

Enhancing Students' Problem-Solving Techniques Through a Special Project Course

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Abstract

The EET program at Eastern New Mexico University is a four-year program serving students coming from regional high schools, two-year community colleges, and two-year technical schools. The course Special Project is a senior level capstone course. Students are required to do two projects. In each project a marketable prototype of the design must be produced. Students enhance their knowledge of issues involved in the production of a design such as time estimation, components availability, the design difficulty, and the problem solving skills.

Introduction

Throughout their undergraduate curriculum, engineering technology students will plan, develop, and present semester-long projects in their field of engineering technology. Working on these projects, students gain knowledge and skills in project handling, technical writing, problem-solving skills, evaluation process, and oral presentation techniques. Many times the projects are not completed on time because of lack of estimating the difficulty of the design, or the time interval required to gather components and assemble the given design. Most problem solvers skip the step of estimating the difficulty of the problem that they are trying to solve, or if they do estimate it, they take that estimate lightly. The Estimate Approach¹ claims that by investing in developing a good estimate of the effort to solve the problem, the overall solution effort will be reduced and perhaps minimized.

In the book "Design Tools for Engineering Teams"¹, the following is given for problem-solving steps:

A team must share a common thought process for effectively finding solutions to problems. While there are many methods for solving problems, they all share four key principles:

1. The problem must be clearly defined, so people know what problem is being solved and what the successful solution of the problem will look like.
2. Merely "solving" symptoms must be avoided; everyone must focus on identifying and eliminating the underlying causes of the problems.
3. The chosen solutions must eliminate the problem and not cause additional problems in the future or in other places in the organization.
4. Once fixed, problems must stay fixed. The organization must track and measure solutions to problems.

There are multiple ways to break down the steps to solving a technical problem¹. In a simplistic approach one must:

- Identify the problem
- Define the problem
- Research the cause
- Explore solutions
- Act on a solution
- Observe the solution
- Evaluate the success of the solution

This builds a systematic approach to linking problem solving and critical thinking.

There are other ways also that a faculty can help students become problem solvers², and it is suggested from the literature and research that cooperative or small group learning:

- Increases students' learning and achievements through active participation
- Develops higher-level intellectual reasoning and problem-solving skills
- Develops positive attitudes towards others and the subject area
- Reduces students' isolation through teamwork.

This approach of small group learning is already implemented in most of the engineering and engineering technology courses.

Too often, the concept of problem solving skills is confused with the ability of students to solve problems. How a student approaches the problem, whether it is a calculus assignment or a lab experiment, is more important than just finding the correct solution. Understanding these skills can aid the student in a variety of other courses³. The approach that is chosen to solve a problem and produce a reasonable design that satisfies a set of specifications is more important than producing a solution. Many times students attend laboratory, conduct the given experiments without understanding the contents of the experiments, or the objective associated with each experiment⁴.

Special Project Course

A major component of this course requires learners to plan, develop, and present two semester-long projects in their field of engineering technology on a subject of their choice which demonstrates knowledge and skills in project handling, technical writing, problem-solving and evaluation processes, and oral presentation techniques. The course enables students to: (1) complete two projects based on their field of interest, (2) prepare an effective written technical report, (3) plan and produce presentation materials which most effectively communicate the intended message for their technical oral presentation, and (4) apply concepts and practices of their field of experience to develop and effectively present their projects to colleagues and faculty.

Evaluation Criteria

Instructional methods include class discussion, student selected semester projects, written technical reports, and oral presentations of student work. Evaluation is accomplished in three primary stages. In the first stage, students are required to select a project topic of choice in a technical area related to their respective course of study. Creativity and imaginative thought in selecting a topic of interest are encouraged and expected in this stage. After selecting a project topic, students must plan, design and produce a formal written proposal.

In the second and final stages of evaluation, students must complete written reports that fully describe the project as it developed and reached completion. Reports are evaluated differently in the progress and final stages than the proposal stage. However, the reports include information from the initial proposal, progress made or status of the project, time line for completion, and cost estimate or analysis.

The Multi-Stage Approach

In the Special Project course the goal is to change the approach of designing a project. The new approach takes advantage of breaking the task of designing into a three-stage process and incorporates a step-by-step approach to complete the given design. When a student finishes with the last stage the design is complete. In the proposal stage, students are required to have paper copies of their designs and are asked to identify all of the components for the proposed design and overall characteristics of the project. Also, the availability of the components, the cost, estimated time required, and the technical knowledge of an individual student about the proposed project are discussed. In the progress stage, students will give a presentation about the status of their projects, technical problems, and troubleshooting approaches that they have chosen. At this time, every student must have a working circuit for his or her project. Students who have technical problems and must do troubleshooting are required to consult with the course instructor about the chosen approach for troubleshooting. In the final stage, a prototype of the proposed design must be produced in an appropriate case for marketing purposes.

Summary

Offering a special project course for electronics engineering technology programs provides EET students with the opportunity to develop and discuss project topics related to different aspects of computer hardware and software. This type of course also provides a means for student academic achievement. In a special project course, requiring students to do multiple projects will enable students to learn from their mistakes. The most common mistakes are time estimation and factors related to the troubleshooting of the project. Generally, project completion has a higher rate of success for the second project than the first one. Furthermore, for the second project the oral presentations and technical reports are presented more professionally.

Bibliography

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