AC 2011-716: WEB-BASED, ACTIVE LEARNING MODULES FOR TEACHING STATISTICAL QUALITY CONTROL

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Dr. Miguel A. Gonzalez serves as the Associate Dean and Director for the School of Engineering and Computer Science in the University of Texas Pan American's College of Science and Engineering. He has a significant amount executive industry experience where he held managerial and executive positions including President and CEO of a large Citrus processor. Throughout his experience, Dr. Gonzalez' professional and academic activities are focused on an overall mission to provide opportunities for student involvement by developing and maintaining a strong reputation of excellence. He has developed a strong track record of teaching effectiveness based on consistently good teaching evaluations, and he has won some departmental awards in this area. Dr. Gonzalez and colleagues from UTPA and Michigan State University were awarded Honorable Mention in the American Society of Mechanical Engineers 2004 Curriculum Innovation Award competition. Furthermore, his service as an Associate Editor for The IEEE Transactions on Education has provided him with a means of enhancing and maintaining his knowledge on the issues affecting engineering education. In the area of professional achievement, he has been able to obtain over Four Million Dollars in funding for his academic activities from various sources including NASA, The National Science Foundation, The Texas Higher Education Coordinating Board's Advanced Research Program, U. S. Department of Commerce, The Texas Manufacturing Assistance Center, The U. S. Department of Education, and The U. S. Department of Labor. One of his current interests is in the area of manufacturing systems for rapid response Manufacturing. An extension of this work is the current effort that established the UTPA Rapid Response Manufacturing Center in a consortium of academic institutions, economic development corporations, industry, local, state, and federal governments. This initiative is an integral component of the North American Advanced Manufacturing and Research Initiative (NAAMREI). Dr. Gonzalez is a founding leader of the initiative which seeks to develop the infrastructure for an integrated PK through practice educational system for the Rio South Texas Region. This endeavor involves a strong relationship with the Economic Development community, South Texas College and Region One Education Service Center which facilitates the activities of the proposed project. Because of his experience and role as a regional leader in a wide variety of endeavors, Dr. Gonzalez has served and continues to serve in leadership positions in technology based economic development in the Rio South Texas Region.

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Web-based Active Learning Modules for Teaching Statistical Quality Control, 2011 Update

Background

The purpose of this research is to investigate the use of simulation-based active learning tools in engineering education in the application of quality principles within a manufacturing system. The learning modeling will emphasize active learning and higher order cognitive skills in Bloom's taxonomy of learning. Students will interact with a virtual manufacturing plant through web-based applications that can be used within almost all Internet browsers.

Implementation

A series of active learning modules will be developed to cover the important tools for statistical quality control. Each learning module will have four major components: an assignment, a rubric, web-based application(s) and assessment materials. All learning modules share access to the Mouse Factory. The Mouse Factory is an html-based web page that describes the manufacturing plant. The Mouse Factory contains a plant layout, bill of materials and parts lists. The bills of materials and parts list contain import quality information used to complete the learning assignments.

Unique configurations for each student are created and stored in a MySQL database. Web-based applications for each learning module are created using Java Server Faces (JSF) technology. JSF allows "smart" web applications that separate the presentation of information from data processing. Information is presented using servlets and Java Server Pages and data processing is implemented in JavaBeans. JSF allows the use of JDBC to allow easy access of database information to the JSF applications. A final advantage of this approach is the fact that all software is open-source. The JSF applications are developed using NetBeans and implemented on the GlassFish application server. The MySQL data is also an open source applications.

Learning Modules

The learning modules present students with the "real world" decisions required to implement statistical quality control. Many of these decisions are denied students taught by traditional methods of lecture plus homework. There are two major categories of learning models for statistical quality control: design of experiments (DOE) and statistical process control.

The statistical process control learning modules are more mature than the design of experiments learning modules as two of these modules were developed in the Phase I activities. There are five proposed learning modules for statistical process control: tools for process improvement, control charts for variables, control charts for attributes, process capability indices and gage R&R analysis. During the Fall 2010

semester, tools for process improvement, control charts for variables and process capability indices learning modules were used. A design flaw was found in the control charts for attributes learning module that precluded its use in Fall 2010. The Gage R&R analysis was also not used due to the lack of availability of gage blocks.

The learning modules for design of experiments were used for the first time in the Fall 2010 semester. The first DOE laboratory requires students to benchmark the performance of injection-molding machines at an initial (non-optimal) setting. The second learning module requires student to use a fractional factorial experimental design with the fewest possible experimental units to identify the important factors, develop a statistical model and locate an improved set point. Students are then required to compare the performance of the initial setting with the improved setting.

Assessment

There are two primary modes of assessment. Students are evaluated on their performance in answering metrics contained in the assignment and rubric. Student performance is divided into four categories: exceptional (A-level), effective (B-level), acceptable (C-level) or unsatisfactory (D-F level). Students are also given a survey to examine their perception of their understanding and confidence in answering the learning goals.

Test Sites

The research team is actively recruiting test sites. The learning modules have been implemented at the University of Texas – Pan American and will implemented in the Spring 2011 semester at Texas Tech University.

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