Developing Engineering Education In Egypt-
Experience and Achievements

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Introduction

An Engineering Education Development Project (EEDP) was initiated in Egypt in January, 1992 [1,2]. The project has been funded through a loan agreement between the World Bank and the government of Egypt. The project generally aims at the upgrading or the redesign of educational programs at the eighteen Egyptian faculties of engineering. This includes the upgrading of academic curricula, human resources (teaching and support staff), and laboratory and instruction programs and tools. The participation of the different engineering faculties has been allowed through a competitive proposal process involving open review and assessment with peer-review involvement. In earlier papers [1,2], the process of proposals submission and selection for funding was described at length. The selection process was repeated in cycles of six months each at the beginning of which proposals were submitted and by the end of which some proposals had been approved for funding. The implementation of approved proposals commenced immediately thereafter by initiating the process of curriculum development ,the preparation or refurbishing of the site of newly approved equipment, the design of staff training programs, and the preparation of tender documents and other procurement procedures.

Also, the EEDP project management has introduced and indeed executed a number of support programs which ensured the accomplishment of the project's global goals optimally and cost effectively. The project is now more than five years old, no new proposals are accepted for funding any more. All efforts are currently devoted to the implementation of one hundred-sixty proposals for education development in eighteen colleges of engineering across the nation.

Proposal Implementation Monitoring & Assistance

The EEDP management has set up a Proposal Implementation Monitoring Committees (PIMC) to ensure that the proposed program is executed properly and in accordance with a pre-approved time schedule. The PIMC committees report to the EEDP management on the progress of successful education development programs with special emphasis on such vital aspects as:

(1) site preparation and infrastructure refurbishing .
(2) equipment installation, commissioning ,and utilization.
(3) curriculum development and the preparation of renovated courseware material.

Also a program has been introduced whereby smaller faculties of engineering can be assisted in implementing their proposed education development programs. The most likely candidates for this program are those faculties of engineering who benefited at an earlier time from the

Proposal Preparation Assistance Service[2]. Others may also apply for this program and in such a case they must demonstrate their inability to implement their proposed education development programs without outside help. The Proposal Implementation Assistance Service (PIAS) primarily provides the expert service necessary for this purpose. One or more experienced professors from a leading institution will be assigned by the EEDP management to undertake the task of assisting the institution in question by:

(1) supervising the preparation of site and the development of associated infrastructure.
(2) inspecting the new equipment ,subject them to acceptance testing and supervise their installation.
(3) helping in curriculum development and in the preparation of the necessary instruction materials and courseware.
(4) making appropriate recommendations for future curriculum development and propose methods of diffusing and sharing experience with other institutions.

Table 1 summarizes the numbers of funded development plans classified according to disciplines.

Table (1) Distribution of approved projects by discipline

Discipline	No. of Proposals	Total Budget 1000 $
Electrical Engineering	27	2348
Computers	14	1767
Electronics & Communications	18	1403
Material Engineering	9	1283
Structures, Solid Mechanics & Concrete	8	1227
Physics	14	1117
Mining, Metallurgy & Petroleum	8	913
Systems & Control	6	764
Thermodynamics	7	728
Fluid Mechanics	6	661
Mechanical Design	5	557
Architecture	7	540
Soil Mechanics	5	441
Workshops	2	412
Engineering Mechanics	7	412
Survey	2	267
Hydraulics & Irrigation	2	265
Engineering Chemistry	7	257
Engineering Drawing	2	151
Libraries & Educational Facilities	2	150
Chemical Engineering	1	106
Naval Architecture	1	72
Total	160	15841

Fig. (1) shows the distribution of budget received by colleges for development. Larger budgets normally went to larger colleges.

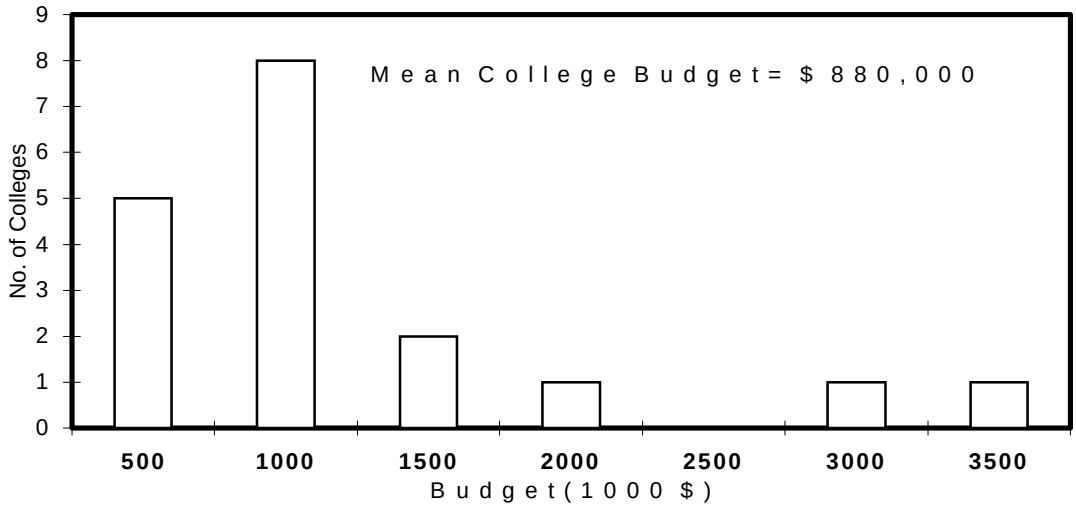

Fig. (1) Distribution of college budgets

Fig. (2), meanwhile, shows the distribution of development projects budgets. Some small proposals received less than $ 30,000 while some huge and more comperehensive proposals received budgets in excess of $ 500,000 .

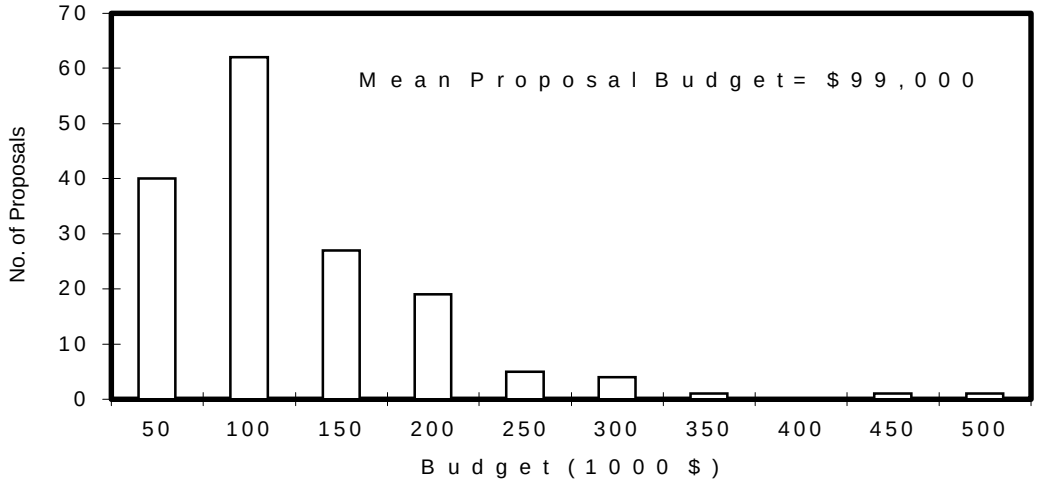

Fig. (2) Distribution of proposal budgets

EEDP Role in the Cooperation Between Universities & Industry

The EEDP management has realized that cooperation between universities and the industry creates a marriage of both theoretical study and practical skills in a coordinated manner. In an earlier paper [2], the activities promoted by the EEDP in this direction were shown at that time to include:

Industry involvement in EEDP policy making, where the steering committee of the EEDP has four members (out of a total of twelve) from the industry representing both public and private industrial corporations.

Industrial links as criterion for funding ,where one of the criteria for accepting a proposed education program for funding is to provide enough evidence that the knowledge acquired by the graduates of that program is of direct relevance to existing industry.

Curriculum development based on Industrial needs, where feasibility studies made by teams from faculties of engineering are funded by the EEDP to scan the industry for material that will help in the development or upgrading of courses. A typical example of this policy is described in the following section.

Accreditation based on industrial link

All faculties of engineering in Egypt are government-owned ; their staff are government employees. Therefore, all degrees granted by an engineering faculty is automatically accredited as soon as the institution is established. This fact -in the opinion of many experts- had an adverse effect on engineering education. It is now widely believed in Egypt and elsewhere that only through continuous evaluation and accreditation that higher education may be appropriately developed .

The EEDP management has examined the issue of education evaluation in more depth and has launched a study which aims at the establishment of an independent evaluation and accreditation body for engineering education. The study team began by consulting the charters , procedures , and regulations of many reputable accreditation organizations such as ABET in the USA, Engineering Council's professional societies in the U.K.,..etc. A comprehensive document was eventually produced ,in October 1994, which contains the principles, goals, criteria, and procedures of a suitable engineering education accreditation program. The scheme is being implemented on sample engineering programs in selected institutions. The institution was told in advance how to prepare itself for evaluation while potential reviewers were educated on evaluation procedures.

One of the major criteria which must be met for a program to be successfully accredited is the program's professional link with industry. This must be manifested by one or more of the following evidences:

- Technical liaison between the faculty members and the industry in the form of consultations.
- Training procedures in the industry for students.
- Presence of representative from the industry on Faculty councils and committees.
- Support offered by the industry to the institution.

Since the time when the EEDP activities were last presented to an ASEE meeting [2] , the following aspects of university-industry cooperation have become evident under the catalytic influence of the EEDP :

Industry-supplied equipment

Some faculties of engineering expressed -through the EEDP project activities- their need for some equipment that were available in the industry and were no longer needed there. The industrial firms involved were very receptive to these requests and not only gave away the

equipment but helped in their testing and installation. They even gave advise about means of modifying the use of the equipment. A recent example is when an Iron & Steel Company provided the Electrical Engineering Department in a Faculty of Engineering with high voltage sources for use in its educational purposes that were originally used for X-ray detection techniques.

University equipment lent to industry

The EEDP is encouraging the offering of a loan facility to industry of specialist equipment when they are not viable for the industry to purchase. An example is allowing an Aluminum industrial plant to use the magnetic field meter owned by a faculty of engineering -and used in research- to measure the levels of magnetic field exposure in the plant.

Computer-related development

Computer-based development programs for the industry are operated by the faculties of engineering where relevant software is developed. The capabilities of engineering faculties are thus well demonstrated to the industry. The EEDP projects itself as the medium through which this link is established.

Using university testing facilities

Facilities available at the faculties of engineering which are normally used for research as well as educational purposes are encouraged to contribute to solving real industrial problems. The EEDP -where a nearly complete inventory of educational facilities is accessible- is acting as liaison between the two bodies.

Development of Coursewear on Measuring & Control Instrumentation From An Industrial Perspective - A Case study

The Faculty of Engineering at Cairo University applied to the EEDP for "Seed Fund" to finance a feasibility study which aims at exploring the possibilities of developing of a new course material in the area of "Measurements & Control". In the current curriculum of that school, this area encompasses four dedicated courses offered to electrical engineering students in their third ,fourth ,and fifth years of study. In addition, other courses such as electronics , circuit theory, computer-hardware, automatic control, electrical power, electrical machines, must be equipped with some basic information in modern instrumentation to satisfy their required practical orientation. The team formed for the purpose of executing the preliminary study , and later implementing the full application of its results , comprised faculty members from various electrical engineering disciplines.

As it is the standing policy of the EEDP, the feasibility study was intended to ultimately produce a comprehensive proposal to be submitted again to the EEDP management requesting its full support for the implementation of the scheme developed during the preliminary study.

Elements of Preliminary Study

The Seed Fund targeted the following objectives :

(1) The performance of a comprehensive scan of the current courses belonging to the area under study: their contents, time allocation, textbooks and references, laboratory facilities, enrollment....

(2) The identification of the industrial needs in this area. This comprised the following action:
-Field visits to major and relatively modern industries to identify their current instrumentation and control gear. Emphasis is put on instrumentation schemes with microprocessor-based structures.
-Field visits to more traditional and older industries to identify the areas where modernization in measurement and control may be needed.
-Acquisition of technical data and specifications on equipment.

(3) The determination of the needs for developing integrated course-ware in the study area, including: course material, required laboratory equipment, instructional tools, human resource,..etc.

(4) The preparation of a comprehensive proposal ,which accounts for all the elements listed in (1) to (3) above, to be submitted to the EEDP for funding.

Selected Industries

The preliminary study targeted the needs of five major industrial sectors, namely, the Chemical Industries, the Food Industries , the Metal Works Industry , the Textile Industry , and the Electric Power generation and distribution. Two manufacturing companies were chosen for the study purpose, namely, The Egyptian Sugar and Distillation Company , and The Egyptian Aluminum Company. In addition, The Egyptian Electricity Authority , the sole electric power utility organization was also included in the study.

The Final Proposal

The preliminary study was completed in six months and -as promised- produced a full proposal for educational development in the targeted area. The proposal was later refereed and approved at a budget of nearly US $ 200,000. The proposed development plan included the following major features:

1- The procurement and installation of modern educational instrumentation and control facilities, including:
Basic measuring instruments, both analog and digital; Sensitivity Bridges or measurement and calibration; Data Acquisition systems; Spectrum Analyzers; Transducers such as those used in the industry; Digital & Micro-Processor kits; Chart Recorders; in addition to a full line of computer-based instructional tools such as multi-media setups.

2- Re-design of the courses in view of the gained industrial experience and in such a way as to put the modern instrumentation , control , and calibration equipment to full student use.

Engineering Library Automation

The EEDP is currently executing an ambitious plan to automate engineering libraries in eighteen colleges of engineering across the country, and their interconnection via a nation-wide computer

network. In order to achieve this goal a specialized committee (the Engineering Library Development Committee ELDC) was formed and given the responsibility to plan and design the required system. They began by carrying out a survey of Library Automation Systems currently in use in Egypt. It has also put out a Request for Proposal concerning the implementation of the Computer Network for Engineering Libraries and solicited responses from major Egyptian companies working in the field of computer applications and computer networking.

Based on the experience gained since the ELDC was formed two years ago, and making every possible effort to adopt the latest technology and state-of-art in library automation software, the ELDC has compiled a Book of Specifications for the proposed system for the automation and Internetworking of Engineering Libraries in Egyptian Universities.

The Automated Library System of Engineering Faculties in Egyptian Universities comprises two main parts: the Library Automation Software and the Computer Network for Engineering Libraries.

The Library Automation Software (LAS) allows the execution of standard library functions required in an academic library, both in Arabic and in English. In so doing, the software conforms to existing standards and provides user friendly interfaces. In addition, the required software allows the exchange of records with the standard-compliant library automation software. It also provides access to its information via the INTERNET.

Meanwhile, the Computer Network for Engineering Libraries (CNEL) provides access to the database of the library collection in different Engineering Faculties. It should also provide access to the INTERNýET from any node in the network. Additional capability is the provision of an integrated management system that enables the system administrator to carry out various configurations, performance, fault, and security management. The ability to support multimedia CD-ROMs and provide video conferencing is also gained.

Development of Multi-Media Instructional Materials

The EEDP offered its support to the efforts made by groups of professors to develop multi-media materials for engineering students. One typical good example was to develop multimedia educational support aids for teaching Fluid Mechanics and Aerodynamics subjects at Cairo University. Such material could be also used by students of many other disciplines. The efforts focused on utilizing latest technologies in multimedia area and the experience gained by the Aerogroup during the last years in the design and use of computational and graphical presentation techniques as teaching aids and/or support. The efforts are partially supported by IBM Egypt and UNESCO. A visibility plan preceded the work and was designed to acknowledge the project sponsors.

The general goal is to develop an Interactive Multimedia based Prototype Educational Courseware covering topics of fluid mechanics-field theory, possibly usable by other fields (elasticity, electromagnetics, hydraulics,...). The developed product is usable by individual students for education/training support and by instructors as teaching/lecture support aid.

Detailed objectives are :

to select topics that can be widely used by other departments. For example the set of topics falling within the framework of the field theory currently in use are: Fluid and Aero Mechanics courses at the Departments of Aerospace Engineering and Mechanical Power Engineering, Electromagnetic courses at the Electrical & Electronics Engineering Departments, Hydraulic and Hydrology at the Department of Civil Engineering.

to incorporate sets of cascaded solvers varying in levels of approximation starting from simple closed form solutions to use of discrete, generalized coordinates, adaptive solvers to model physical flow problems. The simple solvers help enhancing the understanding of the physical phenomena. The more sophisticated solvers will help understand, simulate and estimate more realistic field problems such as; Air loading on Buildings at the Departments of Architecture, Site Aerodynamics in Environmental studies, Ventilation and Reservoir-Simulation for Departments of Mining and Petroleum, ... etc..

to utilize comprehensive data visualization to enhance learning capabilities and faster comprehension of the difficult physical flow problems. Charting, vector maps, line and flooded contouring, and animated simulations will be extensively used.

to use multimedia capabilities such as stills and video clips to provide alternatives to site seeing, and expensive laboratory experiments. Carefully planned narration's and sound effects will certainly help focus on important and critical issues.

References

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