Developing an Undergraduate Industrial Technology, Engineering Technology and Engineering Majors in a Single Educational Environment.

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Abstract

This paper proposes an efficient design of an educational environment where the engineering and technology studies blend to offer the students a wide range of experience and knowledge. In addition, it provides the local communities and industry with integrated workforce that has a high diversity of engineering and technology skills. Also by offering majors in Engineering, Engineering Technology, and Industrial technology in a single educational environment, institutes offer a flexible and diverse environment that is of a great attraction to students due to the options it provides them, thus retaining a higher percentage of enrolment.

Introduction

There is an increasing trend among many of the higher education institutes to have an Industrial Technology (IT), Engineering Technology (ET), and engineering undergraduate majors offered in a single department, college, or across multiple colleges. This paper is intended to discuss a set of guidelines and strategies to enable efficient design, development, and implementation of these programs. These guidelines are intended to create a cooperative and integrated educational environment where these programs are operated.

A common mistake found in the designing of these programs; the curriculum sheet associated with each program is created by taking a subset from a larger number of courses that are being offered. The proposed design in this paper is based on developing an educational information model and a course structure layout for each program major prior choosing the courses. It is believed that following this approach, should result in a better program design.

Program Design

Undergraduate engineering and technology programs can be designed based on three main educational constituents [1, 2]. These are: Engineering Science, Engineering and Technology Applications, and Hands-on type of Experience. Figure 1 shows a pie chart that could be used as an information model to determine the size of each constituent. For example, in an Engineering program the amount of science should represent the biggest sector of the pie, while in an industrial technology program it is the hands-on.

To further explain this concept; to teach a Strength of Material course in the three programs. In the Engineering program, the course structure and outline should reflect a science based approach. This means that the fundamental concepts based on differential equations and integration are used to develop the formulas. The focus will be on how to drive these formulas and using them to solve symbolic and layout problems. Real world problem are rarely used. In an Engineering Technology program, the course structure and layout should reflect on how to use these formulas to solve real world application. While In an industrial Technology, the course structure and layout will use top-down approach rather than a bottom up approach compared with the previous cases. A top down approach is an approach where the course instructor starts with the real life problems and further breaks down the problem into smaller sub problems. With the help of simplified formulas; students will be able to prove safe the design.

No-matter what course in which program; a successful course should include the three educational constituents (Figure 1). Figure 2 shows the extend information model that could be used for the three programs. The difference will be the percentage of each constituents (depends whether the course is offered in, Engineering, Technology, or Industrial Technology Program).

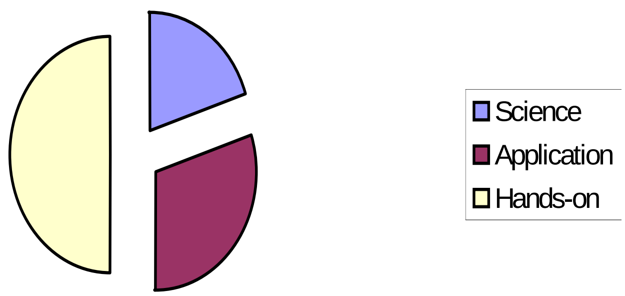


Fig. 1 Information Model for a Generalized Technical Program

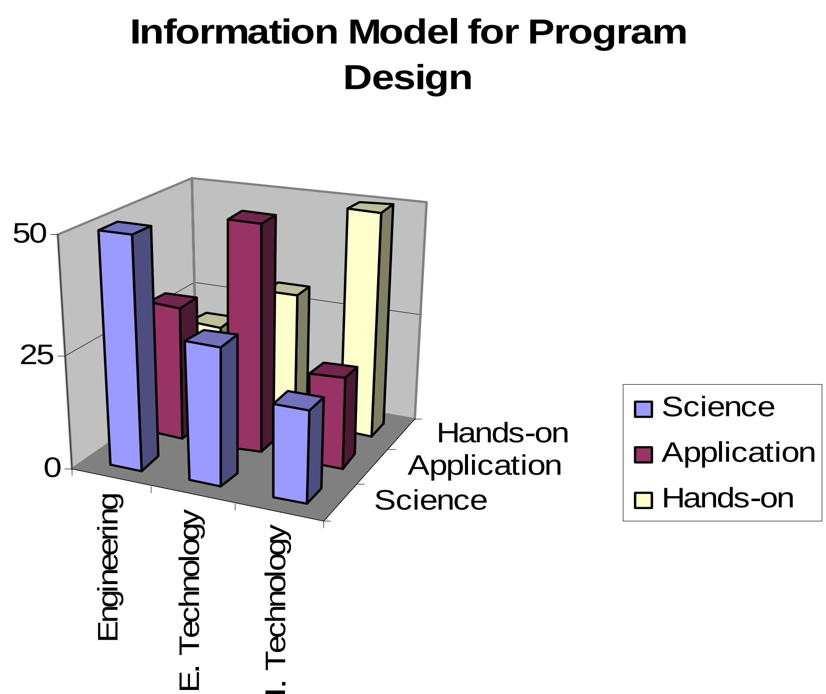


Fig. 2 A Proposed Educational Information Model for Engineering and Technology Programs

Figure 3 shows a general course layout structure for the three programs. It is based on offering three sets of course: Engineering set, Engineering Technology set, and the third set is the Industrial Technology. The Engineering program has the majority of its courses are from the engineering set, the remaining is divided between the Engineering Technology and the Industrial Technology sub-sets. The Engineering Technology program has the majority of its courses from the Engineering Technology set; the reaming is divided between the Engineering and the Industrial Technology sub-sets. The Industrial Technology has the majority of its courses from the Industrial Technology set that include the management component and the remaining is divided between the Engineering and the Engineering Technology sub-set.

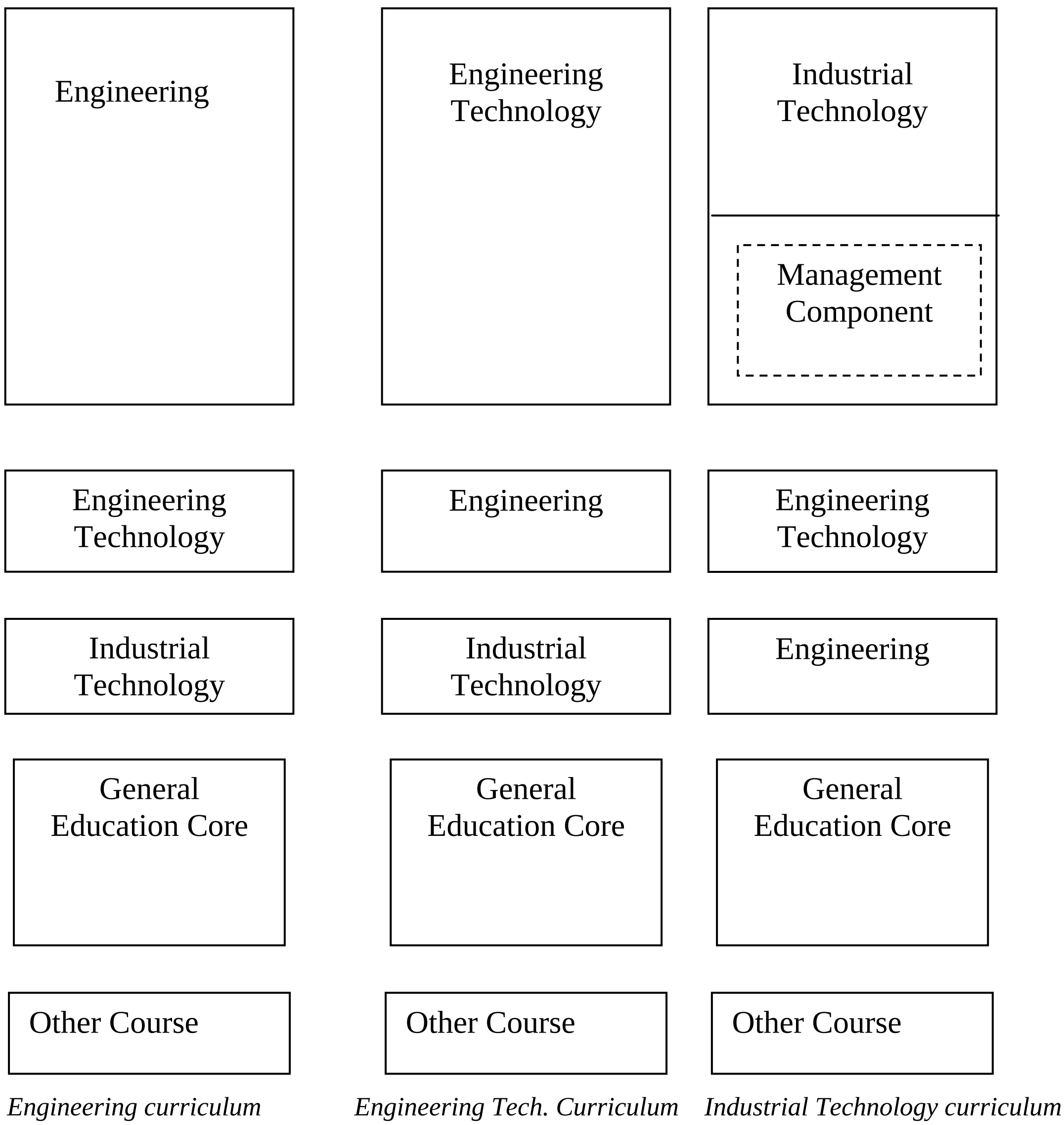


Fig. 3 The Proposed Curriculum Course Layout Structure for the Three Programs

SUPER UNIVERSITY, COLLEGE OF SCIENCE

B.S. Engineering Technology 131 S.H.

GENERAL Education: 48 S.H

Foundation:

ENG 1310,1320
MATH 2471
COMM 1402 Speech Communication
Chemistry 1341, 1141, 1342, 1142
Music or Theater
Political Science 2310, 2320
Eco 1020 Economics I

Humanities and Visual and Performing Arts

Art, Music
Philosophy
HIST 1000 History of Civic Society
Physical Education

MAJOR core Requirements (63)

ENGR 2300 Materials Engineering
ENGR 3311 Mechanics of Material
TECH 3322 Development of Technology
TECH 2344 Power Technology
TECH 3364 Quality Assurance
TECH 4345 Methods Engineering and Ergonomic
TECH 4374 Digital Electronics
TECH 4390 Internship (2 sections)
MATH 2472 Calculus II
MATH 3305 Intro to Probability and Statistics
Math 3323 Differential Equations
Math 3348 Deterministic Operation Research
Math 3375 Engineering Mechanics
PHYS 1430 Mechanics and Heat
PHYS 2425 Electricity and Magnetisms
PHYS 3315 Thermodynamics/optics
ECNO 3313 Labor Economics
ENG 3303 Technical writing
MGT 3303 Management of Organization

Specialization 24

MGT 4330 Prod. & Operation Management
TECH 2310 Machine Drafting
TECH 2330 Fundamental of Material Removal
TECH 4330 Foundry & Heat Treatment
TECH 4357 Facilities Design
TECH 4362 Manufacturing Processes I
TECH 4367 Human Resource or Labor relation
TECH 4391 Manufacturing Proce II

SUPER UNIVERSITY, COLLEGE OF SCIENCE

B.S. Industrial Technology 131 S.H.

GENERAL Education: 48 S.H

Foundation

ENG 1310,1320
MATH 2471
COMM 1402 Speech Communication ___
Chemistry 1341, 1141, 1342, 1142
Music or Theater
Political Science 2310, 2320
Eco 1020 Economics I (Macro)

Humanities and Visual and Performing Arts

Art, Music
Philosophy
HIST 1000 History of Civic Society
Physical Education

MAJOR core Requirements (36)

ENGR 2300 Materials Engineering
ENG 3303 Technical Writing
MGT 3030 Organization
TECH 2344 Power Technology
TECH 2370 Electricity/Electronic
TECH 3310 Industrial Design
TECH 3322 Development of Technology
TECH 3364 Quality Assurance
TECH 4345 Methods Engineering and Ergonomic
TECH 4380IndustrialSafety
TECH 4390 Internship (2 sections).

Specialization (47)

TECH 1330 Assembly Processes
TECH 2310 Machine Drafting
TECH 2330 Fundamental of Material Removal
TECH 4330 Foundry & Heat Treatment
TECH 4357 Facilities Design
TECH 4362 Manufacturing Processes I
TECH 4367 Polymer Properties
TECH 4373 Industrial Electronics
TECH 4374 Digital Electronics
TECH 4391 Manufacturing Processes II
Chemistry 1142
Chemistry 1342
Math 1317 Trig.
Math 2417 Pre Calculus
Physics 1420 General Physics

Other Requirements

Geog 3303 Economic Geography
MGT 4330 Production and Oper. Mangt.

SUPER UNIVERSITY, COLLEGE OF SCIENCE
B.S. MANUFACTURING ENGINEERING 131 S.H.

GENERAL Education: 48 S.H
Foundation:
ENG 1310,1320
MATH 2471
COMM 1402 Speech Communication ___
Chemistry 1341, 1141, 1342, 1142
Music or Theater
Political Science 2310, 2320
Eco 1020 Economics
Humanities and Visual and Performing Arts
Art, Music
Philosophy
HIST 1000 History of Civic Society
Physical Education
MAJOR Engineering core Requirements (57)
ENGR 2300 Materials Engineering
ENGR 1413 Engineering Deign Graphics
TECH 3364 Quality Assurance
TECH 4345 Methods Engineering& Ergonomics
TECH 4345 Digital Electronic
ENGR 3311 Mechanics of Material
ENGR 3315 Engineering Economic
TECH 3316 CAD
TECH 3373 Circuits and Device
ENGR 4365 Tool Design
ENGR 4376 Control Systems and Instrument
PHYS 1430 Physics I
PHYS 2425 Physics II
MATH 2472 CACULUS II
MATH 3305 Intro to Probability and Statistic
MATH 3323 Differential Equations
CS Elective
MGT 3030 Organization
MGT 4330 Production and Operation Mangt
Area of Specialization (24)
TECH 2332 Material Selection__
TECH 4367 Polymer Properties
TECH 4392_Micro Electronic Manuf.
TECH 4391 Manufacturing Proce II
ENGR 4363 Concurrent Engineering
ENGR 4396 Manufacturing System Design
ENGRG4380IndustrialSafety

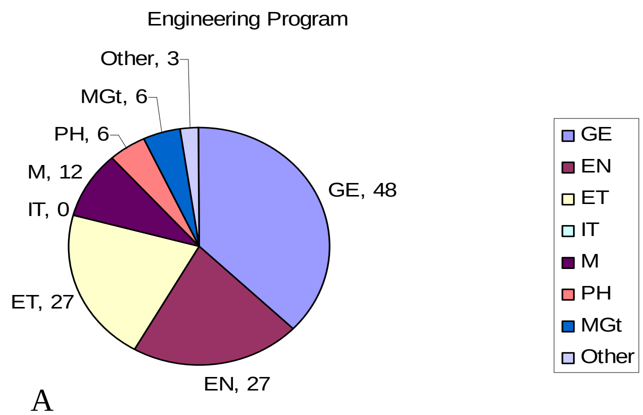
Fig. 4, 5, 6 Manufacturing Engineering, Technology and Industrial Technology Curriculum Sheets

Case Study

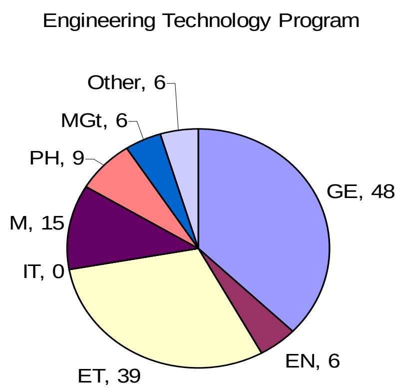
In order to verify the concept of the information model and the course structure layout presented in this paper, a case study was taken from an existing school. The three programs are offered in a single department; Manufacturing Engineering, Manufacturing Engineering Technology, and Industrial Technology. Figures 4, 5 and 6 show the program curriculum sheet for three programs. The detailed statistical break down for each program is listed in table 1. Figs. 7 a, b, c show the pie chart representation of table 1.

Table 1 the Distribution of the Credit hours among the three Programs

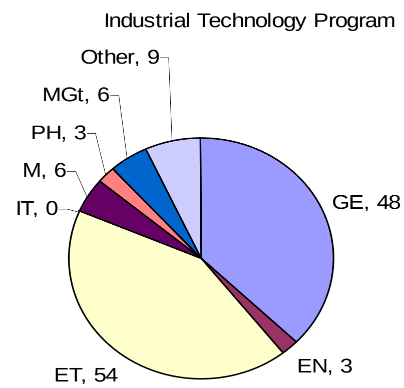
Courses	Engineering		Engineering Technology		Industrial Technology	
	Courses	S.H	Courses	S.H	Courses	S.H.
General Core	16	48	16	48	16	48
Engineering	9	27	2	6	1	3
Technology	9	27	13	39	18	54
Industrial Technology	-	-	-	-	-	-
Mathematics	4	12	5	15	2	6
Physics	2	6	3	9	1	3
Management	2	6	2	6	2	6
Other	1	3	2	6	3	9
Total		**129**		**129**		**129**



A



B



C

Fig. 7 The Distribution of the type of courses offered in the three Program (A- Engineering, B- Engineering Technology, C-Industrial Technology)

Discussion

The analysis of the information presented in table 1 and Fig 7 reveals the following:

- Mathematics courses are the highest in the Engineering Technology Program.
- Hands-on based courses are very law in all programs.
- Many Courses in the Industrial Technology are low in Hands-on type of experience.
- The engineering program has many Engineering Technology courses.

Thus may lead to the following:

- The Industrial Technology courses become more of a continuing education type of courses.
- Migration of students from the Engineering technology to the Engineering Programs due to high mathematics and Math-based course contents.
- The graduate of the Engineering program becomes sort of Engineering Technology graduate.
- Difficulties in getting the different programs accredited.

Proposed Modifications
In order to correct the current situation and in accordance with the proposed program design model presented in figure 1 and in agreement with the definitions presented by the America Society of Engineering Education ASEE , and National Association of Industrial Technology NAIT [3] the following modifications are suggested:

Create at least five industrial technology courses to be added to the industrial technology curriculum. These courses are intended to increase the Hands-on portion of the program(s). As an example of these courses: Solid Modeling, Computer Aided Manufacturing, Advanced CAD, Robotic programming, and Computer Numerical Control Programming. If resources are limited (student enrollments, addition of new faculty member, etc), these courses can replace some of the existing courses such as: Computer Numerical Control replaces Manufacturing Process II. The fundamental of metal removal course becomes an engineering courses and to be removed from the industrial technology program. Industrial design and machine drafting can be grouped together. This will give the opportunity to add two new courses to the industrial technology curriculum such as: Solid Modeling and the Computer Aided Manufacturing courses. Decrease the Mathematics portion of the engineering technology program to the same level of the engineering program. At least two or three of the industrial technology courses to be included in the engineering technology program with the loss of one or two math courses. The facility design course becomes and engineering course. Table 2 shows the new modification depicted at fig. 8.

Conclusion

The proposed approach to design three undergraduate program majors; engineering and engineering technology and industrial technology in a single educational environment has been presented. The proposed approach is based on designing a course structure layout and an education information model. The three educational constituents of the information model (Science, Application, and Hands-on) has to be determined for each program. The case study has proved the validation of the proposed approach and provided a unique guideline to smooth out the modifications with minimal or no finical burdens on the offering institute. The results of these modifications will results in great program improvements that may reflect on better educational services to the students.

Table 2 the Modified Distribution of the Credit hour among the three Programs

Course	Engineering		Engineering Technology		Industrial Technology	
	courses	S.H	Courses	S.H	Courses	S.H.
General Core	16	48	16	48	16	48
Engineering	12	36	6	18	2	6
Technology	6	18	10	30	11	33
Industrial Technology	2	6	3	9	7	21
Mathematics	4	12	4	12	2	6
Physics	2	6	2	6	1	3
Management	1	3	2	6	3	9
Other	0	0	0	0	1	3
Total		**129**		**129**		**129**

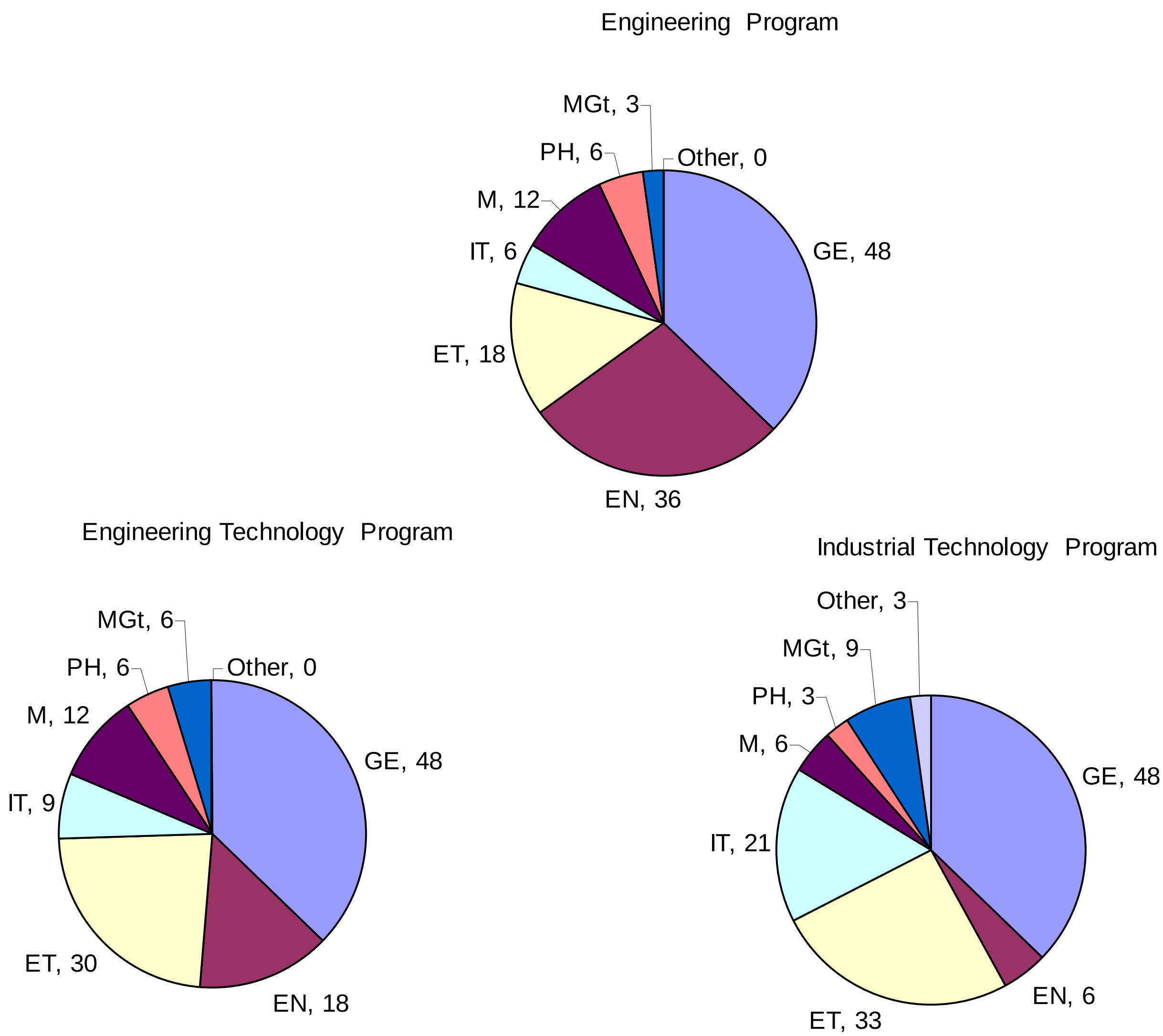


Fig 8 The Proposed Modifications to the three Programs

References

1. Gadalla, M.A.," Bridging the Gap between Engineering and Technology programs, A Case Study Approach", the 2002 ASEE Annual Conference & Exposition, Montréal, Quebec, Canada, June 16-19, 2002.

2. Gadalla, M.A.," Excogitating a new Category of Computer Users to benefit CAD/CAM Industry", Presented at 2003 ASEE Annual Conference & Exposition, Nashville, Tennessee, June 22-25, 2003.

3. ASEE Web site Engineering Technology http://www.eteducation.org/qa/qa1.html

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Dr. Mohamed Gadalla is an assistant professor at Texas Sate University, His area of expertise is in CNC Machining and Manufacturing Information Systems. Prior to his appointment at Texas state he was the Program Coordinator for the Computer Integrated Design and Manufacturing at Kean University, NJ.