A Novel Approach to Designing Engineers

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The following describes a recently redesigned introductory engineering course *Orientation to Engineering* at Carleton University in Ottawa. We have opted to approach the task of presenting introductory engineering material to faculty-wide audience of approximately 800 first year engineering students. As we have *retooled* the course from an introduction to statistics, drafting, and professional rights and responsibilities, into a course that requires the student to confront problem solving and reporting in the context of *design.* As the context is design, we have adopted the perspective of designers. Our design task: to produce solid potential engineers. While we will not know the results of our experiment for several more years, initial feedback from students is encouraging. They appear to have developed strong software, and coping skills.

Like many contemporary universities, first year engineering students at Carleton University are required to take an introductory general engineering course. This is in part a response to the accreditation requirement that requires an introduction to the concept of professionalism and engineering professional practice in the early years of engineering programs. While there can be little argument that the concept of professionalism is important, there is generally time in such a course to offer a more comprehensive view of engineering practice, i.e. an *Introduction to Engineering* per se.

The key elements included in the Carleton offering may be broadly described as professionalism, measurements and managing measurement data, design: synthesis and analysis, and reporting. It is said that professional engineering design generally involves identifying a need and proposing one or more feasible solutions (synthesis), analyzing competing solutions for decision purposes (analysis) and then the decision must be reported (reporting). More often than not engineering measurements are needed either to define the problem or to support the analysis. Of course, the entire process must stand up to the highest standards of professionalism in every sense of the word.

It is our view that software tools can be identified to support each of the key elements suggested above. For example reporting is generally supported by word processing, spreadsheet and sketching software (e.g. Microsoft applications). Managing measured data is for the most part supported by spreadsheet software (e.g. Microsoft Excel data tools). Analysis is supported by a computer algebra software (e.g., Maple) on the one hand and linear algebra software (e.g., Matlab) on the other. Synthesis is supported by contemporary CAD software (e.g., AutoCAD, or IntelliCAD). Excel, Maple, and Matlab are also a very convenient programming tools for both synthesis and analysis.

Taken together, software applications to areas suggested above provide students with a powerful set of computer tools for the remainder of their programs and indeed for their first forays into professional practice, and beyond. It is the contention of these authors that software tools such as Microsoft Office (or Corel Suite, or similar), Matlab, Maple, etc., are becoming so widely used that they can almost be considered pervasive in contemporary engineering. Therefore, the reasons for including these software as *engineering tools* somewhere in the engineering curriculum are, more or less, compelling. If they are included in first year, students gain the advantage of being able to use them, at increasingly complex levels, throughout their careers as engineering students.

Additionally, we have started to rely on WebCT (web Classroom Tool), for all of our course administration: from dissemination of course outlines; supporting documentation for software use; practice problems and their solutions, the lectures (all prepared in Power Point). Moreover, class tests are delivered and corrected by WebCT. The idea being to enhance the notion of modern web-based concurrent engineering design and communication practices. The aim of using the internet is not distance learning as espoused in [2], rather real-time management of 800 students.

Apropos, we have changed the focus of this course from a static introduction to the engineering profession, to an active hands-on introduction to engineering practice through appropriate problem solving in the laboratory aided by instruction on the effective use of various software as engineering tools. The course material, as outlined in [1] is grouped into four parts: 1) The Engineering Profession; 2) Managing Engineering Data; 3) Manipulating Structured Data; 4) Engineering Design. Their assessment is based on six laboratories, two projects, and two laboratory tests.

These 800 first year engineering students take *Introduction to Engineering* in the Fall semester. They share one computer laboratory with 60 workstations in 14 laboratory sections, reserved for their use. A serendipitous byproduct is that the laboratory itself promotes a community atmosphere to which the students really seem to feel they belong.

The redesigned version of this course has been well received. Students generally appreciate the objectives and realize that the software applications, in particular, will be useful to them. Similarly faculty members generally support the direction this course has taken.

REFERENCES

[1] Hayes, M.J.D., Bibby, M.J., Turgeon, M., McTavish, S., *Introduction to Engineering*, Pearson Custom Publishing, Boston, MA, U.S.A..

[2] Palloff, R.M., Pratt, K., 2001, *Lessons from the Cyberspace Classroom: the Realaties of Online Teaching*, Jossey-Bass, San Francisco, U.S.A..

