Teaching a Database Course with Collaborative Team Projects[+]

Jae-Hwa Choi[*]

〈Abstract〉

This paper describes an effective teaching approach to an undergraduate database course. This research draws on practical experience based on the hands-on practice approach which leads students to develop a database application utilizing various tools. Students not only learn concepts, methodologies, and tools of database technology in class and through online multimedia learning aids, but also practice how to integrate them through collaborative team projects. The course employs collaborative learning approach and multimedia and internet technologies. Students are encouraged to work collaboratively on assignments and projects and to learn independently through online multimedia learning aids.

+ 이 논문은 1996년도 단국대학교 교내 연구비 지원에 의하여 연구되었음.

* Department of Business Administration, Dankook University

1. Introduction

The database course has been one of the fundamental information systems (IS) courses in most undergraduate IS programs. In undergraduate IS curriculum it is a rule rather than an exception to cover the system development subject with both database management systems (DBMS) and traditional programming languages. This reflects the real world practice of system development with DBMS as well as programming languages. This is reaffirmed by the recent IS curriculum model[1] which recommends the physical design and implementation subject to be taught with both implementation tools (Davis et el. 1997).

An important component of a database course is learning the practical aspects of developing database application (Choi 1995, Choobineh and Ram 1997, Urban and Dietrich 1997). IS 97 Model expects database courses to be application oriented (Davis et el. 1997). In addition to the fundamental theory and concept of database technology, a database course needs to cover popular methodologies and related tools. They include, system development life cycle (SDLC), prototyping, database design tool or computer-aided software engineering (CASE), DBMS, 4th generation language (4GL), and traditional programming language or visual programming language.

It is a challenging task to teach a database course focusing on concepts and skills that students can apply to the implementation of real world database application and the use of available tools. The database course needs to be designed effectively and administer judiciously. Experiences show that teaching theory/concept, methodologies, and tools all together in a semester is best achieved by performing a collaborative team project (Choi 1995, Choobineh and Ram 1997, Urban and Dietrich 1997). When the collaborative team project is combined with the use of information technologies such as multimedia and World Wide Web (WWW), learning effectiveness will be significantly improved.

Faculties have long been using innovative teaching techniques to improve learning processes of a database course. Choi (1995), Choobineh and Ram (1997), and Urban and Dietrich (1997) discuss a team project approach in a database course. Choobineh and Ram (1997) discuss their experience of conducting team projects in a database course and provides some useful guidelines. Urban and Dietrich (1997) lead students to a cooperative group project through self-paced assignments. Choi (1995) directs students to perform a group project using a multimedia programming language tutorial.

In this research the collaborative team project approach advances one step further by tightly combining collaborative learning with multimedia and internet technologies. We make the learning of database application development stimulating and engaging by providing students with a set of online multimedia learning aids. Online multimedia learning aids, consisting of multimedia virtual projects and multimedia tutorials as well as class notes on the internet, serve as a resource for the students. Online multimedia learning aids are

1) We call it IS '97 Model in this paper. This model is summarized in Section II.

designed to lead students to the completion of the collaborative team project.

The purpose of this paper is to share with the reader our experience in designing and running a database course. Section 2 summarizes relevant pedagogical backgrounds and proposes a database course as a realization of the system implementation area of the IS97 model. Section 3 describes the collaborative team project which is the key ingredient of the database course. Section 4 describes the online multimedia learning aids we have developed. Section 5 discusses key issues for running a collaborative team project from experiences and lessons learned. Conclusions and future works are discussed in Section 6.

2. A Synthetic Database Course

Integrating the practical side of a database application development into the theoretical curriculum of a database course is a challenge (Urban and Dietrich 1997). This section describes the rationale of the design and implementation of a database course in which teaching/learning effectiveness is significantly improved by the integration of the collaborative team project and information technologies.

2.1 Collaborative Learning

Norman and Spohrer (1996) articulates the condition in which effective teaching and learning is achieved as follows:

> Students learn best when engrossed in the topic, motivated to seek out new knowledge and skills because they need them in order to solve the problem at hand. The goal is active exploration, construction, and learning rather than the passivity of lecture attendance and textbook reading. The major theme is one of focusing education around a set of realistic, intrinsically motivating problems. Students work to solve these problems, often in groups, often in over-extended periods of time.

Collaborative learning and active learning strategies have been used by many educators (Hiltz 1994, Skillcorn 1996, Urban and Dietrich 1997). Collaborative team project approach is an implementation technique of the collaborative learning. Collaborative team project supports philosophies of student-centered learning in which faculty guide students to develop and structure knowledge. It has three attributes of effective learning process (Alavi 1994, 1995):

- active learning and construction of knowledge,
- cooperation and teamwork in learning, and
- learning through problem solving.

Gasen and Preece (1996) discusses key issues for effective learning from collaborative team projects. Three categories of issues with collaborative team projects are:

- pedagogic issues
- group dynamics
- administrative issues

Pedagogic issues include the changing roles of faculty to support learning. Group dynamics is of central importance to the success of group projects. Administrative issues are concerned with supporting, regulating, and assessing students collaborative work.

Students tackling with the collaborative team project tasks become much more productive

when they are delivered just-in-time knowledge or the right knowledge at the right time. The usefulness of a collaborative team project can be greatly enhanced by providing access to interactive learning systems and media supported training, which deliver just-in-time knowledge. This is especially true when students are asked to learn and use software tools to perform tasks for the project.

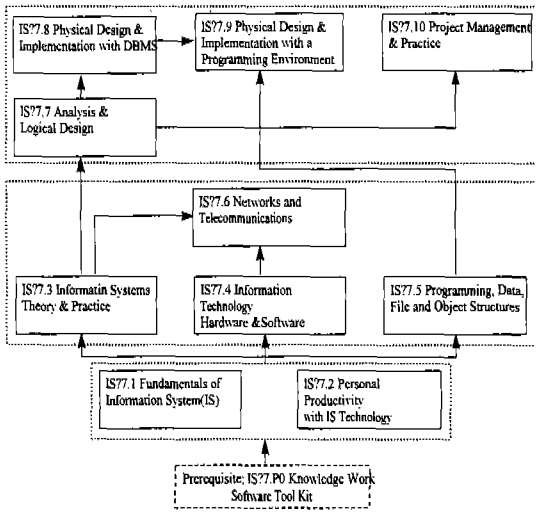
Multimedia technology has been utilized for collaborative learning (Hiltz 1994, Skillicorn 1996). Interactive multimedia systems are developed to deliver individualized, contextualized, and just-in-time knowledge and skills to users. In interactive multimedia systems, the locus of control shifts to the learner. Students have greater control over their learning and the role of a faculty is either non-existent or one of a coach, a facilitator, or a guide.

2.2 System Development Knowledge in IS97 Model

To reflect the rapid change in underlying knowledge and technology, the undergraduate IS curriculum has been carefully reviewed by major IS-related organizations such as the Association for Computing Machinery (ACM), Association for Information Systems (AIS), and Association of Information Technology Professionals (AITP, formerly DPMA). Recently a final report containing a new IS curriculum model has been published (Davis et el. 1997). The report contains curriculum resources and guidelines for implementing undergraduate IS programs. Figure 1 shows the courses and their precedence relationship in terms of prerequisites suggested in the IS97 Model.

As shown in the upper part of Figure 1, the system development knowledge encompasses analysis and logical design, physical design and implementation, and project management and practice. Physical design and implementation is performed in two different settings - DBMS and programming environment. That is, IS97 Model reveals that both the DBMS approach and the traditional programming approach to system development need to be covered in the undergraduate IS curriculum.

Coverage of the system development knowledge suggested in the IS97 Model can only be possible by offering all the courses. However, not all undergraduate IS programs cover system development knowledge by clearly separating DBMS implementation and programming implementation. In some situations, the undergraduate IS program in the business school does not put heavy emphasis on programming skills. In other situations students may not be able to take both courses in the IS 97 Model. This may be due to degree requirements or IS curriculum implementation.



<Figure 1> IS 97 Model

One approach is to combine theory/concept, methodology, and tools topics of the system development courses in the IS97 model and to create a synthetic database course. In the following we describe how we cover all these topics in a database course successfully.

2.3 The Database Course

To meet with the demand from real world and IS97 Model, we designed a database course primarily for undergraduate business majors with an IS interest. The course objective is to :

- learn fundamental theory and concept of database technology,
- learn and practice database application development methodologies, and
- master basic skills of database application development tools.

To achieve the course objective, the class basically does the following :

- Faculty introduces database theory/concept, methodologies, and tools in class and computer lab.
- Students acquire basic skills of a DBMS and other tools through the lab session and online multimedia learning aids.
- Students understanding and skills are put to test through a collaborative team project on an ongoing basis throughout the semester.

The material to be covered in one semester course is rather extensive. The course focuses on theory/concept while the minimum amount of class time is used to teach students the application of methodologies and tools. Yet, students can not simply be told that they must apply methodologies and tools to real world database application development. We employ collaborative learning approach and multimedia and internet technologies. Students are encouraged to work collaboratively on assignments and projects and to learn independently through online multimedia learning aids.

Database concepts that are covered include an introduction to database systems, data model and database design, relational database implementation, query language, transaction, data administration, and a brief introduction to new database technologies such as client/server architecture, distributed databases, data warehouse, and Web-DB link .

The IS97 model recommends that at least one procedural language as well as substantial exposure and use of a 4GL is essential in the undergraduate IS program. Microsoft Access is used as the primary DBMS package in the database course. We also selected a visual programming language to show how professional-looking applications using the graphical user interface of Windows can be created by students who have no previous training or experience in computer programming. We chose the Microsoft Visual Basic as it lets users to develop Windows applications without getting into the nuts and bolts of a programming language.

Collaborative team project requires students to go through a database application development process by developing a database application system for the real world problem of their own choice. This exercise gives students the opportunity to integrate database theory/concept, methodology, and tools, and reinforces the learning experience. Table 1 shows how synthesis of knowledge is achieved through the collaborative team project.

<Table 1> Project Steps and Synthesis of Knowledge

Project Steps	Theory/Concept	Methodology	Tools
Requirements Analysis	Information Engineering	Data Flow Diagram, Data Dictionary	CASE tool
Conceptual Design	Entity-Relationship (ER) Data Model, Object Oriented (OO) Model	ER Diagramming, OO Modeling	ER Modeling tool, CASE tool
Conversion to a Relational Model	Relational Data Model, Normal Forms	Conversion Rules	ER Modeling tool, 3NF Algorithm
Database Creation	Relational Algebra, Relational Calculus	Data Definition Language, Data Manipulation Language, Data Dictionary	DBMS, Query Language (SQL, QBE)
Application Development	System Development Life Cycle (SDLC)	CASE, Rapid Application Development (RAD), Prototyping	CASE, DBMS tools, Application Generator, Visual Basic

When helping students to understand what is involved with the team project, there are real advantages to providing students with virtual projects through multimedia technologies. The project implementation requires the knowledge and skill of DBMS package and visual programming language. Learning Microsoft Visual Basic is primarily done through the multimedia tutorial after a brief introduction to the basics of the language in class. With online multimedia learning aids students can learn themselves outside the class on their own pace.

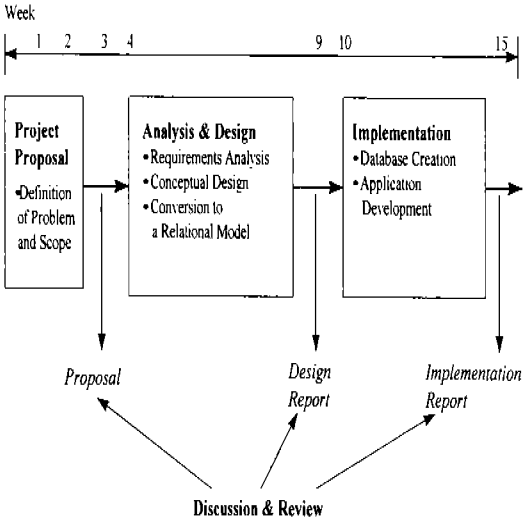
3. Collaborative Team Project

The purpose of the collaborative team project is for students as a group to experience the practical activities of database application development in the real world. Every topic covered in the class is immediately applied to the project. Sample projects from the previous semesters are provided to give general guidelines about the project.

3.1 Project Phases

The project is performed in a sequence of steps following the typical database application development process. The sequence corresponds to the order of concepts that are introduced and exercised in class. As shown in Figure 2, the project is broken down into three major phases. Time line shows an approximate time

plan in a 15 week course. The first phase is to select and define the problem. The second phase is the analysis and design. This phase involves the requirements analysis, data modeling, and logical design of the system. The last phase is to implement the design.



<Figure 2> Project Phases

A problem is selected and solved by a project team of three to four students. They are assumed to be hired by a customer as a consulting team specializing in database technology. At this stage faculty helps to define the scope of the project to be manageable as a term project.

The analysis and design phase consists of three tasks and ends with the database design report and presentation. First, each team identifies the users' requirements in the enterprise. The requirements analysis consists of three activities: collection of the requirements, documentation of the requirements, and analysis of the requirements. Next, each team designs a conceptual schema for the problem domain. Using the entity relationship (ER) data model for the conceptual design, each team identifies entities, relationships, and constraints. Lastly, from the ER data model each team converts to a relational data model. Each team needs to examine whether tables satisfy the third normal form (3NF) or Boyce-Codd normal form (BCNF). Relational constraints such as primary key, foreign key, and others are specified.

The implementation phase includes database creation and application development. Using the Microsoft Access, each team implements the database schema and applications that use the database. First, each team creates tables, load them with data, and runs sample queries against the database. Each team then uses the query facility, report facility, form facility, and menu facility to implement sample applications. Each team implements sample applications to show how user applications are supported. In addition to the basic applications, each team is required to use Microsoft Visual Basic to develop advanced applications.

3.2 Report and Presentation

Students discusses with faculty about the project progress regularly. Each team is required to do two presentations and reports. Table 2 shows outputs of the collaborative team project :

<Table 2> Project Output

Phase	Output	
	Presentation	Report
Analysis & Design	Design presentation	Design report
Implementation	Implementation presentation	Implementation report Users manual Programmers reference

At the completion of the requirements analysis step each team needs to develop a preliminary report detailing requirements analysis. This includes queries, input screen formats, reports, a cross reference table, a data dictionary, etc. The interim report is checked and approved by the faculty. At the end of the conceptual design step each team turns in a *design report* detailing the conceptual schema and the corresponding relational schema in addition to the modified requirements analysis.

The final *implementation report* documents all activities and features of the project. The report consists of two parts. The first part is the *user's manual*. User's manual describes how the system can be used by a naive user who is assumed to know very little or nothing about the database technology. The second part is the *programmer's reference*. Programmer's reference contains technical information of the current system which will be used by other database professionals in the future. Naturally, many documents in the database design report will be included in this manual. Printouts of database table structure, current table content, application code, and sample design and run of the applications are also included in the report as appendices.

The first presentation is given after the analysis and design phase of the project is completed. This presentation gives students an opportunity to review their design and to exchange opinions and ideas among teams. Finally, each team presents its database project implementation in class. Each team demonstrates some applications.

The collaborative team project involves learning to work to schedule and directing ones own work and that of others, and perhaps most important of all, experiencing being part of a team whose members are interdependent in their aim to achieve a common goal. Some major issues for running collaborative team project are discussed in Section 5.

4. Online Multimedia Learning Aids

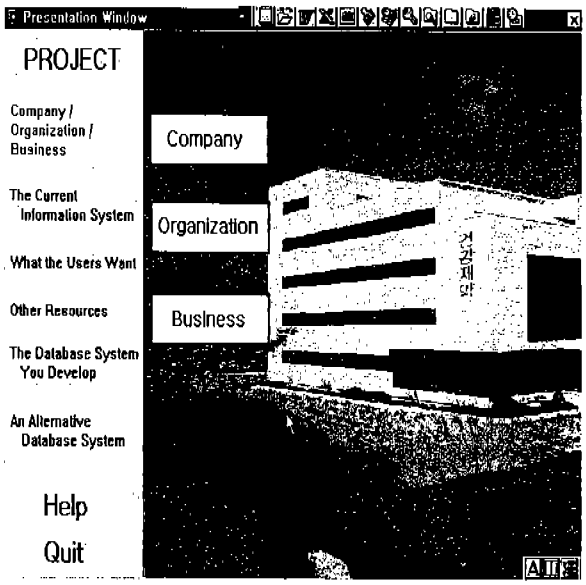
Multimedia Virtual Project (MVP) is developed based on the principle of problem solving approach. By placing the project in context, students have a much better chance of constructing a scheme for how the project needs to be carried out. Both MVP and multimedia Visual Basic tutorial are implemented using a commercial authoring tool, Authorware Professional for Windows by Macromedia, Inc. WWW is used to provide guidelines to database design process. WWW also has class materials such as syllabus, lecture notes, and assignments.

4.1 Multimedia Virtual Projects

Virtual projects in MVP are being developed from students real projects in previous classes. We contacted companies which provided generous help to student projects. Some agreed to become fictitious virtual companies. Management and end user interviews, work activities, and plant processes were captured in a video camera. Pictures of people, building, and facilities were taken. Documents such as forms and reports were collected and scanned. These materials were edited and put together following the structure of MVP.

MVP incorporates multimedia rich presentations

with images, audio messages, and video clips. It provides a simple Web-like navigation control and a HELP button that can be called up at any time. From the first screen of MVP, students select a specific organization from available virtual projects. Each virtual project is about a real company in disguise. Once a virtual project is selected, the learning activity of the virtual project starts by going through the phases of the collaborative team project. Following the project description, students as a group develop a database application to solve the organizations problem.



<Figure 3> The MVP Menu Screen

Figure 3 shows the Company/Organization/ Business screen of the Kun Gang Pharmacy Co. virtual project. The company is selected from PROJECT option which lists available virtual projects. Necessary and sufficient information for the virtual project are available under different menu headings:

- Company/Organization/Business
- The Current Information System
- What the Users Want
- Other Resources
- The Database System You Develop
- An Alternative Database System

Students learn about the company by clicking Company, Organization, and Business button after they click the Company/Organization/ Business menu. Company/Organization/Business provides general information about the company, its organization, and business activities. The Current Information System describes the current IS and how business is conducted. Through What the Users Want, students identify what the new database system has to offer in addition to what the current system is doing. Other Resources provides more information and pointers to other sources.

In MVP business information and rules are recorded in a variety of forms. They include video clips and voice recordings from the interview with management and end-users in the organization. Documents such as business forms, reports, and procedure manuals currently being used are stored. By following the typical requirements analysis technique, students perform requirements analysis tasks by visiting the first four menus. With the information from the requirements analysis, students perform database design activities. Students also design database applications. The result is stored in The Database System You Develop.

Implementation is done outside the MVP. Students use Microsoft Access and Visual Basic to implement the design they have developed. After the entire project is complete, students

may be interested in seeing a standard solution. An Alternative Database System is a benchmark against which students can compare their solution. Students may make changes to their design after seeing the alternative design.

4.2 Multimedia Visual Basic Tutorial

We decided not to reinvent the wheel for Microsoft Access as the interactive built-in tutorial is sufficient for the introductory course. Students learn this package through the built-in tutorial and the lab training. Microsoft Access tutorial teaches how to set up a database, create a database file, input the data, retrieve the database, and develop form and report applications.

Multimedia Visual Basic tutorial consists of two parts. First part introduces the Visual Basic application development environment and covers the basics of Visual Basic programming with a simple application. Second part teaches students how to develop a Visual Basic project which interacts with the database. Exercise problems in the tutorial lead students to acquire the required level of programming skill for the collaborative team project. As shown in Figure 4 current version is a linear text-based tutorial.

4.3 Web Note

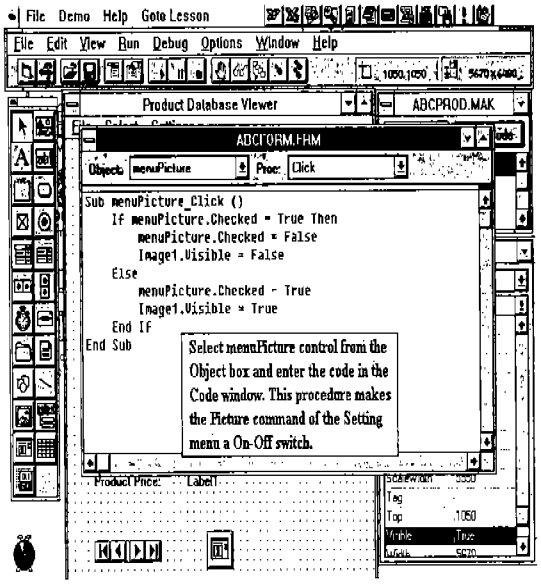
Besides the typical course materials, the guideline to the database application development is accessible from the internet. As the database design process specified in Storey and Goldstein (1993) and Ahrens and Sankar (1993), The guideline explains the process and skills required for database design:

- Comprehending data and requirement analysis concepts
- Creating the conceptual schema
- Converting the conceptual schema into relations
- Discriminating and integrating decision rules

WWW documents are designed by following the guideline in Barron, Tompkins, and Tai (1996).

5. Experiences and Discussion

Ensuring that there are good group dynamics is one of the most difficult challenges for both faculty and students. When the project team is formed, faculty has to make sure that each team consists of members of varying degree of computer skills. This helps students in learning software tools and implementing the project. Role playing among team members and regular role exchange helps students learning process.



<Figure 4> A Multimedia Visual Basic Tutorial Screen

The hard part of the team project is to select a project everybody feels comfortable and to define the scope of it because of differences in students real world experiences. We encourage students to select real world application projects which they have experience, contact, or knowledge about the enterprise. Typically, one or more student with a work background or good contact to a business bring the insights and user requirements about the business. Once the team members decide on the problem, they tend to work smoothly and produced a good result. Most students enjoy their projects. Several have continued working with the project after the semester.

Motivating students to work cooperatively and actively is critical to the success of the collaborative learning. One important philosophy is to encourage students to participate equally and learn as much as possible from the team work. This philosophy is implemented by actively contacting with students and indirectly telling students a formal incorporation of peer group members evaluation in the grading scheme. Choobineh and Ram (1977) also uses peer evaluation method.

Students have more difficulty in doing the requirements analysis and data modeling than learning software tools and implementing the design. It is the design part that more facultys help and feedback is needed. It is this reason that if more supporting materials are given to the students, they will attain the higher level of achievement.

Gasen and Preece (1996) identifies key questions for collaborative team projects. In Table 3 we show the issues and guidelines for each issue that are suggested through experience and literature review.

<Table 3> Issues and Guidelines for Carrying Collaborative Team Projects

Theme	Key Issues	Guideline
Pedagogical Issues	What types of learning activities are needed?	Role play, Student centered learning, Problem solving approach
	What will be the scope and focus of the project?	Specific project goal
	How will the project be integrated within the course?	On going project implementation
	What is the faculty members role in supporting the learning process?	Coach, Facilitator, Guide
	What technologies can support collaborative team learning?	Multimedia, Internet,
Group Dynamics	Who will be in the groups?	Mix of students at different level
	What skills are needed?	Role play, Computer, Communication
	How will group dynamics be supported and developed?	Feedback, Emotional Intelligence
	What technologies can support group processes?	Email, Computer conference, Group Decision Support System (GDSS)
	How does distance collaboration affect group dynamics?	Feedback
Administrative Issues	How do faculty and teams keep collaborative projects on schedule?	Project management
	How should team projects be evaluated?	Presentation, Report, Peer evaluation
	How do technology and distance issues affect the administration of team projects?	Project management

6. Conclusion and Future Work

This paper presents a practice-oriented approach to teaching a database course. We have described the design and implementation of the course. One major motive for designing a database course is to cover the system development knowledge requirement in the IS97 Model as close as possible for the situation where separate information system development courses are not practical. And the pedagogical approach is to give students a real world experience of working together in a team, which will provide valuable experience for their working lives.

Business and engineering schools-and educational institutions in general-are under increased pressure to produce qualified workers. Leidner and Jarvenppa (1995) and Ives and Jarvenppa (1996) assert that information technology needs to be used to transform educational environment and processes. Faculty needs to explore ways of supporting students learning, especially with new information technologies. Online multimedia learning aids found to be valuable since they can offer several different types of learning environments. They can provide multiple vantage points for students to arrive at a deep understanding of database theories and technologies.

MVP needs to become more sophisticated so that it can deliver individualized, contextualized, and just-in-time knowledge to students. More virtual projects will be added as students bring the material from the real world. Current multimedia Visual Basic tutorial needs continuous improvement to become a true multimedia system. Videos are not used in the current version. It is not interactive since it does not provide a hands-on practice with Visual Basic. It also needs self-diagnostic examinations at the end each part.

A much more important future research is to gather empirical evidence regarding the effectiveness of the collaborative team project approach with multimedia and internet technologies. Leidner and Jarvenpaa (1995) have identified areas of future research through the review of the literature on IT in education. We plan to examine whether there is an added value in the approach described in this paper.

〈References〉

[1] Alavi, M., Computer-Mediated Collaborative Learning: An Empirical Evaluation, MIS Quarterly(18:2), June 1994

[2] Alavi, M., Wheeler, B. C., and Valacich, J. S., Using IT to Reengineer Business Education: An Exploratory Investigation of Collaborative Learning, MIS Quarterly, September 1995

[3] Ahrens, J. D. and Sankar, C. S., Tailoring Database Training for End Users, MIS Quarterly, December 1993

[4] Barron, A. E., Tompkins, B. and Tai, D., Design Guidelines for the World Wide Web, Journal of Interactive Instruction Development, Winter 1996

[5] Beattie, K, McNaught, C., and Wills, S., Interactive Multimedia in University Education: Designing for Change in Teaching and Learning, Elsevier Science, 1994

[6] Choi, J., "Teaching Database Application Development with a Multimedia Programming Language Tutorial," Proc. of 23rd Annual Conference of the International Business Schools Computing Association, Kalamazoo, MI, July 23-26, 1995

[7] Choobineh, J. and Ram, S., Practical Aspects of Teaching an Applied Database Course, Data Base for Advances in IS, Summer 1997, pp.70-83

[8] Davis, G. B, Gorgone, J. T., Cougar, J. D., Feinstein, D. L., and Longenecker, H. E., IS 97 Model Curriculum and Guideline for Undergraduate Degree Programs in IS, Data Base for Advances in IS, Winter 1997, pp.1-94

[9] Farr, M, J. and Psotka, J., Intelligent Instruction by Computer: Theory and Practice, Taylor & Francis, 1992

[10] Gasen, J. B. and Preece, J., Collaborative Team Projects: Key Issues for Effective Learning, Journal of Educational Technology Systems, Vol.24 No.4, 1995-96

[11] Goldberg, B. and Richards, J., Leveraging Technology for Reform: Changing Schools and Communities into Learning Organizations, Education Technology, September-October 1995

[12] Hiltz, S. R., The Virtual Classroom: Learning Without Limits via Computer Networks, Ablex Publishing, 1994

[13] Ives, B. and Jarvenpaa, S. L., Will the Internet Revolutionize Business Education and Research, Sloan Management Review, Spring 1996

[14] Leidner, D. E. and Jarvenpaa, S. L., The Information Age Confronts Education: Case Studies on Electronic Classrooms, Information Systems Research, March 1993

[15] Leidner, D. E. and Jarvenpaa, S. L., The Use of Information Technology to Enhance Management School Education: A Theoretical View, MIS Quarterly, September 1995

[16] Macromedia, Inc., Authorware Professional 3.0 for Windows Users Guide, San Francisco, CA, 1995

[17] Maybury, M. T. (ED), Intelligent Multimedia Interfaces, MIT Press, 1993

[18] Norman, D. A and Spohrer, J. C., Learner-Centered Education, Communications of ACM (39:4), April 1996

[19] Ring, G., Electronic performance support systems in higher education, in Interactive Multimedia in University Education: Designing for Change in Teaching and Learning, Beattie, K., McNaught, C., and Wills, S. (Eds), Elsevier Science, 1994

[20] Schwier, R. A. and Misanchuk (Eds), E. R., Interactive Multimedia Instruction, Educational Technology Publications, 1993

[21] Shelly, G. B., Cashman, T. J., and Repede, J. F., Learning to Use Windows Applications: Microsoft Visual Basic 5.0 for Windows, Boyd & Fraser Publishing, 1997

[22] Skillicorn, D. B., Using Distributed Hypermedia for Collaborative Learning in Universities, The Computer Journal, Vol.39, No.6, 1996

[23] Storey, V. and Goldstein, R., Knowledge-Based Approaches to Database Design, MIS Quarterly, Vol.17, No.1, March 1993

[24] Urban, S. D. and Dietrich, S. W., Integrating the Practical Use of Database Product Into a Theoretical Curriculum, Proc. Of ACM SIGCSE Conference, California 1997

[25] Viescas, John, L., Running Microsoft Access for Windows, Microsoft Press, 1996