supports curriculum mapping, reviews and communicates with all members about course content and skill development. PCMS is a web based relational database management system and it is developed mainly using Microsoft technologies such as Active Server pages, Internet information services and SQL server over the secured socket layer. Curriculum module, Administration module and the Student Performance module are three main module in PCMS. Administrator module updates the course module and the student course evaluation at the end of each semester. Curriculum module contains course materials, course content review reports, course peer-review reports, curriculum committee recommendation and course update reports. Student Performance Module is designed to provide an evaluation of student performances. As a result of developing PCMS there is an increase in communication and collaborative effort regarding instructional strategies, quality of course content, assessment methods and expected program outcomes among the stakeholders. Nevertheless curriculums changes over the time and information related to curriculum may interpret in different way by different members. Therefore this kind of problem will not be able to handle by a conventional database systems.

Automating Curriculum Management Task[7] is a web based tool that support in automating curriculum proposal and change procedures, curricular data maintenance and course catalog publication at the University of Wisconsin-La Crosse. Since the current manual system is paper intensive, inconsistent, confusing and follows a manual workflow it proposes to develop an automated system. This system has

automated many of the manual tasks mentioned above and has reduced the chances of errors and also will speed up the approval process. In addition, it is also expected to lay the foundation for automating other processes such as report generation from records and registration, preparation of undergraduate and graduate catalogs and timetables. This tool has three major modules namely web based user interface to create new course and program proposals, Database and Tool to create reports. Users can interact with Curriculum Management Tool through the web pages and it includes navigation, requesting information, and submitting data, viewing reports and performing various other actions. The web pages reside on a web server running Apache Tomcat web server. Upon request of user it will connect with the web server and the web server will retrieve or update relevant details in Oracle database.

Curriculum Management System (CMS)[5] is an automated system which supports the entire curriculum process from planning to implementation to assessment. They mainly discussed about changing academic environment in higher education and current mechanism for curriculum development and curriculum representation. As per the above two criteria CMS has designed to develop with four different functions: Curriculum maintenance, Visualization, analysis and assessment. All the details about the curriculum such as college, school, department, degree program, courses, learning units, objectives and etc are stored in a database. Curriculum maintenance function provides the primary mechanism for data entry and the maintenance of the curriculum database. Curriculum visualization function provides the various views of the curriculum database to different stakeholders. Allowing users to analyze the curriculum for completeness and consistency, the Curriculum analysis function provides additional query and reporting capabilities. The last function Curriculum assessment provides an assessment mechanism to check whether student has achieved the expected competence. In fact CMS provides fast and consistent approach to manage entire curriculum. Nevertheless CMS does not support for defining and classifying detail list of learning outcomes. Since CMS is using conventional database approach to maintain curriculum it will not be able to support the dynamic changes in curriculums.

2.3 Modern Approaches to Curriculum Design

Paivi Poyry and his colleagues presented their approach of CUBER: A Personalized curriculum Builder [13] for the students in the higher education level. They identified that learners face difficulties in searching higher education courses to match their specialized needs. As a solution to the above problem they proposed the CUBER system and the ontology. CUBER system is mainly targeting students who plan to do courses in a virtual university which is co-operation of several universities. They have identified the lack of common ground for information exchange between participating universities and countries as one of the major issues in virtual university. Therefore this problem has been addressed by the use of metadata and the ontology. CUBER system has been designed to be a search engine or a broker system that enables many kind of students search for study units from the institution providing higher education. Technically this system consists of three main components: a knowledge base for standardized course descriptions and domain knowledge, a search engine for finding the courses and generating study packages and an authoring interface for entering and maintaining course metadata. The knowledge base includes lexical database, standardized metadata and the ontology. This CUBER metadata and ontology is specially designed for the purpose of higher education offered by Europeans universities and other educational institution. Although CUBER is a better system to build a personalized curriculum for students, it does not support the design of curriculum and development of curriculum in accordance with rapid changes of the educational field with respect to the fast development of technologies.

Since curriculums change over the time it is not easy to keep curricular system updated. And also in accordance with the evolutions of curriculum it should provide the trustworthy course services to the student. As a solution to the above problem, Wenhuan Lu and his colleges present their strategy of Ontology Aware Course Management for Curriculum Evolution Process (OCME) in higher education [18]. This system aimed at establishing a conceptual framework and implement Ontology aware Course Consulting System (On2C). The conceptual frame work is used to share each concern and understanding among multiple stakeholders. In order to cope with different stakeholders On2C includes a Course management System and Curriculum Ontology. On their ontological approach they have developed a curriculum ontology

including curriculum, rational of curriculum, regulation and knowledge. Rational of curriculum provide the vocabularies to describe the intention of curricular evolution. On2C is fixed conceptual systems that fully predict the generic component of curriculum. Therefore it can be reused in a situation dependent curriculum system. It is a biggest advantage in this system. Further this system can be developed to support to intelligent curriculum authoring and consulting.

'Curriculum Management and Review: an ontology-based solution' is a strategy for managing, inspecting and monitoring a full course of study based on ontology [9]. With this strategy they aim to improve overall quality of course offering with the assurance of quality of the courses. In this paper they discussed various use of ontology in e-learning related tasks, Use of ontology as a course management tool. They categorized already available ontology for learning into four major categories. Those are use of ontology to create and share own annotation of learning recourses, use of ontology to enhance the learning object reusability, associate educational process with appropriate element of an ontology and use of ontology to retrieve and organize objects into a course. Apart form this they propose to use ontology as course management tool which cover full course of study. This tool consist predefine domain ontology to monitoring and the management of academic offerings and a visual tool to enable easy access of ontology. Once the reference ontology created manager can interpret the mappings between their own curriculum and the ontology. And also it allows managers to develop overview of the state of their curriculum and show more details about possible problem area of the curriculum. This tool has been tested for the courses offered for the Computer Science Bachelor degree in the University of Trento, Italy. Although they achieved 65% success it was unable to cover social and professional issues in related curriculum area.

ENGOnto: Integrated multiple English Learning Ontology for personalized Education [3] was developed to improve the performance of learners and instructors for exploring web resources to meet the individual's English language development. It integrates multiple relevant ontologies for personalized agent to deal with dynamic changes of learners learning process, interaction between instructor and learner and learning resources in the environment. ENGOnto mainly consist of five ontologies.

Those are people Ontology, Pedagogy Ontology, Language Ontology, Curriculum Ontology and Knowledge Point Ontology. People ontology constructs an interpersonal and person-learning network. Pedagogy ontology specify the type of learning activities, subject domains, learning key stages and so on. Language ontology provides the structure and language learning items of specific subject domain. Curriculum ontology illustrates the actual learning process and structure of the related text book. Knowledge point ontology shows the set of educational targets. Each agent refers the ontology to provide better service to the user. This system mainly considers about the English learner and it developed curriculum ontology for them. And curriculum ontology support only to the personalized learning process but not the curriculum review or design process.

Automated Instructional Design tools(AID) [6] have been used in the development of computer based instructions which enable the analysis of learner's context and goals, strategies and assessment tools, production of instructional materials and evaluation of learner's performance and overall instructional design effort. They had focused on four types of tools that guide users through the Instructional Design (ID) process: expert systems, advisory systems, information management systems, and electronic performance support systems. Expert System for ID was mainly focuses on providing advice to novice instructional designers [13]. Advisory System [1] assists or coach users in accomplishing a given task instead of controlling the problem-solving process with expert knowledge. Information Management System [16] provides computer-aided design environment that supports an ID methodology for teaching the use of software in real-life problem-solving contexts. Electronic Performance Support Systems are self-instructional electronic environments that provide access to "software, guidance, advice, data, tools, and assessment with minimum support and intervention by others"[11]. Even though AID tools support instructional design by focusing on the cognitive aspects, according to the article planning and evaluation phases of ID are not as widely used by practitioners. Moreover it does not automate the whole process of curriculum design but a part of it

System	Main technology	Advantages	Limitations
CACPS	Database, Web server,	Automate the curriculum planning, automate the course scheduling. Provide feedback.	Does not support for curriculum design and cannot handle dynamically changing situations.
CMS & PCMS	Database	Support planning and implementation of curriculum.	Cannot handle complex and dynamically changing situations.
Curriculum Management task	Database	Support for making curriculum proposal and review reducing errors.	Cannot handle complex and dynamically changing situations.
CUBER:	Metadata ontology Lexical database	Support to personalize the curriculum. Provide better domain knowledge with reusable and shared vocabulary.	Does not support for designer of curriculum.
OCME	Ontology aware Course Management tool	Support effectively tracks the history of curriculum change. Can reuse in situation-dependent curriculum Provide better domain knowledge with shared vocabulary and evolutionary feature.	Does not support for intelligent curriculum authoring and consulting.
ENGOnto	Ontology	Can tackle dynamic changes in learning process, Provides better domain knowledge with shared vocabulary.	Does not support for the design of curriculum.
AID tools	Expert Systems	Can handle dynamically changing situations.	Support only for instruction design.

Table 2.1: Advantages and Limitations in selected areas

2.4 Problem in brief

Curriculums are rapidly changing over the time with the world knowledge. Therefore it is not an easy task to keep curricular system updated and provide trustworthy course services that reflect and correspond to the evolutions of curriculum. And also curriculum design process is more time consuming and many parties are involving for that process. Conventional computing aims at developing programs to do specific task without been able to improve the performance. Therefore conventional software for curriculum design does not provide facilities to automate the design process to meet dynamically changing requirement in a complex environment. Also modern software for curriculum design partially addresses the above issues.

2.5 Summary

Research in curriculum design has identified Automating curriculum Management task, ACPS, PCMS and CMS as classical approaches and CUBER, OCME, ENGOnto, Curriculum Management and Review: an ontology-based solution and Automated Instructional Design as modern approaches in curriculum design area. Among all those research work it is identified that theoretical based approach to design curriculum among negotiation within different parties were not properly addressed. Next chapter describe the technology adopted to solve the problem and how and why those technologies are suitable for the project.