Session 2348

Project Based Instruction in Manufacturing: A New Approach

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This paper will describe the instruction methodology of an undergraduate course in manufacturing which was restructured to use small “hands-on” projects as a basis instruction. the course was previously taught using a methodology of sequentially presented lecture material. the revised course divides the class into teams of student and has each team completely analyze an entire product by dissecting the product into its various component parts. An engineering report is written by each student team and submitted for evaluation of each project.

1. Introduction

Traditional manufacturing technology courses have typically been presented in a lecture format by presenting material in a sequential manner by moving from topic to topic. However, this system is not the way most students that major in engineering and technology best learn (see NSF (4)). In addition, the types of positions these students will be assuming in industry demand that students be able to communicate ideas, work in teams, understand technology, and use integrative thinking. Traditional courses do not emphasis these types of skills sought by employers. Typical teaching materials for traditional manufacturing engineering and technology courses are DeGarmo (2) and Koenig (7).

The problems of teaching using this type of material has been described in work by the NSF (4), Koen (6), and Ulrich & Eppinger (11). In addition, teaching manufacturing topics has been broadened to include such topics as engineering design considerations and quality issues. The new philosophy of teaching manufacturing has been described by Clark & Wheelright (1), Dixon & Poli (3), Ettie & Stoll (5), and Lindeck (8). This paper will explore some of these aspects in more detail and outline a different approach to dealing with some of issues outlined.

2. The Traditional Approach

Traditionally, manufacturing engineering and technology courses have been taught presenting materials in a sequential manner. these are numerous educational materials from which to select and most instructors were themselves taught in this fashion. the advantages of this approach are the ability to cover a large amount of material in a relative short period of time and to be sure that a comprehensive approach to coverage is possible. However, the limitations to this traditional approach are many. For example, this approach does not focus on products, which to a large degree is what manufacturing is about. It is left up to the student integrate the various pieces to see how they fit together. This approach does not focus on how students learn in terms of processing information or materials. this has been described in NSF (4), Koen (6), Susmer (10). In addition, many companies today have their technical personnel working in teams in a collaborative effort as described by Dixon (3), Ettie (5), Lindeck (8), and Ulrich (11).

This traditional teaching approach does not provide for teamwork or for the students to gain experience in working in teams with the inherent problems that this approach presents. Also, students do not develop their presentation and communication skills which are of great value in today’s workplace as described by an NSF report (4).

3. Revised Methodology For Teaching Manufacturing & Technology

The revised curriculum is based on developing direct ties to theory and using practice-based design as a methodology for moving students toward an understanding of manufacturing technology. In addition, students solve a series of small design problems activities to build skills that they will need later in the course. This is all done in the context of team-based activities. the class is divided into small teams of two or three students that undertake these projects and activities together for the entire semester. The team works together to analyze, solve, and write-up all the reports required to complete the project activities. this requires oral team reports for about half the projects which constitute part of the final grade. Table 1 provides a list of some of the types of projects undertaken.

Table 1

Student Projects Activities

1. Slide bar clamp
2. VCR cassette
3. Golf ball accessory holder
4. Electric can opener
5. Corded hand drill
6. Flashlight
7. Electric hand mixer
8. Bicycle
9. Small gas engine
10. Camera

Each of the projects involves some analysis, a design review, and in some cases, a patent search using the world wide web (WWW) to allow the students to explore the latest state of technology for the item of interest. In addition, one complete benchmarking exercise is done with one product type to allow the students to see the importance of quality as a design requirement. The last item is particularly importance since the entire process, rather than a series of separate activities. This also allows discussion of topics such as concurrent engineering, design for manufacturability, and design for assembly. These topics can be naturally brought in to the context of the problem being worked on by the students.

4. Student Assessment

On the first day of class, an assessment instrument is given to all students to all students to determine their prior experience working with this new approach. Usually, few students have ever been in a classroom setting with this approach. At the end of the semester, another assessment is done to determine how successful the semester has been for the students in terms of the overall learning experience and their personal technical development. Today, for three classes that have experienced this new approach, the results have been very positive. Virtually every student indicated that this was a far` superior instructional methodology than the usual lecture, homework, quiz, and test system that traditionally has been utilized.

5. Summary and Conclusions

This paper has described a different approach to teaching manufacturing engineering
utilizing small group projects as a vehicle to emphasize concepts such as design for assembly, design for manuacturability, concurrent engineering, and overall product quality.
This approach depends upon communication, teamwork, leadership, integrative thinking, cooperative learning, and many hands on activities for the students. These activities result
in written projects reports and presentations which form the basis of the grade assigned for the course. The results has been quite positive for the students that have taken the course in this new format.

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