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## **AC 2012-4823: STRATEGIES FOR IMPROVING TECHNICAL COMMUNICATION EFFECTIVENESS SKILLS IN A MIDDLE EAST ENGINEERING PROGRAM**

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# Strategies for improving technical communication competency in a Middle East Engineering Program

## **Abstract**

An important ABET outcome is that engineering students should communicate effectively. Today engineers need be able to work and communicate in multicultural, international teams and be able to influence and cooperate with colleagues in discussion and negotiation. Communicating technical information effectively with others is critical and needs to be developed in academic technical subjects with students who study engineering.

In this paper the authors discuss technical and professional communication competencies taught at The Petroleum Institute, Abu Dhabi. Teaching effective technical communication is challenging in this context as most of the students are non-native English speakers. The paper will describe different communication courses that students have to go through in their freshman year, followed by sophomore engineering design courses and preparing students for a capstone design course. The goal of the communication faculty and freshmen engineering design faculty is to have the students develop skills in technical design and writing, and in effective communication. The paper will also discuss activities and strategies that are used in these technical communication courses. As a result of the various strategies used at the Petroleum Institute, the quality of writing in the final senior design projects have improved significantly.

## **Introduction**

Most universities in the US are multidisciplinary, presenting challenges in the technical communication curriculum<sup>[1]</sup>. Technical communication programs are addressing this issue by building partnerships with programs in mechanical engineering and industrial engineering as has been discussed by Wojahn, et al.<sup>[2]</sup> This paper describes and examines the technical and professional communication competency strategies taught at the Petroleum Institute (PI) of Abu Dhabi in the United Arab Emirates to prepare freshman and sophomore engineering students for their senior level college courses. The PI has an English medium curriculum and for a majority of its students English is a second or foreign language. A description of the communication courses that students experience in the first year will be presented, followed by the sophomore engineering design courses and preparing students for coursework in upper level engineering specializations. The goal of the communication and engineering design faculty is to have the students develop effective communication skills in technical writing and design, and to provide students with opportunities to refine these skills. We will also discuss technical communication activities and strategies that are used in the courses, assessing the same, and feedback mechanisms to improve effectiveness.

## **The Petroleum Institute**

The PI's objective is to provide world-class education in engineering and applied sciences to support and advance the petroleum and energy industries. The Institute strives to develop students as professionals and future leaders in their respective fields of expertise in the UAE and internationally. One of the critical skills to be learned by a graduating student is verbal, written and graphical communications competency in engineering practice and project management. The graduate should also have the corresponding skills to communicate with a range of audiences and contexts, and to employ information technologies effectively.

### **Curriculum background**

Currently the PI offers Bachelor degrees in Chemical, Electrical, Mechanical and Petroleum Engineering, and Petroleum Geosciences. The PI was created in 2001 with the goal of establishing itself as an international institution in tertiary engineering education and research in areas of significance to the oil and gas and the broader energy industries. Incoming PI students are admitted based on their TOEFL score and high school GPA. Most of the students go through a foundation program before they are enrolled as a freshmen student in PI. The foundation program is designed to help students develop knowledge, study skills, technical, analytical, and communication skills which are necessary to meet the PI's entrance requirements and assist them in their future studies at the Petroleum Institute. The foundation program at the PI is called as the Advanced University Placement program.

### **Course structure**

At the freshmen level, there are core courses that need to be completed irrespective of the student's major. The core courses are offered through the Arts and Science Program and some elective courses required for the engineering programs are also offered through Arts and Science. The six departments within the Arts and Science department include Mathematics, Physics, Chemistry, Humanities and Social Sciences, Communication, and General Studies. Students must take these required courses in a sequence.

The general studies department offers a sequence of two Freshmen design courses called STEPS, which stands for Strategies for Team-based Engineering Problem Solving. In STEPS courses students integrate what they are learning in science, mathematics and communications, couple it with teamwork and project management tools and build a working prototype of a useful machine. The requirement to start the STEPS courses is that they should complete the first course of Physics and two levels of communication class. After successful completion of the courses in Arts & Sciences, students enter one of the six engineering departments to do upper level courses and pursue a specialized engineering degree program. As stated earlier, one of the educational goals of the PI is that graduating students will be professionally competent in oral, written, and professional engineering communication skills.

### **Communication course description and objectives**

The PI 1st year communication courses are designed to meet the needs of engineers who are required to be effective and successful professionals. One of the pedagogical objectives is to produce articulate and autonomous learners who are able to use sophisticated thinking and communication skills. The communication department's approach is based on the belief that learners will best develop these skills through the acquisition and articulation of knowledge.<sup>[3]</sup> Therefore the communication courses focus on problem solving and collaborative learning in order to develop technical communication skills associated with:

- Oral and written communication
- Academic, scientific and technical observations
- Qualitative and quantitative analysis
- Professional interaction competencies
- Critical thinking

### **Strategies for improving technical communication skills**

Both of the freshman communication courses build into the curriculum a variety of strategies to develop and improve professional and technical communication skills. In the first course students investigate and design their own research study on topics relevant to their university and academic context. This is done in teams so that they need to use negotiation and collaboration skills in order to successfully complete the research project. They also examine case studies on relevant current events and educational topics. The results are useful to the students and the institute as they learn more about themselves and their own educational environment while developing their communication skills.

The second freshman communication course builds on skills learned in the first course. Students carry out a semester-long academic, educational or technical project that should be useful to themselves and/or the PI. Technical communication “skills are developed as students participate in seminars and work in teams to gather and share information, leading to extensive, full written reports and multimedia oral research presentations”.<sup>[3]</sup> The planning, negotiation and collaboration that develops during the teamwork and research activities are critical strategies set up to facilitate the improvement of student professional and technical communication skills.

Continual assessment of these skills and competencies is done through a variety of instruments, including:

- Weekly individual writing assignments
- Team source review descriptions (both written and oral)
- Team planning meeting minutes (written)
- Written and oral progress reports
- Recommendation report draft revisions (written)
- Final recommendation report (written)
- Oral Presentations

We also evaluate the effectiveness of these course deliverables by eliciting a variety of student feedback, and surveys / interviews from faculty who teach our students later in upper level courses.

Students also complete a department internal course evaluation, in addition to an institute-wide evaluation of the learning environment. Consistent feedback from both students and faculty have been exceptionally affirmative with most students stating that there has been substantial learning and increased competency in technical communication.

### **The STEPS Program**

Strategies for Team Based Engineering Problem Solving Program (STEPS) is PI's freshmen engineering program. There are two levels of STEPS courses, in the first level is more real life problems and in the second level of the course is a more theoretical approach with computer simulation and analysis. Both are core courses to be taken in succession.

The overall aim of the STEPS program is to introduce and expose students to the engineering design process and integrate a range of skills and competencies that will simulate project management and real-world design activities in a professional engineering environment.

This program requires teams of students to respond to client specifications by designing, managing and presenting technically feasible solutions to real-world problems. The program aims to facilitate good engineering practices with a strong focus on behavioral competencies and communication skills. Teamwork, organization, planning, research skills, and problem solving are essential for success. All students are actively engaged in teamwork and solving open-ended problems using methodical approaches and state-of-the-art design and communications tools.

During the semester, students also regularly present the results of their project work using oral, written and graphical communication skills. The progress and development of each team project and each student's contribution is closely monitored and evaluated by qualified engineering design experts and qualified English communication specialists for the purpose of providing helpful feedback and advice to improve project work, communication skills and presentation skills.

In addition to the skills improved from the communication courses, the students in the STEPS courses improve their skills in problem solving. The US Department of Labor describes engineering as the application of theory and principles of science and mathematics to research and develop economical solutions to the technical problems. Engineering has brought a lot of improvement and changes in society, the central most important is the problem solving and problem analysis, that in the physical environment is forcing the formulation of problems and interactive designs of solutions to the center of professional activity, and most of these activities are done by some mechanism of technical communication.

The process facilitating strategy skills by means of technical communication is also improved through the STEPS courses, some of the tools and strategies used are listed below:

- Knowledge of tools and strategies for project management – communicating to the various team members using MS projects to assign resources, and track the progress of the student project
- Graphical Communication – recorded communication by means of engineering drawing, engineering sketches to discuss ideas for the designs
- Students to work as professional teams and record of all the meeting minutes which is also a means of improving technical communication.

The assessment of these skills and competencies are done through a variety of instruments, including:

- Weekly journal assignments (written technical communication skills)
- Literature review (written technical communication skills)
- Team planning meeting minutes (written)
- Conceptual design report (written technical communication skills and graphical communication which includes sketches and computer generated models)
- Recommendation report draft revisions (written)
- Final report (written)
- Oral Presentations (Midterm review presentation , final presentation)
- Poster presentation (Oral communication, graphical communication)

Evidence of the success of this approach and the courses described above is in the faculty assessment that the quality of writing in the final senior design projects have improved significantly during the period of time that these techniques and strategies have been employed in the program.

## **Conclusion**

This article has depicted the technical and professional communication strategies taught at the Petroleum Institute, UAE to first and second year university level engineering students. It is critical that engineering students be proficient in communication competencies and have the corresponding skills to communicate with a range of audiences, colleagues and stakeholders. The core pedagogical objective of the series of courses in this program is to inculcate these skills and competencies to the students to prepare them for their upper level engineering specializations and bachelor degree programs. The sequenced coursework of the two communication courses and the two STEPS courses focus on making this happen. A variety of strategies and techniques are employed and continually assessed to provide the student with a range of opportunities and tools to develop and refine the communication skills necessary to become an effective and successful engineer in today's world.

## **References**

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