Development and Delivery of Data Acquisition and HP-VEE Courses for Technical Personnel

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Abstract

Data acquisition requirements for manufacturing, development, and research indicate a continued demand for the collection and analysis of relevant and meaningful data. Criteria for maintaining data and specifying processing systems must be established.

A team of engineers experienced in curriculum development (who are also the individuals who created Just in Time (J.I.T. Education™) were invited to meet with engineers from an international, high-technology company. This team identified a need for training technicians and designers in data acquisition. Their Engineering Council selected HP-VEE as the standard software to simulate and then acquire data.

Specifications for the program were jointly developed by the team. The curriculum developers using J.I.T. Education™ concepts developed behavioral objectives and organized them to assure that material was delivered as needed. Prerequisite information was separated from the course material; a math diagnostic instrument and a questionnaire on computer literacy was developed and given prior to the course.

The final course was an integrated 60-hour course, 1/2 theory and 1/2 laboratory, interwoven using J.I.T. methodology. More than 45 participants have taken the course and provided feedback via a questionnaire. A Supervisors' Course is being developed. Labs are provided; the supervisors will analyze and evaluate the lab material from the icons backwards.

Introduction

For several years, Northeastern University's Continuing Education Center for Corporate On-Site Training has been working to devise new courses that apply the Just-In-Time Education™ technique. This technique examines the technical topics desired to be taught to potential participants. It then sequences these topics so the knowledge and skills are gradually applied in the course. Potential participants are given a mathematics Diagnostic Tool developed by the authors. The selected participants receive a notebook and a set of texts. Four quizzes on fundamental topics are given throughout the course to

(1) provide Northeastern with information that can be used to determine a grade and (2) provide the students with an assessment of their progress.Curriculum Design

The concept of J.I.T. Education™, developed by the authors, examines those topics that will be taught to course participants. Behavioral Objectives are used to develop topics so the participants apply their pre-existing knowledge and skills sequentially. Therefore, the requirement for recall of old information is minimized. An outline of the course was developed, along with some examples where necessary.

The Engineering Council for the division of the international company were given a few weeks to review the topics and their sequence proposed for the course. In practice, most of the review falls upon the shoulders of one person appointed by the Engineering Council. After revisions and approval, the detailed content of the course was developed.

Curriculum Development

Curriculum development consisted of laying out the course content and determining the mathematics proficiency of potential attendees via the newly developed Diagnostic Tool that was devised to assist in choosing the attendees. The Diagnostic Tool begins with a review of basic arithmetic. It proceeds from word problems through one equation with one unknown and other algebra topics that will be utilized during the course. The participants essentially selected themselves as a result of their self-evaluation via the Diagnostic Tool; they were approved by the faculty in conjunction with a company representative.

Next, the topics were sequenced in an order that gradually applied more complex mathematics and physics. The Nodal Chart, covering a single topic, was prepared based upon the mathematics and subject level expected of the students. The Nodal Chart later becomes a portion of a Unified Concept Chart. See Figure 1. The math node precedes those nodes required to achieve this level of competency (such as $x = yz$). The physics and technology nodes have similar competencies that have to be achieved first.

Upon successful completion and assessment of applying $x = yz$ to Hooke's Law at the physics node, the technology application is next. Upon successful completion of the beam deflection experiment, the product description(s) are then synthesized and documented. The results are then assessed by the faculty. The students now branch to the physics application known as Ohm's Law, $e = Ri$ (electrical technology). They study resistance, and how resistors are applied in electrical circuits. The Unified Concept Chart can also include other layers (such as flow of fluids and transfer of heat energy) based on the math node.

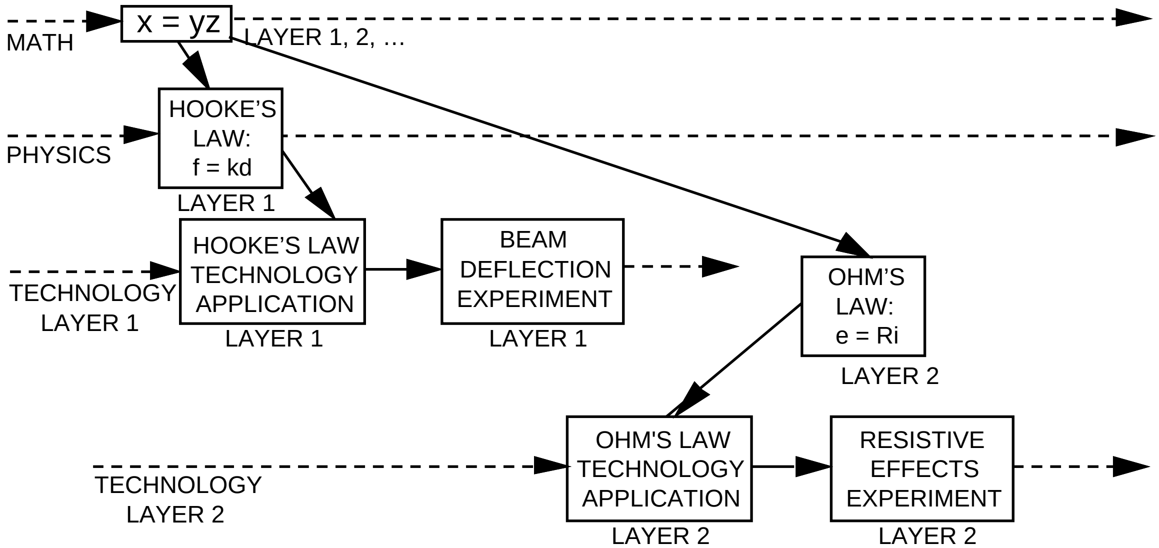

Figure 1. – A Unified Concept Chart

The sequence of competencies is documented via Unified Concept Charts. These charts interlock nodes, units, and disciplines. The development is an interactive process from a layer to a Unified Concept Chart and back again. The charts also provide a basis for systematically organizing the curriculum and sequencing the material to be presented.

The First Course Offering

The first offering was developed referencing four texts that accompany the course. Students received notebooks with comprehensive references to the texts supplied, a copy of each text, and a copy of each overhead slide. Participants were requested to evaluate each session's two-hour content. This rapid feedback allowed the authors, working with the corporate representative, to quickly revise the course material where necessary. This first offering was devised with a 60% lecture and a 40% lab content.

For the laboratory portion of the course that focused upon the HP-VEE material, the classes were split into two groups (because of the number of training computers available). Each group was supported by an employee technical assistant and Northeastern University faculty. These assistants worked the labs ahead of time and criticized the lab presentation and content. Whenever possible, the authors revised and re-issued the labs prior to the actual labs.
Summary of Feedback

Daily Student Evaluations – The daily student evaluations, for both lectures and labs, proved to be invaluable. A one-page form was developed that allowed for an overall evaluation and space for comments. The overall evaluation, covering the entire course on a daily basis, resulted in 511 replies:

Today’s handouts and references were:	Today’s lecture was:
confusing: 46 or 9.0%	too fast: 48 or 9.4%
well done: 452 or 88.5%	very clear: 459 or 89.8%
too basic: 13 or 2.5%	too slow: 4 or 0.8%

The comments were tabulated each day, examined by the authors, and transmitted as given, to the corporate representative.

End-of-Course Feedback – At the end of the course, two questionnaires were given the participants: one that was technical in nature, generated by the faculty (authors) and one that was administrative in nature, generated by the University.

Three months after the course was completed, an external group hired by the corporation sent out a questionnaire to the (20) graduates. Only seven replied. It was condensed and discussed among the authors, the company representative, and the external group. Although the information was of some value, the lack of participant replies and the short three-month interval was very frustrating to the authors because it would probably require one year or more before useful identification of results can be obtained. (That was our recommendation to the corporation.)

Revisions for Second Offering

The first, most frequently received, evaluation comment recommended that the course focus more upon the labs. Therefore, the second offering was changed to 50% lecture; 50% lab. This was very acceptable to the second round of participants.

The course content was revised to reflect both the input of the previously participants and a number of personnel from the Engineering Council. Also, the authors noted that participants seemed confused and frustrated by the separate set of overhead graphs that tracked the course topical content. Therefore, the authors merged the overhead slides with the course content, including the precise reference to pages within each of the supplied texts. This proved to be much better for the participants who can follow the slides with their page references. Each participant can add personal notes on the merged material. It should be noted that the material is, in general, presented as an overview of the topic of interest in order to keep the course length to sixty hours. Further study is placed upon the shoulders of the participants. Evaluation will continue to be on a day-to-day basis; this helps the authors to be certain that needs of future participants are met.

Another important course change was the inclusion of a real-world project for the participants to devise and complete during the last half of the course. There are two options for the project: (1) participants whose project reflects newly desired tests and (2) participants whose projects reflect existing-test data gathering and analysis.

Plans for a Supervisor's Course

It was noticed during the three-month evaluation, that many first-course participants were frustrated by the lack of awareness of their supervisors to their new-found capabilities and its value to the corporation. Thus, the authors are developing an overview twelve-hour course for engineering supervisors. They will spend all of their time examining laboratory experiments prepared previously by the authors and previous participants. The supervisors will manipulate these experiments. After becoming familiar with them, they will vary parameters to see what can be done and not done with the HP-VEE digested test results. Supervisors would then have a better understanding of what the HP VEE material can provide the corporation. It should be noted that three clients of the corporation have sent unsolicited letters of appreciation regarding how much data analysis has improved since the introduction of HP-VEE, and how rapidly the results are available.

The Future

There is a growing market for training in data acquisition and process control techniques and implementations. The authors plan, with the help of Northeastern University personnel, to pursue other corporations who have data-acquisition and process control training needs. A presentation to other corporations prepared for the Northeastern University corporate on-site marketing group is being implemented.

The authors feel very strongly that, after- course evaluation should occur approximately one year after graduation. This time lag is frustrating to some corporate personnel who want near-term results with which to impress their superiors. Time, effort, training, and financial resources are required to design, purchase, install, and test data-gathering equipment before meaningful results can be acquired.

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Biographies

ROBERT B. ANGUS is a Senior Lecturer at Northeastern University with 52 years of teaching experience covering mathematics, physics, and electrical engineering courses. He has authored or co-authored eleven textbooks and numerous technical papers. He has also been an engineer, engineering manager, and senior engineering specialist for more than twenty years and has been an engineering consultant for the past 28 years, specializing in circuit and system design, curriculum development, and technical manuals.

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