Work in Progress – Preview, Exercise, Teaching and Learning in Digital Electronics Education

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Abstract - Through multimedia delivery of new materials, web-based warm-up exercises and interactive classroom teaching/learning, this paper presents an effective approach - PETL (Preview, Exercise, Teaching and Learning) in teaching and learning digital electronics. The proposed pedagogy is a teaching and learning strategy based on the active participation of learners at each stage of the learning process, namely, preview of new topics, web-based warm-up assignments, and interactive classroom teaching and learning. Students briefly preview the new materials delivered through web-based multimedia, and then respond electronically to carefully constructed warm-up exercises which are due before class. The instructor reviews students' responses and adjusts the classroom lesson based on students' concerns and questions. These interactions are important to the academic success of the students. If the classroom environment lacks interactions between faculty and students, and between students themselves. These interactions are very important to the academic success of the students. If students actively participate in the classroom learning activities, they will be more cognitively engaged and as a result be able to achieve a better understanding of new materials.

Through multimedia delivery of new materials, web-based warm-up exercises and interactive classroom teaching/learning, this paper presents an effective approach – PETL (Preview, Exercise, Teaching and Learning) in teaching and learning digital electronics. This pedagogy is based on the active participation of learners at each stage of the learning process, namely, preview of new topics, web-based warm-up assignments, and interactive classroom teaching and learning. Students briefly preview the new materials delivered through web-based multimedia, and then respond electronically to carefully constructed warm-up exercises which are due before class. The instructor reviews students' responses and adjusts the classroom lesson based on students' concerns and questions.

RELATION OF PETL TO PREVIOUS RESEARCH

Multimedia: Multimedia includes a combination of text, graphics, sound, video, and animation sequences, etc to form an interactive visual/audio presentation of information and knowledge. Interactive multimedia can be used to support education and training, to serve as a reference tool and to provide dynamic presentations [1][2]. Educational research showed that if information is conveyed to the students in a combination of text, color, graphics, animation, sound, moving pictures, and a degree of interactivity, the interactive multimedia approach may result in a significant increase in retention, improvement in the learning rate and active learning process [3]-[5]. According to Stoney and Oliver's report, “The use of interactive multimedia can foster and develop cognitive engagement through its ability to attract and hold students' attention and focus.” [6]

WebCT: WebCT technology has been used by educators at more than 2000 colleges and universities in more than 70 countries [7]. The latest version of WebCT – Blackboard is a Web-based course-management system designed to allow students and faculty to participate in classes delivered online or use online materials and activities to complement face-to-face teaching. It is a Virtual Learning Environment that supports online learning and teaching. It can be accessed by registered users from anywhere in the world using the Internet and web browsers.

Just-in-Time-Teaching: JiTT – a web-based learning and teaching strategy was pioneered as a collaborative effort of physics faculty at the United States Air Force Academy and Indiana University Purdue University Indianapolis. It is a feedback-intensive teaching and learning strategy [8][9]. In a typical implementation, students respond electronically to carefully constructed warm-up exercises due before class, and the instructor reviews the answers and adjusts the classroom lesson to meet student needs.

In most engineering subjects, without prior knowledge of new materials, it is very difficult to do any warm-up exercises and have a good discussion of the engineering new concepts. Thus, it is almost impossible to apply JiTT to the instructional activities of engineering without significant modifications.

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Based upon the research and teaching results of JiTT, a new pedagogical approach – PETL is proposed in this project. It consists of multimedia delivery of new materials, web-based warm-up exercises and interactive classroom teaching/learning. The web is used to generate interactivity with the students, deliver preview materials, have students go over preparatory assignments, or simple essay questions shortly before the lecture session. PETL assists learning engineering concepts before the lecture, with the pedagogical strategy known as “active learning” or “interactive engagement” [10], in the subsequent classroom session that is tailored to students' needs.

**PLAN OF WORK**

The Proposed PETL methodology will take up most of the design and development effort. It will lead to instructional materials focusing on digital circuit principles and practices during the sophomore year, incorporating interactive multimedia, the Web, and instructional strategies that promote active learning and problem-solving skills of undergraduate engineering students.

Project PETL is being implemented on a pilot phase during the spring semester of 2008. The PETL exercises are conducted in one semester with control (PETL) and non-control (non-PETL) sessions. Though all content areas are not equivalent in difficulty levels, the students' view on both methods could be provided of having the same students. The results of this experiment can be reached in one semester. The teacher-student interactions, time spent in/out of class presentation, the nature of the preparation, and student attitudes toward the content can be measured through comparing between PETL and non-PETL lecture sessions. The pre-PETL, post-PETL survey, and the interim survey are conducted to assess the PETL practice. A comment box in each warm-up exercise is added to get students' feedback. If anything necessary is brought to the attention of the instructor, it can be corrected in a prompt approach.

Weeks 1 to 5, phase 1: Topics are taught using traditional lecture/recitation format. Pre-PETL questionnaires are conducted in the end of phase one.

Weeks 6 to 10, phase 2: Topics are taught with PETL exercises. Post-PETL questionnaires are conducted in the end of phase two. During phase two, the following instructional activities are carried, which includes students' preview PETL modules, warm-up exercise preparations, adjusted classroom teaching, project assessment with questionnaires, etc.

Week 11 to 13, phase 3: All data gathered from pre-PETL, post-PETL and interim comments are analyzed and processed to evaluate the effectiveness of PETL exercises. The strengths, weaknesses, and value of the project experiences are assessed during this phase. Results are used to improve the quality of the program in the next semester and to ensure the faculty and students continue to see this project as a worthwhile education experience.

**SUMMARY**

A new pedagogy based on Multimedia and world-wide-web delivery of preview module and warm-up exercises, adjusted classroom teaching/learning is presented in this paper. This instructional approach is expected to enhance student learning in the typical digital electronics course. It will encourage students to take an active part in the learning process. For example, the preview materials and warm-up exercises will help students to prepare for learning new contents. The interactive classroom session, built around students' responses to warm-up exercises, replaces the traditional lecture/recitation format. The interactions between the instructor and the students promote active learning, and maximize the effect of the classroom session. The on-line delivery is especially helpful to the learning activities of non-traditional and physically-disabled students, who are underrepresented in the STEM fields.

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**REFERENCES**