A Cooperative Learning Approach in Project Management

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A problem-based cooperative learning approach is described, focusing on a project management course taught to U.S. Army officers at Fort Leonard Wood. The utilization of modern tools such as the Web and computer-based instruction and assessment is highlighted.

Engineering and Education

New trends in industry and economy are changing the face of engineering education. Organizations are forming joint development teams that collaborate for the life of a project and then disperse. Quick response has become a major component of success in business and could be achieved by having companies join forces together and work in a virtual organization environment. To translate this to engineering education practice means to emulate the fast-track project environment, where group members are expected to operate as a highly effective team and deliver quality products on time and within a tight budget.

Providing such an environment for students to work in has been the driving force behind designing the project management course described in this paper.

The product-based-learning approach used in the project management course has been praised in many publications (see references 1 to 4). According to Professor Leifer of Stanford University, "Learning is best done by creating something, a product, that embodies our knowledge. This is product-based-learning". He goes on noting that "PBL is defined as problem oriented, project organized learning activity that produces a product for an outsider". [5]

A background of the degree program within which this course is taught will first be provided. Then the course structure and organization will be described.

Project Management Course at Fort Leonard Wood

The University of Missouri-Rolla (UMR) is one of the four campuses of the University of Missouri system. The MS degree program in Engineering Management is offered on the Rolla campus and as outreach programs at the UMR Engineering Education Center in St. Louis, Fort Leonard Wood, Columbia, industry and government installations in St. Louis, as well as to the National Technological University (NTU). More than 2,200 students have earned Master of Science in Engineering Management degrees from UMR.

A cooperative Master of Science program for U.S. Army officers is offered in conjunction with their Engineer Officer Advanced Course at Fort Leonard Wood. Officers enroll with UMR and take UMR courses while completing their Engineer Officer Advanced Course (EOAC). They then remain at Fort Wood for an additional 16 weeks of full-time UMR studies in UMR courses taught at the U.S. Army Engineer School. One of the keys to the program's success lies in the cooperative awarding of credit by both UMR and the U.S. Army Engineer School for engineering classes taken by the officers in their EOAC.

The Project Management course, EMgt 361, was taught as part of this program. The students had had prior instruction in project management network analysis and scheduling, but were not introduced formally to the management and planning issues involved. With a course in Project Management already completed as part of the Army training, and having been exposed to project management on the job, a traditional project management teaching approach was believed inappropriate. Instead, a guided product-based/case studies-based approach was devised.

A week prior to the first class session, assignments were posted on the class Web site. A partial view of the class Web page is shown in Figure 1.

Assignment to Be Completed BEFORE October 7, 1997:
1. Read Chapters 1 to 4 of the reference "A Guide to the Project Management Body of Knowledge".
2. Download the following modules:
   - **Overview of Project Management:** Supplementary module to assist in learning the basics of project management. Includes self-testing questions. Written in Toolbook Instructor II. Requires Windows and a 1024x768-display resolution.
   - **Project Life Cycle Case Study:** a description of how the Missouri Department of Transportation plans and implements projects. Written in Toolbook Instructor II. Requires Windows and a 1024x768-display resolution.
   - Download **Overview of Project Management** AND **Project Life Cycle Case Study** AND **the runtime version of Toolbook**. File name: pmcbtv3.zip, size: 3.1MB.
1. Unzip the downloaded file. Click here to download a copy of pkunzip.exe
2. Install the software by running "setup.exe"
3. Run and study the overview module (filename: intov3.exe)
4. Answer the quiz questions (3 sets of questions)

Figure 1. Sample Links Extracted from Class Web Site

Instead of relying on a traditional textbook for the class, the students were asked to access a reference manual on the Web page of the Project Management Institute (http://www.pmi.org/) titled "A guide to the Project Management Body of Knowledge". This manual is posted in a format that can be viewed with Acrobat Reader.

As shown in Figure 1, the students were asked to review the first 4 chapters of the textbook prior to the start-up of the course. The students were also asked to download two computer-based modules on project management from the class web site and review them prior to the class start-up date.

Computer-based instruction is used because of its effectiveness in combining the various learning styles of students in one module. Numerous articles on this subject have been published. (See references 6, 7, and 8)

One module, "Overview of Project Management" [9], as partially depicted in Figure 2a, provides supplementary material to assist in learning the basics of project management. It includes self-testing questions, written in ToolBook Instructor II, and is based on 2 popular textbooks on Project Management, one by Kerzner, [10] and the other by Meredith [11].

The second module, "Project Life Cycle Case Study" (see Figure 2b), is a description of how the Missouri Department of Transportation (MODOT) plans and implements projects. It is also written in ToolBook Instructor II. When the class structure was first conceived, this module was supposed to provide the basis for the class project, that is, to analyze the way MODOT plans and manages projects and to recommend improvements to this process. Once the class started, however, the students wanted to focus on a topic that would be of better use to them as Army officers, and thus the topic of the class project changed.
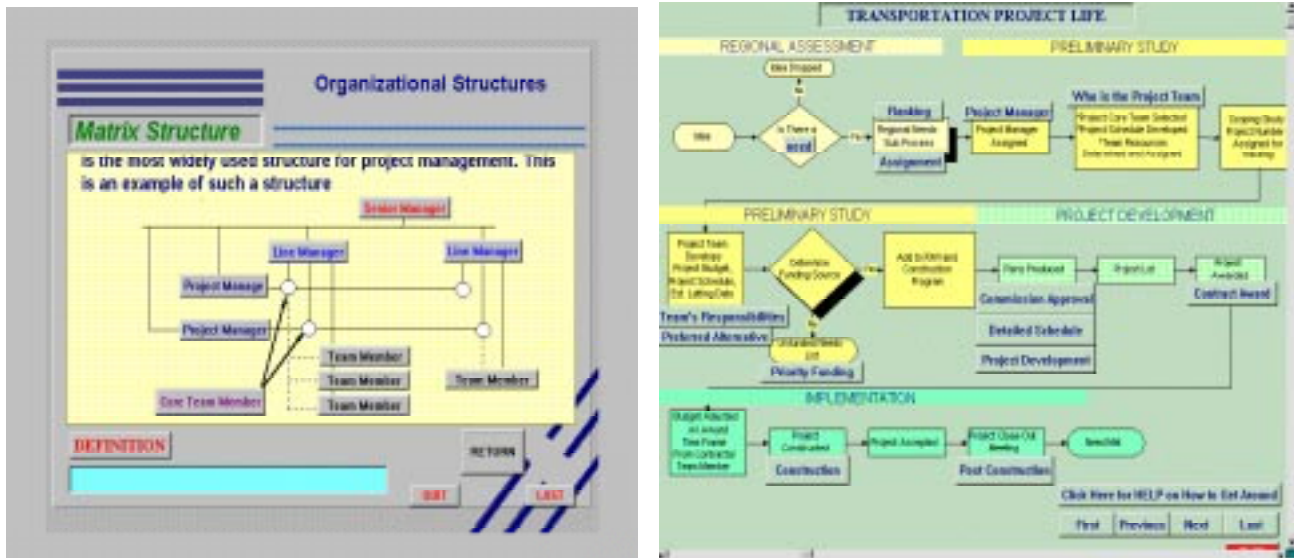
Figure 2. a) Screen for Overview Module   b) Screen from Case Study Module

The class chose the following project goal: to write a how-to manual that can assist Army project managers in the development of a project management plan for a typical Army construction project.

 The class was divided into groups or functional teams, each focusing on a phase of the project life cycle, namely, initiation, planning, execution, controlling, and closing. One group acted as the Project Office team responsible for project integration. Every group was responsible for devising a how-to manual for its focus area and informing the rest of the class on the importance of this area and the issues involved. The groups were also responsible to work with the Project Office and other teams to integrate their work in the final manual. Figure 4 shows the project organizational chart.

As shown in Table 1, the class met during 4 weekly sessions, each session lasting four hours. The students also presented weekly lectures, with guidance from the instructor, covering the content of the PMI textbook. Topics such as Project Time Management, Project Quality Management, etc.... were thus discussed, with a continuous focus on how they apply to the Army and the class project. Time was allocated for the project office team to address the issues related to integration of the individual group work and to logistics.

WEEK	TOPICS	CHAPTERS*
1	Introduction, The Project Management Context, Project Management processes, Project Integration Management Introduction to Microsoft Project	1 , 2, 3, 4
2	Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management	5, 6, 7, 8, Case 1 due
3	Project Human Resource Management, Project Communication Management, Project Risk Management, Project Procurement Management	9, 10 11, 12 Case 2 due
4	Project Plan Presentation. Review and Conclusion Final Exam	

* "A Guide to the Project Management Body of Knowledge", Project Management Institute

Table 1. Class Schedule

The lecture material was supplemented by 2 comprehensive case studies discussing the issues involved in developing project plans and in managing projects.

The final product was a comprehensive manual, full of flow charts and checklists. The content was detailed, sometimes with conflicting information and overlap. Figure 4 presents the table of contents of the final manual and Figure 5 sample flow charts included in the report.

<table>
<tr><td colspan="2">T a b l e   o f   C o n t e n t s</td></tr>
<tr><td>Page</td><td>Subject</td></tr>
<tr><td>2</td><td>Executive Summary</td></tr>
<tr><td>4</td><td>Historical Background</td></tr>
<tr><td>5</td><td>Initiating Process</td></tr>
<tr><td>8</td><td>Planning Process (Core Process)</td></tr>
<tr><td>31</td><td>Planning Process (Facilitating Process)</td></tr>
<tr><td>35</td><td>Executing Process</td></tr>
<tr><td>54</td><td>Controlling Process</td></tr>
<tr><td>57</td><td>Closing Process</td></tr>
<tr><td>58</td><td>Appendix A (Project Team Members)</td></tr>
<tr><td>59</td><td>Appendix B (Planning the Construction Plan - IPRs)</td></tr>
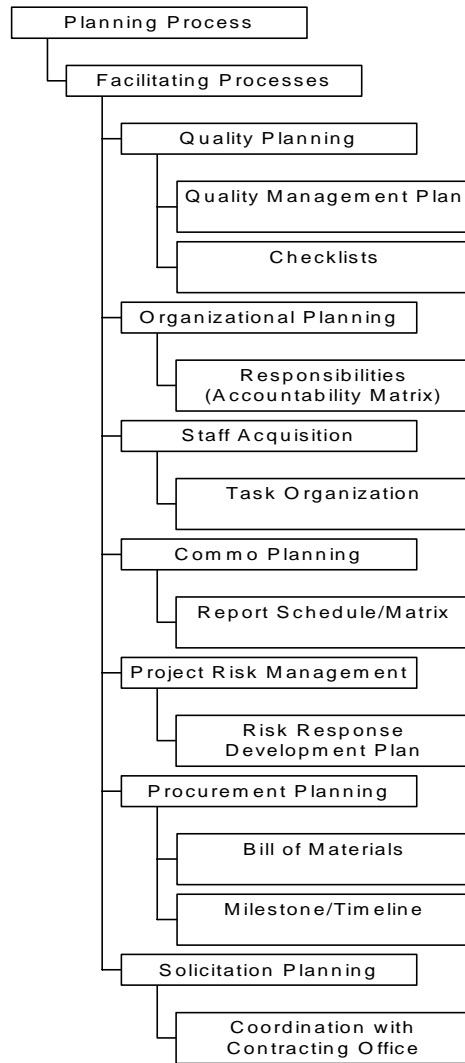</table>

Figure 4. Table of Contents of the Final Manual

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┌──────────────────────────┐
│     Planning Process     │
└──────────────────────────┘
     └┌──────────────────────────┐
      │   Facilitating Processes │
      └──────────────────────────┘
          └┌──────────────────────────┐
           │      Quality Planning    │
           └──────────────────────────┘
               └┌──────────────────────────┐
                │  Quality Management Plan │
                └──────────────────────────┘
                ┌──────────────────────────┐
                │        Checklists        │
                └──────────────────────────┘
          ┌──────────────────────────┐
          │  Organizational Planning │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │      Responsibilities    │
                │   (Accountability Matrix)│
                └──────────────────────────┘
          ┌──────────────────────────┐
          │     Staff Acquisition    │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │     Task Organization    │
                └──────────────────────────┘
          ┌──────────────────────────┐
          │      Commo Planning      │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │   Report Schedule/Matrix │
                └──────────────────────────┘
          ┌──────────────────────────┐
          │ Project Risk Management  │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │      Risk Response       │
                │   Development Plan       │
                └──────────────────────────┘
          ┌──────────────────────────┐
          │   Procurement Planning   │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │     Bill of Materials    │
                └──────────────────────────┘
                ┌──────────────────────────┐
                │    Milestone/Timeline    │
                └──────────────────────────┘
          ┌──────────────────────────┐
          │   Solicitation Planning  │
          └──────────────────────────┘
               └┌──────────────────────────┐
                │    Coordination with     │
                │    Contracting Office    │
                └──────────────────────────┘
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Figure 5.   Sample Flow Charts Extracted from the
Final Manual

Analysis

The class as a whole agreed that this manual should be considered a first draft, to be reviewed by subsequent classes for refinement. The students' feedback was encouraging and challenging. The hands-on approach was praised, including the in-class group presentations. Some students recommended that the structure and goals of the course be described more clearly at the beginning of the course. Some type of traditional textbook was also recommended as a supplemental resource.

From the instructor's point of view, about 90% of the goals set at the beginning of the class were achieved. The students experienced many aspects of project management encountered in work environments. The class worked as a team, experienced the behavioral, organizational, and

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technical issues involved in project management, and delivered a better than average final product.

Current Work

The same approach is currently being repeated in a subsequent class with some modifications. The class syllabus is shown in Figure 6. The class is given the final product of the previous class and is asked to refine it. Every session, the instructor presents the background theory in a lecture format. Groups then present specific reading material and cases as assigned. Two groups then lead the discussion on the class project, collecting the class opinion, and presenting their recommendations.

A committee from the U.S. Army construction and training divisions has been asked to review the final product.

Winter 1998 Schedule (see Notes 1, 2, and 3 below)			
WEEK OF	LECTURE	ASSIGNMENT	PROJECT
March 16	Ch1- Projects in Contemporary Organizations Ref. Ch 1, 2, 3 Ch3- The Project Manager Ref. Ch 2 , 9 Ch4- Project Organization Ref. Ch 2 , 9 Ch5- Project Planning Ref. Sections 4.1,5.2, 5.3 8.1 9.1, 9.2 10.1 11.1, 11.2, 11.3 12.1, 12.2	Page 28: Making Project Management Work Page 146: What It Takes to be a Good Manager Page 187: Matrix Management **Read before class:** **Chapters 1, 3, 4, 5 (textbook)** **Chapters 1 to 5 (PMI Guide)** Final Report of Previous Class	G10 - Project initiation
March 23	Ch7- Budgeting and Cost Estimation Ref. Sections 7.1, 7.2, 7.3 Ch8- Scheduling Ref. Sections 6.1, 6.2, 6.3, 6.4 Problems: 1,2,3,4,5 Ch9- Resource Allocation	G1 - Page 240: Balancing Strategy and Tactics in Project Implementation G2 - Page 278: Methods of Resolving Interpersonal Conflict G3 - Case : A Project Management and Control System for Capital Projects	G10 - Project Planning Project Plan
March 30	Ch10- Monitoring and Information Systems Ref. Sections 4.2 5.4 8.2 9.3 10.2 12.3, 12.4, 12.5 Ch11- Project Control Ref. Sections 4.3 5.5 6.5 7.4 8.3 10.3, 10.4 11.4 12.6 Ch13- Project Termination	G4 - Page 382: On Time Project Completion- Managing the critical Path G5 - Page 604: The Project Management Audit, Its Role and Conduct G6 - Case: The Sharon Construction Corporation	G11 - Project Execution G11 - Project Control and Termination
April 6		G7 - Page 556: Criteria for Controlling Projects According to Plan G8 - Page 654: Knowing When to Pull the Plug G9 - Case: page 487: Riverview Childrens Hospital	G10- Presentation G11- Presentation Final

Note 1. Chapters are from Jack Meredith and Samuel Mantel; "Project Management: A Managerial Approach, Third Edition, Wiley.
Note 2. Reference chapters and sections are from "A Guide to the Project Management Body of Knowledge", Project Management Institute (http://www.pmi.org/).
Note 3. G1, G2... refer to Student Group 1, Student Group 2 ...who are in charge of presenting the adjoining case or reading assignment.

Figure 6. Syllabus of Current Project Management Class at Fort Leonard

Conclusion

Shying away from traditional lectures and focusing on a product as a class goal proved to be an excellent way of teaching professionals who were self-motivated, mature, and eager to learn. This approach will be repeated whenever possible.

The use of innovative tools, such as cooperative learning, the World Wide Web and multimedia courseware has proven to be very effective and natural. These tools will be fine-tuned and used again in future courses.

References

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5- Forthcoming in Kluwer, "Evaluating Corporate Training: Models and Issues", posted on the National Technological University's Web site, URL Address: http://www.ntu.edu/, Nov. 97.

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7- Neu, E. C., 'Computers and Overheads vs. Multimedia in the Classroom'
1996 ASEE Annual Conference & Exposition, June, 1996, Washington D. C.

8- The Synthesis strategic Plan. WWW Synthesis Coalition Home Page: http://synthesis.org

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10- Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling.", 5th edition, Van Nostrand Reinhold Publishing Co.

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Biographical Information

Dr. Najm is an adjunct associate professor at the Engineering Management Department of the University of Missouri-Rolla. He teaches courses and conducts research in project management and enterprise-wide integration. He is also an affiliated faculty member at the Instructional Software Development Center where he is involved in the development of computer-based multimedia courseware.

Dr. Najm received his Bachelor of Science, Master of Engineering and Doctor of Engineering degrees in mechanical engineering from Texas A&M University. He developed, integrated and installed several software applications in CAD/CAM, management planning and control, robotics, apparel design, and computer-aided process planning. He also developed AutoCAD-based computer programs to analyze building cooling/heating loads. He provided technical assistance to a variety of companies, including the Missouri Department of Transportation, Rawlings Corporation, Missouri Enterprise, Mid-America Manufacturing Technology Center, and DemMaTec Foundation.