AC 2012-3806: WEB-BASED, ACTIVE LEARNING MODULES FOR TEACHING STATISTICAL QUALITY CONTROL

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Web-based Active Learning Modules for Teaching Statistical Quality Control, 2012 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 modules emphasize active learning and higher order cognitive skills in Bloom's taxonomy of learning. Students interact with a virtual manufacturing plant through web-based applications that can be used with 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 contains four major components: an assignment, a rubric, web-based application(s) and assessment materials. All learning modules incorporate the Mouse Factory. The Mouse Factory is an html-based web page that describes the manufacturing plant. The Mouse Factory website 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 for the JSF applications. A final advantage of this approach is the fact that all software is open-source. The JSF applications were developed using NetBeans and implemented on the GlassFish application server. The MySQL data is also an open source application and the applications run on an OpenSUSE Linux server.

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. The learning modules for SPC are:

- Tools for SPC,

- Control Charts for Variables,
- Control Charts for Nonconforming Data,
- Control Charts for Nonconformity Data,
- Process Capability Indices, and
- Measurement Systems Analysis (gage R&R).

The learning modules for SPC can be accessed at http://quality.engr.utpa.edu/ccli/SPCLaboratories.

Another set of learning modules for teaching design of experiments is available. 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. A learning module for response surface methodology (RSM) is also available. The DOE modules may be accessed at http://quality.engr.utpa.edu/ccli/DOEProjects and the RSM module is available at http://quality.engr.utpa.edu/ccli/MouseFactoryRSMLab.

Assessment

There are two primary modes of assessment. Students are evaluated on their performance in answering questions contained in each assignment and specified in an accompanying rubric. Student performance is divided into four categories: exceptional (A-level), effective (B-level), acceptable (C-level) or unsatisfactory (D-F level). Students were 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 Texas Tech University with a planned implementation at Arizona State University in Spring 2012.

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