A Proposed Approach to Design an Efficient Program in Industrial Technology

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Abstract

Technology education at the university level can be grouped into: Engineering Technology (ET) and Industrial Technology (IT) Programs. These programs are primarily focusing on applications in Engineering Science. A typical IT curriculum includes: hands-on type of experience courses, courses on humanities, liberal arts, physiology, management, economic, etc. The graduates of these programs are workforce that can be used in many workplaces such as: industry, government, educational institutes, financial institutions, etc.

Although the graduate of IT programs has a wide scope of knowledge in many areas, he or she can still suffer from a lack of some fundamentals in mathematics, and core courses that are considered as core elements in building a sound skeleton of a scientific knowledge. It is believed that by efficient design of the IT curriculum many of these pitfalls can be avoided.

In this paper a case study of a program design and development in industrial technology in Computer Integrated Design and Manufacturing Technology (CIDMT) will be shown. The conflicting factors to be considered and resolved in the curriculum design will be highlighted and discussed.

1. Introduction

The National Association of Industrial Technology (NAIT) defines Industrial Technology as a field of study designed to prepare technical and or management oriented professionals for employment in business, industry, education, and government. Industrial Technology compared with Engineering and Engineering Technology is primarily involved with the management, operation, and maintenance of complex technological systems while Engineering and Engineering Technology are primarily involved with the design and installation of these systems. [1].

Historically, Industrial Technology programs grew out of colleges and universities, to prepare secondary school industrial arts teachers. As more and more graduates took industry management jobs the program began to better prepare students to enter industry. Slowly industrial technology evolved as an identity resulting in new separate degree programs. While industrial arts programs focused on technology and psychology, later industrial technology programs combined technology and management. Table 1 shows a brief historical view of the IT programs [2].

Table 1 Early Industrial Technology programs:	
Bradley U. (Ill.)	1939
Southern Illinois U.	1944
Arizona State U.	1947
San Jose State (Calif.)	1950
Texas A & M	1950
Ohio U.	1952
Stout State (Wis.)	1956

A typical Engineering Program provides technically oriented students with engineering knowledge to prepare them to design, Research and Development (R&D), and supervise, the existing and new technologies.

Engineering Technology is the part of the technological field that requires the application of scientific, engineering knowledge and methods combined with technical skills in support of engineering activities [5]. Engineering Technology programs started in the early 1960s. It was originally started to provide industry with the type of workforce needed to operated the current technology and have fundamental knowledge of these technologies.

Community colleges provide two main services: first, to provide graduates with associate degree, which normally takes two years. Associate degree represents the fastest way to introduce young workers to the market. Secondly, many students join community colleges to take courses specially summer courses that can be transferred toward their degree in the university.

2. Program Design Criteria

2.1 Interdisciplinary Vs. Multidisciplinary

Both approaches are designed to cross the hard line drawn by fixed disciplinary. In general, the Interdisciplinary program is a program that is tailored to better suit the students objectives, compared with traditional approach. As an example of Interdisciplinary program is the Biomedical Engineering, where it is performed as a joint program between the Engineering and Medicine schools. The result of this augmentation is a completely new program that is independent of both schools. In the Multidisciplinary approach, is to bring together more than discipline together, without crossing the hard lines of the composing disciplines. The student in a multidisciplinary system is expected to be aware of the different area and disciplines, but not to be an expert in any of them. It is left for individual study or the work environment to refine and sharpen the student skills. An example of the multidiscipline approach is the integrated engineering program at the University of Western Ontario (WWW.uwo.ca).

2.2 Science, Application, Hands on

It is important to recognize the difference among these educational poles of learning: Science, Application, and Hands-on. To explain the difference among these concepts in a better light and to highlight the way to apply them in a proportion that would benefit the students the most, we can take teaching a course like "Strength of Material" as an Example.

First, the Science approach is basically the theoretical base and the fundamental information given to the students to supply them with the information they need to know and which they can apply later. I.e. The behavior of material under different loading conditions such as : tension, compression, bending , and torsion. The focus will be on how to drive formulas and using them for symbolic problems. Real world problem are seldom used as examples. Second, the Application approach would be focusing on how to apply these formulas to Cases in Real World so that the student would be aware of the applied part of the science and how to use the theory and apply it in realty. Hands on approach, is basically a top-down approach rather than a bottom up approach. To better explain this, an example would be studying a bridge, the student would experiment the different loading condition, changing the bridge structure and see the effect on the load carrying capacity, etc. Such an approach would introduce the student to real world cases of how to build a bridge, what are the different structural elements and how to use them. But it is very obvious the student lack the necessary skills to carry on design analysis.

Although It is very obvious that a successful course will include the three educational quality criteria but due to the course time limitation it is very important to compromise among the three criterion. Figure 1 explains the concept in a pie chart format.

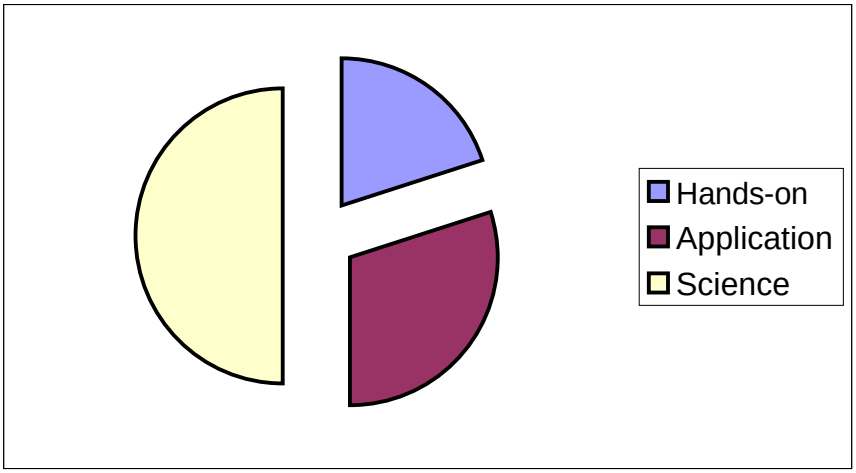

Fig. 1 Constituents of a Generalized Technical Program

3. Program Design Steps

The following steps were followed to design a program in computer integrated design and manufacturing technology at Kean University.

a- The first step would be to write the program establishment mission statements. The mission statements should be written to reflect the main objectives that are to be fulfilled by such a program.
b- Writing the recipient career performance will cast more light on the mission statement
c- Reciting the factors that lead to pitfalls in the existing program help to avoid these pitfalls in the new program
d- Stating clearly the Program design criteria as explained in section 2
e- Stating clearly the main knowledge bodies that constitute the program
f- Curriculum design and Course selection
g- Curriculum revise

4. Case Study

The following is the new degree program in Computer Integrated Design and manufacturing technology program in Kean University.

4.1 Mission Statements

The objective of the CIDMT program at Kean University is to provide a quality technology and management education in addition to practical and hands on training. The acquired skills are a culmination of science; hands on experience and computer and system integration centered around a manufacturing and management core

4.2 The Recipient Career Performance

Student graduating from the CIDMT program are expected to have the following characteristics:

1- Technology Generalist: The student must be aware of a wide variety of technical subjects.
2- Hands-on Experiences: The student must develop sufficient expertise on using state of the art equipment.
3- Engineering Awareness: The student should have enough basic engineering knowledge to carry on some design and design analysis tasks to permit the pursuit of an engineering career if desired.
4- Business and Management Orientation: The student should have enough knowledge and background to serve at the entry level in the global market place. It also enables him to switch to management career if he/she desired.
5- The Graduate is prepared to switch career and adapt to job market requirements in the least amount of time.

4.3 Pitfalls to be avoided

The following factors need to be avoided in designing the curriculum for the new CIDMT technology program at Kean University:

- Limited Flexibility.
- General Education should be linked to the major requirement.

- The area that supports computer knowledge needs to be clearly integrated with the body of the curriculum.
- Others, how the courses are related need to be refined (prerequisites and exquisites).

4.4 Curriculum Design Criteria

Due to the limited number of credit hours, it was decided that a multidisciplinary approach would be more appropriate for the curriculum design. While in the course outlines an interdisciplinary approach is better used.

4.5 The Program Main Knowledge Constituents

The following is a list of subjects that are to be covered in the program

1- Computer Aided Design Technology.
2- Computer Aided Manufacturing Technology.
3- Networking.
4- System Integration.
5- Management.

4.6 Curriculum Design and Course Selection

Figure two and three shows the existing and the proposed curriculum sheet of the existing and the proposed Degree program at Kean University. We can notice the following modifications in the proposed program:

1- General Education Section has been shorten
2- General Education Part has been modified to better suits the objective of the major (Matrix and Linear Algebra course was added, and the calculus course was removed).
3- Increased flexibility by adding the free technical electives to complement the major.
4- The management window has been improved.
5- Course requirements for the area of specialization has been modified to better fit the students and better reflect the industry needs.

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School of Business, Government and Technology
(28204) Computer Integrated design and Manufacturing option 136 -137 S.H.
Office 908-527-2926/203 Email cidm_bgt@hotmail.com Website www.keanati.org

NAME_____
ADDRESS_____
S.S _____
STUDENT I. D. #_____
MATRICULATION DATE_____

ID 1001 Freshman Seminar_____

Kean University ( ) _____

GEENRAL EDUCATION REQUIRMENTS: 61/62 S.H.

CORE REWQUIRMENTS 19 S.H.

ENG 1020 Composition_____	3
ENG 1100_____	3
ENG 1200 Intell. & Cult. Trad._____	3
ENG 2020 Inquiry and Research _____	3
ENG 2203 Lanmarks World Lit._____	3
PHYS 2091 Physics I _____	4

BREADTH REQUIRMENTS: 33 -34 S.H.

HUMANITIES	1 2. S.H.
COMM 1400 Speech	3
(Three courses from at least two areas)	
English	3
Fine Arts	3
Foreign Language	6
Music	3
Philosophy & Religion	3

SOCIAL & BEHAVIORAL SCIENCES 12 S.H.

* ECO 1020 Economics I		3
* ECO economics II		3
PSY 1000 General Psychology		3
History	OR	
Political Science	OR	
Sociology or Anthropology		3

BIOLOGICAL & PHYSICAL SCIENCE 4

PHYS 2092 General Physics II 4

MATHEMATICAL SCIENCES 3. S.H.
MATH 1051 College Algebra 3

HEALTH &PHYSICAL EDUCATION 2/3 S.H.

Health Education	2
Physical Education	3

ADDITIONAL COGNATE COURSE: 9 S. H.

CPS 1031 Intro to Computers	3
MATH 1054 Pre-Calculus	3
Math 2411 Calculus	3

MAJOR REQUIRMENENTS 74 S. H.
CORE REQUIRMENTS 13 S. H.

TECH 2920 Comp. In Tech	3
TECH 1200 Intro. To Comp Aided Drafting	4
TECH 2900 Prep. Tech. Documents	3
Tech 2421 Materials & Automated Proc's	3

AREA of SPECIALIZATION 34 S. H.

TECH 2404 Machine Tool Production	3
TECH 2410 Computer Anim./Rapid Prototyping	3
TECH 2415 CAM/CNC	4
TECH 3439 Comp. Integ. Machine Element Design	3
TECH 3430 CAD/CAM	3
TECH 4415 Computer Automated Systems	3
TECH 4425 CIM Programming and Database	3
TECH 4440 Robotics & Non-Trad. Mfg.	3
TECH 4421 Comp. Integ. Prod. & Inv. Con. Manag	3
TECH 4442 Prod. Measurement Improvement	3
TECH 4450 Comp. Integrated Deign & Mfg.	3

MANAGEMENT 15 S.H.

ACCT 2200 Principles of Acctg	3
MGS 3030 Human Resources Mgmt	3
MGS 2110 Quantitative Methods	3
TECH 3900 Ind. Stat & Quality Cont.	3
FIN 3310 Mgmt of Corporate Fin	3

GUIDED ELECTIVES 12 S.H.

_____	3
_____	3
_____	3
_____	3

A. Communications 12 S.H.

TECH 3900 Quality Mgmt _____	3
TECH 3440 Unix Administration _____	3
TECH 3438 Net Sys. Adm._____	3
TECH 3442 Net & Support_____	3

Fig 2 The Existing Program of Computer Integrated Design and Manufacturing at Kean

KEAN UNIVERSITY
COLLEGE OF NATURAL, APPLIED AND HEALTH
(28204) **B.S. INDUSTRIAL TECHNOLOGY (CIDM OPTION)** 128 S.H.
(EFFECTIVE: 9/02)

NAME_____
STUDENT I.D.#_____
START TERM_____
ID 1001 Freshman Seminar[1]_____

TRANSFER INSTITUTIONS (X) CREDITS
_____ _____
_____ _____
_____ _____
In Progress ( )_____
Kean University ( )_____

GENERAL EDUCATION REQUIRMENTS: 53-57 S.H.

FOUNDATIONS REQUIREMENTS[2]: 12-15[3] S.H.

ENG 1030 College Composition _____	3
MATH 1000 Algebra for Coll. Students	3
COMM 1402 Speech Communication for	3
Critical Citizenship_____	3
GE 202X Research & Technology_____	3

DISCIPLINARY/INTERDISCIPLINARY DISTRIBUTION REQUIREMENTS:

HUMANITIES 9 S.H.

ENG 2403 World Literature _____	3
Fine Arts or Art History _____	3
Philosophy or Religion _____	3
Foreign Languages _____	3
Music or Theater _____	3
Interdisciplinary _____	3

SOCIAL SCIENCES 9 S.H.

*HIST 1000 History of Civic Soc. in America	3
Psy 1000 General Psychology ____	3
Eco 1020 Economics I (Macro)_____	3

SCIENCE & MATHEMATICS 11 S.H

*MATH 1054 Pre-Calculus_____	3
CPS 1231 Fundamental of Computer____	3
Phys 2091 Physics I _____	4

HEALTH/PHYSICAL EDUCATION 2,3 S.H.

ID 1225 Issues Contemporary Health__	3
OR	
Physical Education_____	3

CONCENTRATION[4] 7 S.H.

Math 2995 Matrix and Linear Algebra____	3
Phys 2092 Physics II _____	4

ADDITIONAL REQUIREMENTS 3 S.H.

ECO 1021 Economics II (Micro)	3

CAPSTONE

Tech 4450 Computer Integ. Design & Manuf.	3

MAJOR REQUIREMENTS 71 S.H.

CORE REQUIREMENTS[1] 13 S.H.

TECH 2920 Comp. In Technology	3
TECH 1200 Computer Aided Drafting	4
TECH xxxx Materials Science and Technology	3
TECH 2421 Manufacturing Processes	3

AREA OF SPECIALIZATION[1] 28 S.H.

TECH 2410 Computer Anim./Rapid Prototyping	3
TECH 2404 Machine Tool Prod./Non-Trad. Mach.	3
TECH xxxx Numerical Control & Tool Design	4
TECH 3439 Integrated Machine Element Design	3
TECH 3430 Computer Aided Design& Manufact.	3
TECH 4415 Automated Systems Integration	3
TECH 4425 Manag. Warehouse&Distrib. Operat	3
TECH 4440 Robotics & Automated Systems	3
TECH 4442 Prod & Production Measurements	3

FREE TECHNICAL ELECTIVE 6 S.H.

TECH 3440 Unix Administration _____	3
TECH 3438 Net Sys. Adm._____	3
TECH 3250 Advanced CAD _____	3

MANAGEMENT 15 S.H.

ACCT 2200 Principles of Acctg	3
MGS 3030 Human Resources Mgmt	3
MGS 3410 Basic Marketing	3
FIN 3310 Mgmt of Corporate Fin	3
TECH 3900 Ind. Stat. & Quality Control	3

GUIDED ELECTIVES 12 S.H.

MGS 4010 Production Mangt. (to get a minor in Mangt.)	3
_____	3
_____	3
_____	3

Fig 3 The Proposed Program of Computer Integrated Design and Manufacturing Technology at Kean University

5. Conclusion

In this a paper a systematic methodology is proposed when designing an industrial Technology program. The curriculum design reflects the three main constituents of a technical program: (Science, Application and Hands-on). It is believed that following this approach will maximize the output of the Industrial Technology graduates and improve his/her competitive edge in the job market.

6. References

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5. Harriger, B., 1992, " An Engineering Technology Approach to Manufacturing Education", Autofact, 92, Nov. 10-12, Detroit Michigan, 27-35.

Biography

Dr. Mohamed Gadalla is working as an assistant Professor of Technology and Computer Integrated Design and Manufacturing Program Coordinator at Kean University, Department of Technology. Dr. Gadalla graduated from Cairo University as an honor student. He obtained his Master Degree in Mechanical Engineering from the same school. He obtained His Ph. D. from University of Western Ontario in Canada. He worked as a visiting scholar in several Universities in Canada, Germany, Egypt and United States.