Train the Trainer Video for Problem Solving Using Project Teams

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Abstract

Students from Engineering and Engineering Technology Programs should be able to work together as members of Project Teams to find solutions to technical problems. The objective of this session is to show sections of a professionally produced “Train the Trainer” videotape using students from Electrical and Mechanical Engineering Technology Programs working together on project teams to solve technical problems. This video will show the teaching methodology for collaborative learning including: writing specifications, brainstorming, solution evaluation, sketching, and testing of solutions. Students worked together as members of project teams to find solutions to an actual electromechanical design problem using a hematology analyzer from industry. This videotape of student teams is edited and PowerPoint slides are inserted outlining the step by step procedure; students also write papers for this project. As a Senior Project Engineer with 14 years experience in industry managing project teams consisting of other Engineers and Technicians, finding new Engineers and Technicians to hire with project team training was important. Also under the ABET guidelines, teaching collaborative problem solving is recommended. This method can be used in any number of technology courses and will help the student prepare for problem solving and working in a team environment.

Attendees willing to use this video and participate in a research survey will be given a free copy of the video.

I. Introduction

The following is a method of problem solving used by project teams in industry[1]. It has been tailored for use in courses taught in Engineering and Engineering Technology. This example was used in an introductory course in Engineering Technology and was completed in about two hours. These methods could be expanded and applied to projects of various lengths of time in other courses, including a capstone design project.

The project consists of the class dividing into project teams with three or four students on each team[2]. For each step comprising the method, a different person shall be responsible for taking notes that will then be distributed to other team members. Each group will submit only one copy of each completed step; the group will decide the division of these tasks. Each student will then be asked to combine the tasks into a report and provide an individual summary page. The components will be as follows:

II. General Format

Steps	Format	Student Assignment
Introduction Technical Explanation	Time: 45 min Presenter: The Instructor Assignment Explanation Props: Hematology Instrument Hematology Tube Transparencies: Optics Diagram	One student from each group will submit written explanation of the problem to group members.
Part #1 Create Design Specifications	Time: 15 min Students ask questions to generate specs. Resulting specs listed on chalkboard.	One student from each group will submit written specs to team members.
Part #2 Brainstorming Session	Time: 15 min Moderated by Instructor. List generated by students placed on chalkboard.	One student from each group will submit brainstorming list to team members.
Part #3 Select Three Best Possible Solutions	Time: 15 min Students suggest criteria for pro-con evaluation. Students select two or three best items from Part #2 based on criteria.	One student from each group will submit pro-con evaluation to team members.
Part #4 Rough Sketches	Time: 15-min Students create rough sketches of solutions from Part #3. They work as individuals and then in groups.	Students submit design sketches.
Part #5 Testing of Solution	Time: 15 min Students suggest ways to test solution. List generated on chalkboard.	One student from each group will submit list of ways to solution to team members.
Conclusion	Final explanations of what students are to hand in.	Individual report of combined tasks and handouts with individual summary cover page.

III. Give a Technical Explanation

An operational explanation of a sample hematology analyzer[3] is provided and a particular technical problem is presented.

> For this product, blood is collected from the vein and placed in a hollow tube about three inches in length and 1/8 inch in diameter. The tube is then centrifuged at high speed and settles in layers according to the density of the different components in the blood. These components consist of red blood cells, white blood cells, platelets, and plasma. The glass tube is coated with special chemicals to accent the color of the different components of the blood, as shown in Figure 1. This tube is then placed in an instrument that scans each tube eight times with a laser beam to measure the band lengths and then calculate the value of each of these components in the blood. The objective of the team assignment is for the students to come up with a mechanism for holding this glass tube in place and rotating the tube eight times so the beam can scan the tube each time.

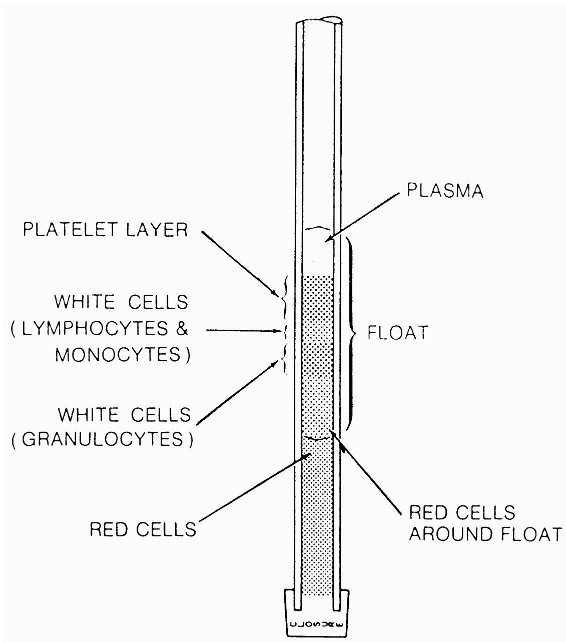

Figure 1 - Centrifuged Separated Layers

IV. Determine the Nature of the Problem and Create Specifications *(Part 1).*

The team then asks several questions in order to help them compile a list of specifications needed to meet the requirements for the given problem.

A sample list of specifications generated by student questions is:

Tube Holder / Rotator Specifications

Tube Rotation Motor

1. Tube is to be scanned every 45 degrees +/- 5 degrees for a total of eight scans per tube.
2. All eight of the scans would need to be completed within 16 seconds, with the tube being held still for a total time period of one second during each of the eight scans.

Tube Holding Device

1. Must be able to hold a three-inch long glass tube with a rubber stopper on one end.
2. The maximum allowable obstruction of the glass tube by the holding device is $1/8^{th}$ of an inch on each end allowing a length of 2 ¾ of an inch to be scanned.
3. The area between the tube and the lasers optical path must be free of any and all obstructions.
4. The tube must be easy to insert and remove from the instrument without breakage.
5. All tubes have the same dimensions within .001 inches.
6. Tube is allowed to move 0.05 inch along the axis between each scan. Characteristics of the tube will allow the software to align each scan.

V. Brainstorm to Compile a List of Possible Solutions [4](Part 2).

A list of ideas created by the team are placed on a chalkboard using the following guidelines:

1. No judgment is passed on any particular idea at this time.
2. Provide as many ideas as possible, even though some of them appear unrealistic.
3. Use a given idea to spark others.
4. Suggest things that actually exist that could be adapted to solve the problem.

Brainstorming Results

Tube Holding Device

Slots	Gravity	Tape
Glue	Vacuum	Wheels

Spring Loaded	Rollers	Velcro
Rotisserie	Clamps	Clips
Blood Magnet	Suction	Bands
Static	Fingers	

Note: If this were an actual problem in industry, or a class project, the team would be given time to perform additional research on the items on the list and time to find additional items to add.

VI. Select Three Best Possible Solutions (Part 3).

The team selects the criteria for judging the best possible solutions, then the team evaluates and selects three of the solutions produced in the brainstorming session.

THREE BEST POSSIBLE SOLUTIONS
(Pro-Con Evaluation)

Tube Holding Device

		cost	size	availability	life	meet specs
First Choice:	Spring loaded	ok	ok	ok	ok	ok
Second Choice:	Rollers	ok	ok	ok	?	?
Third Choice:	Clamps	ok	?	ok	?	ok

These items could be weighted if a more thorough analysis was required.

Student Comment - "During the pro-con evaluation of the tube holding device we concluded that the spring-loaded device would easily meet all of our needs and also would be easy to manufacture in-house. We had some doubts as to whether the rollers would meet our limited obstruction requirements and also felt that clamps could not be sized small enough to fit our design or meet life requirements."

VII. Produce Rough Sketches (Part4)
A rough sketch completed in class of each selected solution is produced and are shown in Figure 2.

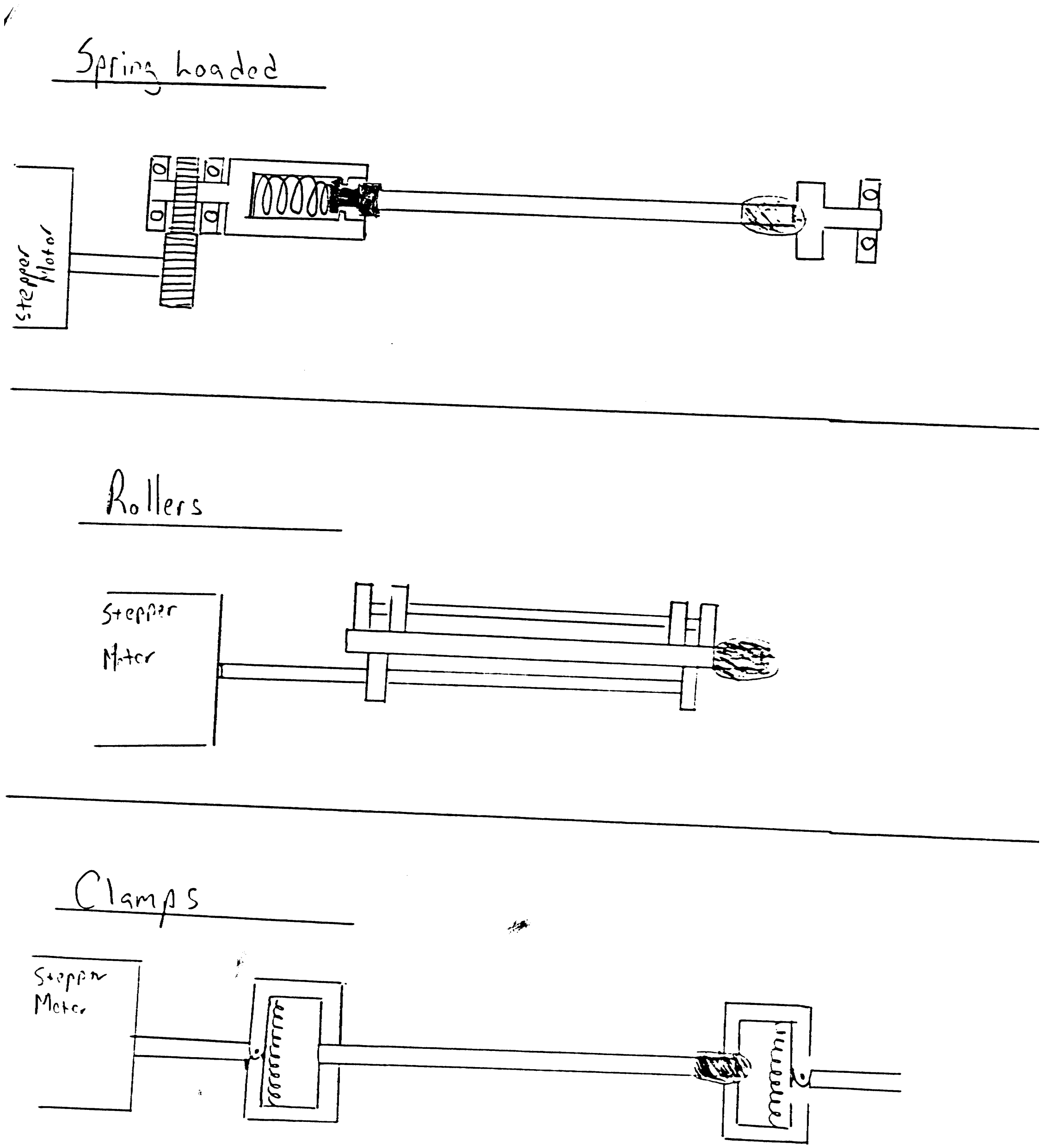

Figure 2 - Copy of Student Rough Sketches

VIII. Solution Testing (Part 5).

A list of possible ways to conduct tests on each solution is generated.

<u>TESTING THE DESIGN</u>

Some of the possible methods to test the design include the following:

1. Rotate the tube and check to see if it scans every 45 degrees. After eight scans, the tube should be back at its starting point.
2. Scan empty tube with no markings to verify no obstructions.
3. Have many people insert a large number of tubes in the instrument to test ease of use and no breakage.

Conclusion

As a Senior Project Engineer with 14 years experience in industry managing project teams consisting of other Engineers and Technicians, finding new Engineers and Technicians to hire with project team experience was important. Historically, solutions produced by student teams have been quite similar to those of actual industrial project teams. Students will write papers based on the team project, which could be reviewed or presented to the local industrial advisory board. If this was used in a design course, students could have parts made in order to build and test their designs.

Bibliography

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Michael Marcus is an Assistant Professor of Electrical Engineering Technology at Pennsylvania State University York Campus. He received an Associate Degree in Electrical Engineering Technology and a Bachelor of Science Degree in Electrical Engineering from Pennsylvania State University. In addition, he holds a M.S. degree in Electrical Engineering from Fairleigh Dickinson University in N.J. While in industry, he was a senior project engineer and managed instrumentation project teams consisting of other engineers and technicians.