Work in Progress - MeTube: A Novel way to teach Database to Undergraduates

James Z. Wang, Tim Davis, Mike Westall and Pradip K Srimani
Clemson University, jzwang@cs.clemson.edu, tadavis@cs.clemson.edu, westall@cs.clemson.edu, srimani@cs.clemson.edu

Abstract - **In this paper, we describe the principles, outlines, and implementation of a new undergraduate database course using *MeTube* (a variation of the well known YouTube) as a motivational semester-long project, which is attractive, fosters creativity in students and is complex enough to introduce DBMS theories and techniques. We provide detailed course assessment results and describe our experience from past two semesters.**

Index Terms - MeTube, CPATH, DBMS, Problem-based Instruction.

INTRODUCTION

The purpose of this paper is to describe the redesigned "Database Management Systems" course in details – the problem domain, the motivation, objectives and learning outcomes, course content, and assessment processes and results. A rigorous embedded assessment mechanism has been introduced into this course to measure the degree to which stated learning outcomes are attained. The work of Walker and Fraser [1], and the dynamic assessment of Brown [2], based upon Vygotsky's zones of proximal development [3], have served as the foundation on which the assessment mechanisms are built.

STUDENT LEARNING OUTCOMES

To extend the TEXNH instruction approach [3] to our current senior-level undergraduate database course, CPSC 462: Database Management Systems, we designed a semester-long multimedia database project and adopted a problem-based teaching method. Students are required to design and implement a web-based multimedia database system, MeTube, throughout the semester while the instructor teaches concepts, theories and tools to address the needs of different project phases, as identified by the instructor in the syllabus.

This course has six expected learning outcomes: (1) Students shall understand conceptual modeling concepts and be able to use ER Model to design database applications. (2) Students shall be familiar with relational data models and be able to design relational database schemas from ER diagrams. (3) Students shall be able to use an industry standard query language (SQL) to query the relational databases. (4) Students shall understand the basic concepts of query optimization and learn simple query optimization techniques. (5) Students shall gain experience in designing and implementing web-based database systems. (6) Students shall improve oral and written communication skills through written and oral presentation of their projects. These course outcomes collectively contribute to the program outcomes of the Bachelor of Science (BS) in Computer Science (CS) at Clemson University.

Implementation of the MeTube system accomplish these objectives with a real-world problem with which students are familiar, and in which they have great interest due to the creative nature and degree of artistic expression that is rarely found in a traditional database course. The students implement their MeTube systems using MySQL, an open-source DBMS system, and PHP, a widely-used general-purpose scripting language that is especially popular for Web development. MySQL and PHP are key parts of LAMP (Linux, Apache, MySQL, PHP/Perl/Python), a fast growing open source enterprise software stack. More and more companies are using LAMP as an alternative to expensive proprietary software stacks because of its lower cost and freedom from lock-in. Therefore, training students developing the MeTube system using MySQL and PHP will meet the increasing demand for open-source application developers.

METUBE SYSTEM DESCRIPTION

MeTube system is a modified version of the popular YouTube system (http://www.youtube.com). We believe that a class project based on such an extremely popular, culturally relevant system will motivate students to acquire and appreciate skills in database management systems and web technologies. By implementing MeTube system, students will attain the expected learning outcomes more efficiently since the opportunity to show their creativity and artistic expression (rarely found in a traditional database course) will keep them interested. The open-ended problem expects students identify their own MeTube system requirements by exploring YouTube system; a basic requirement specification is provided to the students to ensure that their implementations meet the minimum requirements expected in the course.

DIFFERENT PHASES OF THE METUBE PROJECT

The *MeTube* project consists of the following six phases:
Phase I: Students identify system requirements to complete a conceptual schema of the *MeTube* system using the Entity-

Relationship (ER) model. **Phase II:** Students use MySQL database management system to design relational schemas actual database tables for the MeTube system. **Phase III:** Students design complex SQL queries to insert and retrieve the information in the multimedia database, and evaluate the performance. **Phase IV:** Students design the web interfaces for users. **Phase V**: Students test their *MeTube* system, evaluate system performance, and optimize database and PHP programs. **Phase VI**: Students prepare a project report, and make an oral presentation on their project.

COURSE CONTENT OUTLINE

To allow students to succeed in their *MuTube* project and attain the expected learning outcomes, related concepts and techniques are offered to students in a timely manner according to the project needs. These concepts and techniques include:
Database Design Specification (1 hour), (2) *Conceptual model and ER diagram (2 hours*), (3) *Relational data model and database schema (2 hours*), (4) *Database normalization (2 hours*), (5) *SQL language through MySQL (3 hours*), (6) *Index, key, and other constraints (2 hours), (7) Query Optimization (2 hours),* (8) *Web server, HTTP, HTML. PHP (4 hours),* (9) *HTTP form, script design and Multimedia presentation (3 hours)* (10) *View, Triggers, and Stored Procedure (3 hours),* (11) *Performance Evaluation and System Improvement (3 hours):*

ASSESSMENT RESULTS

Assessment is, in the most general constructivist case, a difficult issue, since the validity of an individual accommodation is difficult to judge with a common measure. Because problem solving in new contexts is the key development, overlays of scaffolding and cognitive apprenticeship offer us some clear directions for the assessment task. We performed a systematic and detailed assessment of our approach using both direct measures (direct examination of student knowledge and skills against measurable learning objectives) and indirect measures (student surveys) that ascertain the opinion or perception of the value of learning experiences.

Course Outcome Assessment

We used the midterm, final and the semester long team project to assess the course outcomes in a cumulative manner. The methodology was similar in both Fall 2007 and Spring 2008; we give the details of the Spring 2008 semester.

Midterm (Spring 2008): It was a comprehensive exam up to the point in the semester – it contained 7 questions – Q2, Q5 and Q7 contributed to assessment of course outcome (1), Q3, Q4, Q5 and Q6 contributed to assessing course outcome 2 and Q5 and Q7 contributed to course outcome 3. For each course outcome, each student's score for a given question was normalized with the maximum possible score – the normalized scores for all questions used for a given outcome were then added and normalized to get the composite score for that course outcome.

Final and the Project (Fall 2007): Final Exam had 10 questions – Q2 and Q8 contributed to course outcome 1, Q2 and Q3 contributed to outcome 2, Q2, Q8, Q9 and Q10 contributed to outcome 3, Q1, Q8, Q9 and Q10 contributed to outcome 4, and Q1, Q4, Q5, Q6 and Q7 contributed to outcome 5. The semester long term project had 5 interim evaluations (P1, P2, P3, P4, P5), a final report and an oral presentation by a team member – P1 contributed to course outcome 1, P2 contributed to outcome 2, P5 contributed to outcome 5. The composite score for each outcome was computed as previously.

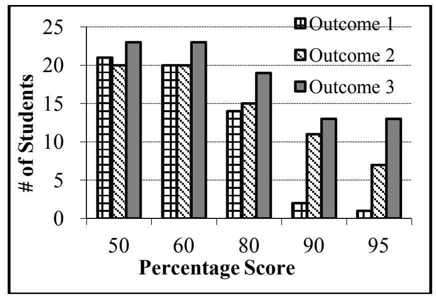

FIGURE 1: COURSE OUTCOMES (MIDTERM, SPRING 2008)

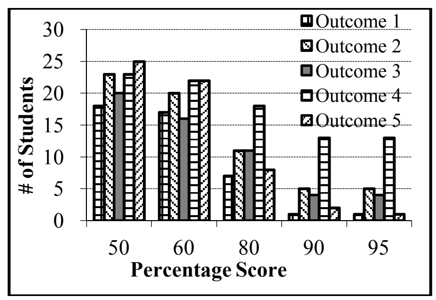

FIGURE 2: COURSE OUTCOMES (FINAL, SPRING 2008)

ACKNOWLEDGMENT

This work is supported by the National Science Foundation under grant CPATH EAE: TEXNH – Evaluation, Adoption and Extension, Award number 0722313.

REFERENCE

[1] S. Walker and B. Fraser, "Development and validation of an instrument for assessing distance education learning environments in higher education", Learning Environments Research, Vol. 8:289-308, 2005

[2] A. Brown, D. Ash, M. Rutherford, K. Nakagawa, A. Gordon, and J. Campione, "Distributed expertise in the classroom", In G. Salomon, editor, Distributed cognitions, pages ***7:*** 188-228. Cambridge Univ. Press, Cambridge, England, 1993

[3] T. A. Davis, R. M. Geist, S. Matzko, and J. M. Westall, TEXNH: Trial Phase for the New Curriculum, *SIGCSE Bulletin (Proceedings of SIGCSE 2007)*, March 2007.