

The International Journal of Engineering Education

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- J. E. (Tim) Holt** 496-501 The Status of Engineering in the Age of Technology: Part I. Politics of Practice
Historians of modern times characterise the world at the beginning of the 21st century as entering a new era, one principally defined by a constantly advancing technology. The place of the engineer in this new technological society, however, does not seem to be notable to the historical view. This paper argues that it is the changing base of industrialisation from production to consumption that has diminished the prestige and prominence of engineers; for the decision what to make to sell is not an engineering one. Engineering is now captive to managerial agenda driven by the market, and engineers exercise power only within that mandate. The paper proposes that, if the profession aspires to change this and to play an influential role in developments of this remarkable age, it must first acknowledge that technological action is now socially constructed. It then has to commit itself to rebuilding the foundations of engineering education on the central principles of human affairs as well as on its traditional attachment to the physical world. What is needed is nothing short of a new vision for engineering in the future, a radical shift in the culture of professional engineering.
- Steve Rothberg, Fiona Lamb and Andrew Wallace** 502-511 Computer Assisted Learning in Engineering Degree Programmes: A Survey at the End of the 20th Century
The findings of a 1999 survey of Computer Assisted Learning (CAL) materials in use in engineering degrees is described. The survey concentrated on the UK with a smaller exercise conducted in Australia, and explored packages used, modes of use, interactivity and student attitudes. The survey revealed widespread but not prevalent CAL material use amongst the academics surveyed, who appreciated the pedagogical benefits but were less convinced that the right material is already available. They prepare their own material as often as selecting an off-the-shelf package for use in the early years of degree programmes, especially for coursework and tutorials. Time-tabled use and the incentive brought by assessment appear important in maintaining positive attitudes amongst students. Comparing major English-speaking HE markets in the UK, Australia and US revealed how little material is implemented across borders, suggesting the availability of a wealth of materials yet to be exploited.
- Shigeo Hirose** 512-517 Creative Education at Tokyo Institute of Technology
Basic educational principles and detailed curriculum of creativity education that the author introduced in the Department of Mechanical and Aerospace Engineering of Tokyo Institute of Technology are discussed. The basic educational principle is to give students as much hands-on experience as possible, and challenge them with assignments to design original mechanical systems. The curriculum includes the following: a course focused on the hands-on exercise of taking many types of machines apart, a course for groups of students to design and manufacture a 'street performer robot' consisting of mechanical and electrical components using computer control, and a course to design and draft original machines that satisfy pre-assigned objectives.
- Stephen R. Yeomans and Andrej Atrens** 518-528 A Methodology for Discipline-Specific Curriculum Development
A methodology and framework for discipline-specific curriculum development in a local context is described. These activities, as part of the Thailand-Australia Science and Engineering Assistance Project, were in response to a needs analysis for curriculum assistance to a number of publicly-funded Thai universities in the engineering priority area of Materials Processing and Manufacturing. The paper outlines a strategy for the delivery of a centralised curriculum development workshop for academic staff, follow-up visits and local curriculum activities with participating universities, and the presentation of technical short courses as guidance for such activity in other settings and/or discipline areas. This paper is part of a process of documentation so that others can apply the developed methodology and framework for curriculum development. While the paper is a report on curriculum activities in a particular setting, it is written in a manner that allows application of the methodology to other settings. The reader is advised that each curriculum activity needs to adopt a methodology and strategy to fit the particular circumstances being considered. To assist in applying this approach elsewhere, a description of the various steps in the curriculum process, and typical responses to some of the more global issues, have been presented. Full details are available in the various TASEAP reports prepared by the authors. Specific detail has been omitted where this detail does not provide any information for generalized consumption.
- Mechanical Engineering*
- V. J. Box, P. R. Munroe, A. C. Crosky, M. J. Hoffman, P. Krauklis and R. A. J. Ford** 529-537 Increasing Student Involvement in Materials Engineering Service Subjects for Mechanical Engineers
The design and preparation of a series of interactive computer-based tutorials for first year mechanical engineering students allowed them to become actively involved in their learning as a means of overcoming the problems with large tutorial groups. The students were taking an introductory subject in materials engineering, and the tutorials led the students through a number of modules providing information, simulations and examples. The student response to these tutorials was overwhelmingly positive, although some negative responses suggested that some tutorials were too long. Some revision of these courses resulted in their length being reduced as a consequence.

A simple laboratory experiment is described, which allows the students to: (i) familiarize themselves with the basics of computer interfacing and data acquisition and (ii), examine the relationship between computer sampling rate, sensor resolution and extracting reliable information from the measured data. It is shown that often data are taken at a rate faster than the pulse train generated by the sensor. This means some adjacent data points can have the same value. Thus, the rate in which the data change, if determined based on these points, is zero even though it is actually not. Least-squares linear regression, using many points, is shown to potentially produce more meaningful information. The experiment has proven to be very effective in providing complementary practical understanding to senior mechanical engineering students enrolled in the 'Automatic Control' course. It will also be incorporated within a 'Mechatronics System Design' course, which is currently under development.

Manufacturing Engineering

D. J. Petty, S. J. Hooker and K. D. Barber 546–557 The Federal-Mogul Business Game: The Development and Application of an Educational Aid for Planning and Control

Manufacturing Planning and Control (MPC) systems have attracted great interest in recent years. Teaching of this subject however is challenging because of the difficulty of providing appropriate examples in an academic environment. This paper describes a business game developed by a leading automotive components company. The objective of the game is to illustrate the benefits of reducing complexity within manufacturing systems in simplifying planning and control. The paper describes the development process for the game and provides detailed playing instructions. Finally, the paper reviews the use of the game in both an industrial and an academic context.

C. W. Ziemian 558–568 A Systems Approach to Manufacturing as Implemented within a Mechanical Engineering Curriculum

Recent innovations implemented towards the goal of improved manufacturing education within a small mechanical engineering department are described. The paper discusses evolution of curricular and facility improvements, the program objectives, the constraints bounding the developments, and the effects of completed modifications. Initial efforts targeted the need to incorporate hands-on laboratory experiences within the introductory manufacturing processes course. Subsequent activities have involved curricular adjustments focused on the integration of design and manufacture, and on the associated use of geometric dimensioning and tolerancing practices. Most recent improvements include the development of an elective course in computer aided manufacturing, the impact of an evolving manufacturing research program, and the value of a partnership with the local Small Business Development Center.

Sheng-Jen ('Tony') Hsieh and Patricia Yee Hsieh 569–579 Intelligent Tutoring System Authoring Tool for Manufacturing Engineering Education

Intelligent tutoring systems (ITSs) have potential for making computer-based instruction more adaptive and interactive, but development in the area of manufacturing engineering has been rare. However, recent developments in the area of ITS authoring tools may make this technology more accessible. The objectives of this study were to: 1) evaluate the feasibility of faculty course development using an ITS authoring tool; and 2) evaluate the instructional effectiveness of the developed courseware. An ITS authoring tool called XAIDA was used to develop a tutorial on how to use a computer numerical control (CNC) machine. This paper summarizes the results of a preliminary evaluation conducted with 25 undergraduate manufacturing engineering students. The results suggest that instructional development in XAIDA is feasible and quick, and that students learned from and enjoyed the tutorial.

Information Technology

Brian L. F. Daku 580–587 A Self-Checking Interface For MATLAB-Based Interactive Exercises

Effective computer-based educational learning tools must engage the student with significant questions to deepen understanding of the subject. These tools should also provide immediate feedback to the student and, if necessary, direct the student into remedial work. This paper describes the construction of a self-checking interface that can be used to evaluate student answers to challenging questions in an interactive computer-based educational tool. This self-checking interface has been implemented using MATLAB. An example exercise, taken from a computer-based tutorial that uses this self-checking interface, demonstrates how the interface operates.

Chemical Engineering

Stephanie Farrell, Robert P. Hesketh, James A. Newell and C. Stewart Slater 588–592 Introducing Freshmen to Reverse Process Engineering and Design Through Investigation of the Brewing Process

Freshman engineering students at Rowan University are introduced to engineering design through a series of hands-on engineering and design projects. These design experiences in the first semester are incrementally progressive; their purpose is to lead the students into the second semester and a single, in-depth, reverse engineering project. Previous projects have included the dissection of several inexpensive commercial products such as coffeemakers, toothbrushes, water purifiers, and hairdryers. This paper describes our effort to introduce reverse engineering and design of a process into the course. The focal point is a laboratory project in which students investigate a process for the production of beer. After a brief introduction to the brewing process and a comparative technical evaluation of commercially available beers, the students set out in teams to perform a hands-on, reverse-engineering investigation of the fermentation process and home-brewing equipment. Next, each team plans a commercial venture involving the brewing process. The teams plan their ventures (which may range from a brewery or restaurant to a full-scale brewery and distribution network), and present their designs and a marketing plan to the other groups. The brewing process introduces freshman students to engineering fundamentals related to material balances and stoichiometry, fluid flow, heat and mass transfer, and biochemical reactions. This project, meets several educational objectives: to develop creative and critical thinking, to introduce design principles, to provide hands on experience, to develop teamwork and communication skills, and to stimulate enthusiasm for engineering.

Aziz M. Abu-Khalaf 593–599 Improving Thinking Skills in the Unit Operations Laboratory

A programme to develop and improve thinking skill in the Unit Operations Laboratory as related to other skills is presented. The programme is divided into three areas: having the right attitude, practicing thinking techniques and tools, and recognising and avoiding thinking errors. It also considers the role of the instructor and the assessment method, emphasises inquiry-oriented and reflective activities, and maintains continuous interaction and immediate feedback from the instructor. The paper includes practical examples on exploring knowledge and experience and on troubleshooting.