Integration of Aspenplus (and other Computer Tools) into the Undergraduate Chemical Engineering Curriculum

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Summary

The development of the microprocessor has changed the way we approach undergraduate education. Our students can now be challenged with the solution of problems that are closer to "real" problems because of our ever expanding computing tool box. The implementation of these ideas is not without problems as we (and I am sure many others) have discovered. Effective use of a number of computing tools requires that students develop a more than surface familiarity with those programs. We, at UAH, are addressing this problem by integrating a number of computing tools throughout the curriculum.

At UAH, computing tools such as Fortran and Spreadsheeting have been integrated across the curriculum. What this means is that students in each chemical engineering course are expected to solve homework problems using each of these tools. During the past year, we started using Maple V a Computer Algebra System in many of our courses. Senior students were, till recently introduced to process simulation tools during the senior design courses. The combination of learning a fairly sophisticated program with the demands of learning process design and implementing some of these ideas for their design projects was, in most cases overwhelming. By the time students developed mastery over process simulation software tools, the semester usually drew to a close and the design projects were due for final presentation. We felt that prior experience with simulation tools would have been very beneficial.

UAH's Office of the Provost/Vice President for Academic Affairs initiated a Teaching MiniGrant program during the Spring of 1997. This call for proposals was designed to assist faculty members who wished to improve a course, some part of the curriculum or in some other way assist student learning in the university. The idea of developing course material to help Chemical Engineering students with Aspenplus seemed to be appropriate for support under the Teaching MiniGrant program.

My proposal was accepted for funding and I was released from teaching one course during the Fall 1997 Semester for developing course materials. The teaching grant allowed me to hire an undergraduate chemical engineering student who from the previous spring semester had developed some familiarity with Aspenplus.

My objective was to select example problems in Mass Balances, Thermodynamics, Reactor Design, Mass Transfer Operations and Chemical Engineering Design that will help teach some of the basics of process simulation in general and Aspenplus in particular to students. I deliberately chose example problems for which either a written solution was available or problems which were assigned previously and so students had solutions. I feel that this approach allows students to develop some confidence in the use of process simulation software.

Project Implementation

The first step in the process was the writing and debugging of problems using Aspenplus' Model Manager. Each critical step of the model creation process and the results from actual simulation runs were then captured as gif or jpeg images from Sun workstations. Detailed notes were then written to illustrate these figures in LaTeX and these notes were translated into HTML using LaTEX2HTML. LaTeX is a document preparation system, originally written by Leslie Lamport and consists of macros built on top of the typesetting package TeX written by Donald Knuth of Stanford University. TeX/LaTeX is available free for many CPU's and many operating systems and can be retrieved from any of the Comprehensive TeX Archive Network (CTAN) sites, http://www.dante.de (or ftp.dante.de) or http://www.tex.ac.uk (or ftp.tex.ac.uk). LaTEX2HTML is a PERL script originally written by Nikos Drakos of Leeds (U.K.) that translates LaTeX documents into HTML for viewing using browsers like Netscape Navigator. LaTEX2HTML can also be obtained from any of the CTAN sites. These notes were then placed on the Engineering Web server here at UAH and can be accessed at http://www.eb.uah.edu/che/courses/Aspenplus (for a discussion of this project) and http://www.eb.uah.edu/che/courses/AspExamples/ (for navigation through different UAH-course specific pages with Aspenplus examples). This Web page building exercise is by no means complete, but the teaching minigrant gave it an excellent jump-start.

The next step in implementing the ideas of the mini-grant involved tutorial sessions (2 hours each) for students in ChE 244 (Stoichiometry), ChE 344 (Chemical Engineering Thermodynamics), ChE 441 (Reactor Design) and ChE 443 (Mass Transfer Operations). During these sessions, students were shown how to access Aspenplus and create their own simulation by following the tutorial examples on the ChE WWW pages. On the Sun Workstations, they could effortlessly go back and forth between reading and studying the tutorial on the ChE Home page and actually creating their own simulation in Aspenplus.

Conclusions - What did we learn?

It is too early to tell if these short tutorial sessions had any real impact on student learning. We also do not have a way of knowing if this approach will help students when they take the senior design courses. We did learn however that 2 hours per class was simply too short a time for anything but a very superficial overview of process simulation tools. A fairly significant fraction of the short time we did have was spent on dealing with some issues related to the Unix operating system.

Increasing the number of hours of tutorial sessions for Aspenplus alone at junior and sophomore level classes is impractical for two reasons: a) it will take contact time way from regular classes where students are taught the fundamental concepts and b) the difficulty of running such tutorial sessions on top of other teaching responsibilities during regular semesters.

Our objectives are to help develop in students the discipline of critical thinking and the ability to solve problems. The computer can plays a very useful role in this process. Our students now graduate with a modicum of expertise in the use of a number of modern computer tools for solving chemical engineering problems, this project will help add steady state simulation programs to that mix.