UNIQUE APPROACH TO TOTAL QUALITY MANAGEMENT IN A QUALITY PLANNING AND CONTROL LABORATORY

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In recent years, Total Quality Management tools and principles have been increasingly introduced into engineering curriculum. This paper describes a unique approach to integrating TQM in the laboratory of a Quality Planning and Control course which had previously focused solely on statistical control of quality and precision linear measurement. The new approach includes a team building component, Lab Development Project and TQM Follow-up Project. In the Lab Development Project, the students are customers of each other and must improve their product, a laboratory exercise, based on other students feedback. The TQM Follow-up Project is a means for the students to further apply the concepts and tools of Total Quality Management to analyze and recommend improvements to a common process.

Introduction

In the Manufacturing Engineering and Engineering Management programs at Miami University in Oxford, Ohio, the Quality Planning and Control Course (EGR 334) is a required course in the junior year of study. For many years, the content of the EGR 334 had focused on statistical control of processes and the use of linear measurement tools. A relatively recent addition to the course content is a study of TQM principles and tools.

When TQM had been introduced to the course, it was in the form of a section added at the end. The Memory Jogger II[1] and selected readings were used to supplement the required course textbook.[2] The basic TQM principles of customer focus, continuous improvement, work-as-a-process, and teamwork were discussed in class. In-class exercises were performed using basic TQM tools.[3,4] While students appeared to learn the material in the classroom setting, a more hands-on approach was desired to reinforce the concepts. An expansion of the objectives of the laboratory of the course was looked at as a means to provide such an applied approach.

The existing laboratory accomplished two objectives: 1) providing the students with a minimum level of competency on a variety of measurement tools and 2) reinforcing classroom theory. While two hours per week in the fifteen week semester were allocated only five, two hour lab sessions were actually used for laboratory exercises. (The remainder were replaced with one hour lectures.) Two new pieces of laboratory equipment had been acquired but lab exercises had not yet been developed for them. The timing was very appropriate for developing a completely new approach to the laboratory incorporating the new equipment as well as TQM concepts.

In developing the new laboratory approach it was important to add the TQM emphasis (keeping the existing objectives) while staying within the time available. Six lectures at the end of the semester had been dedicated to TQM principles and tools not covered in the traditional statistical quality control course. By spreading out the remaining course content, these six lecture hours

were easily made into six two hour labs. Further streamlining of the course material allowed the new lab approach to take advantage of the all fifteen available weeks.

The New Quality Laboratory

The new quality control laboratory experience was designed to provide students with a complete TQM experience while still learning measurement techniques and reinforcing classroom theory. After some fundamental teamwork training, students work in teams to continuously improve a product to meet customers needs. The fifteen weeks of laboratory activity are outlined in Table I. Each activity is then discussed.

Table I. Quality Planning and Control Lab Outline

Activity	**Duration**
Team Building Exercise	1 week
Lab Development Project	
Lab Equipment Research Phase	2 weeks
Lab Equipment Presentations/Demonstrations	1 week
Develop Customer Requirements	1 week
Initial Lab Development	2 weeks
Continuous Improvement Phase	4 weeks
TQM Follow-up Project	
Process and Problem Analysis	3 weeks
TQM Poster Session	1 Week

Team Building

In the first week, the class participates in a team building exercise called the "Project Planning Situation".[5] This simulation serves a dual purpose: 1) Organization members are helped to understand and practice the behaviors and skills that contribute to effective group problem solving and decision making and 2) Students learn a process for managing projects that can lead to increased efficiency and more effective results.[6]

The team building exercise is similar to the "Space Survival" and "Desert Survival" exercises developed with the support of the National Science Foundation.[7] The students work on a problem individually, then work together to reach a consensus solution. The advantage of this commercially developed exercise over "free" ones is that students become familiar with activities necessary in planning, organizing, implementing and controlling a project. The students are much more likely, in the future, to work on projects than they are to get lost in the desert.

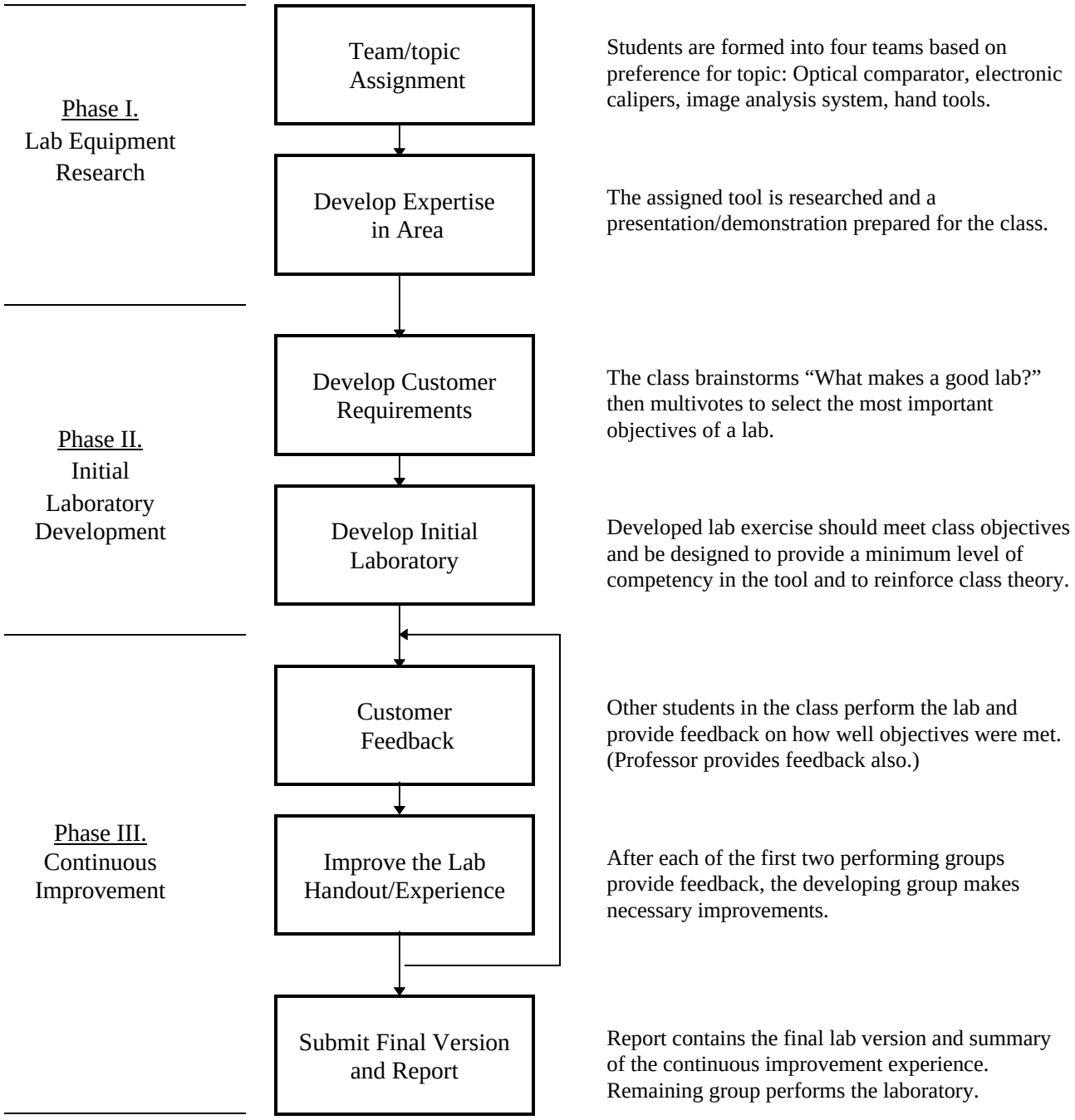
Lab Development Project

Important TQM concepts not easily reinforced in classroom activity are those of customer focus and continuous improvement. The Lab Development Project was conceived to allow the students to learn the value and importance of customer interactions while participating in a

continuous improvement project as a part of a team. In this component of the lab, they gain competence with a variety of tools as well as reinforce the classroom concepts/theories.

The Lab Development Project is divided into three phases: I. Lab Equipment Research; II. Initial Development and; III. Continuous Improvement. The phases and overall flow of the project are depicted in Figure I.

Figure 1. Lab Development Project Phases



In the EGR 334 Lab Development Project, students work as a team to develop a hands-on learning opportunity for other students in the class. Each team researches a quality tool topic and develops a laboratory exercise. Feedback from the team's primary customer (other students in the class who perform the lab) will allow the developing team to improve upon their product (the lab experience/handout) several times prior to project completion.

TQM Follow-up Project

In the Lab Development Project, each team went through a common process: the process of developing a laboratory exercise. The TQM Follow-up Project is a means for the students to apply the concepts and tools of Total Quality Management to analyze and recommend improvements to the process of developing labs. Identification of customers, documentation of the current process and problem analysis techniques are used subsequent to making of specific recommendations for improving the process.

Although customers were discussed prior to development of labs, the topic is revisited. In teams the students had to identify and categorize their customers as internal, external, direct and indirect.[8] The next step in the project was to document the process using deployment flowcharts. Again, this was a team effort.

New student teams are formed for this project, ideally with no members of a Lab Development team serving on the same TQM team. This is especially important in the next step of the project, identification of problems in the process using fishbone techniques. The final step was to make recommendations to improve the process based on root causes found during problem analysis.

Each TQM team's work is documented in the form of a poster. The final lab is a poster session where students critique each others posters and vote on the best one. Students are also required to write, individually, a description of the quality tools used and to discuss their success.

Assessment of the Laboratory

This approach has been used for three semesters in the Quality Control and Planning course with improvements made each semester based on the student recommendations in the TQM Follow-up project. A total of six lab sections have performed the project with fifteen to twenty students in each section..

The students tended to be rather opinionated on whether they liked or disliked the lab. This is reflected in the most recent final course evaluation with student responses to the statement:

"Laboratory experiences were effective instruments for learning"
Agree: 60% Neutral: 12% Disagree: 28%

The students that liked the laboratory approach made numerous positive comments in their final report summaries. This excerpt from a student paper summarizes the realizations as noted by many students in the class:

> "This project helped give a better understanding of Total Quality Management and Continuous Quality Improvement. It brought unity, improved group communication and the ability to work well with others to achieve a common goal or objective. We were able to focus on a customer and to continuously improve our process. We also realized how difficult it was to make a perfect process and how there always seemed to be room for improvement." [9]

While the majority of students felt the EGR 334 laboratory was a positive learning experience, a significant number of the students in the class did not. This lab required that the students communicate with each other and be dependent upon each other in ways not found in typical engineering laboratories. The students had to communicate not only within their own team but to provide feedback to other teams. In order to continuously improve their labs, the developing team was dependent on the performing teams to take their lab seriously and provide good constructive criticism. Several students appeared to be uncomfortable with this type of dependency. It is hoped that as these students move into team oriented, customer focused industry environments upon graduation, that they will come to better appreciate the experience of the EGR 334 laboratory.

References

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