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On Improving Chemical Engineering Education in the Philippines

by
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ABSTRACT

The task of improving chemical engineering education admits of two solutions. We can first consider the needs of the non-academic sector, and then we can look at the problems from the viewpoint of the academe itself. Various specific programs of action are proposed based on the experience of the University of the Philippines Department of Chemical Engineering.

INTRODUCTION

This paper presents ideas and proposals on how chemical engineering education in the Philippines can be improved. It proceeds from the broad assumption that there are two main areas from which the task of improving the training of present and prospective chemical engineers can be approached. One such approach is through improved contact among the academe, industry, and professional organizations. Through such interaction, educators remain aware of the current needs and demands on the profession and can therefore act to make chemical engineering education responsive to such needs and demands. Another approach is to tackle problems in the academe from within the academe itself. Therefore, tackling these factors head-on is a significant step in improving chemical engineering education. Any recommendation made in this paper could also be applied to other engineering professions.

THE STATE OF CHEMICAL ENGINEERING IN THE PHILIPPINES

Present-day indicators tend to show that the national economy is on its way to recovery. Industry and business are increasingly confident that their positions appear to be in a modest upswing. As industry and business expands, the demand for technical manpower correspondingly rises. Notable is the fact that chemical engineers are in greater demand today than, say, in the previous five years. In addition, as the tasks of industry become more complicated, the requirements on the training of the chemical engineer become all the more demanding. Today, he is not only expected to be able to work with computers, he has to have some managerial and entrepreneurial skills as well.

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More significant is the problem brought by industrial expansion: a shortage in applied research. Actually, this problem has been existing for a long time. In the academe, for example, very few students are motivated to conduct research. Graduate students tend, in general, to opt for the non-thesis program. Very often, those who do conduct research work steer clear of topics more relevant to industry. Indeed, it is unfortunate that when industry feels ready to explore new products and processes, there is a shortage in scientific data and research from which novelties and improvements can arise. And it is here where the academe necessarily plays a leading role.

It is the observation of one of the authors (Jose) that chemical engineering activities in the Philippines are practically stagnant compared to its Southeast Asian neighbors, in particular, and to the world, in general. In the World Congress III of Chemical Engineering held in Japan in 1986, only one Filipino attended and presented a paper (out of about a thousand papers presented) [1]. In the Fourth Asian Pacific Confederation of Chemical Engineering Congress held in Singapore in 1987, there was only a single paper from the Philippines submitted for presentation [2]. Although funding is available, hosting a chemical engineering congress in the Philippines (with papers in the true sense of the field) would not be feasible due to the scarcity of papers from the academe and industry. Of course, we should consider that most multi-national companies in the Philippines tie their research with their mother companies, and that the Philippine economy has been through a moribund state.

During the last convention of the Philippine Institute of Chemical Engineers, it was concluded that to prevent a further widening of the socio-economic gap between the industrial and the rural areas, diffusion of technology and human resources towards the latter should be encouraged. Accordingly, employment and the rural economic standard would improve if countryside enterprises are spurred on.

Meanwhile, chemical engineering education is hampered by several problems in the academic institutions. There is a net diffusion of talents from the universities as teachers seek higher-paying jobs elsewhere. Potential researchers shy away from projects because of the prevailing lack of facilities and funds to support them. There is also a need to upgrade the standards of schools that offer degree programs in chemical engineering.

GOALS AND OBJECTIVES

In 1985, the U.P. Department of Chemical Engineering formulated well-defined goals and objectives for its own program of improving chemical engineering education. The thrusts defined reflect the idea that improvement in education can proceed from the point of view of the industrial sector and the consideration of problems in the academic community. The goals are as follows:

1. To make chemical engineering at U P. responsive to the needs of industry and national development.
2. To develop and maintain a well-trained and highly motivated faculty.
3. To make available to industry and government institutions the physical and human resources of the department.
4. To take a major role in the activities of professional organizations.

SPECIFIC PLANS AND PROGRAMS

Based on its experience in implementing these goals the U.P. Department of Chemical Engineering is putting forth specific programs of action which it feels can be adopted nationwide for the improvement of chemical engineering education.

Linkage Programs

To make chemical engineering education more suited to present realities in the country, a specific program that can be pursued is the establishment of links with industry and the government. Through periodic contact between the academic sector on the one hand, and industry and

government on the other, the problems, needs, and goals of the latter can be identified. The academe can then take steps such as streamlining the chemical engineering curriculum or introducing more relevant courses and program of studies. To tailor the chemical engineering curriculum according to industrial expectations, the U.P. Department has several proposals. One possibility is for the academe to hold formal dialogues, seminars, training courses, and exchange programs with industry. These could serve as venues wherein feedback on the relevance of the current curriculum can be aired. The department can also institute new courses of practical importance, such as process design, process control, biotechnology/biochemical engineering, and production/manufacturing engineering, among others.

Practical Considerations

Chemical engineering education can also be shaped so that it can help the government in its program of rural development. In 1986, the Department launched a program on Rural-Oriented Chemical Engineering Technology (ROCET). Some projects initiated under this program are the charcoal-fired drier for fish, fruits, and crops; charcoal maker; and low-cost alcohol rectifier. Easily and cheaply fabricated, these new technologies are envisioned to enable local farmers and fishermen to process and raise the market value of their own products. Other endeavors are biogas production and rice hull utilization, technologies that can form the basis of small-scale industries in the countryside. Indeed, these projects exemplify a means by which the academe can foster the diffusion of low-cost technology to alleviate socio-economic gaps between the industrialized centers and the agricultural countryside.

Another area in which chemical engineering education should be focused is in the exploitation of indigenous resources and materials. New research directions include coal technology and development of building materials. An idea that has originated from the department is the local manufacture of reagent and food-grade chemicals. Research on this field should initially be subsidized by the government. Although the same idea has been picked up by another government institution, the U.P. Chemical Engineering Department will continue to pursue the project as there are many chemicals that could still be included in the list.

Exchange Programs

The Department is also aware of the value of exchange programs and collaboration with other institutions. To promote research in the country, it is felt that institutions throughout the country should be willing to share facilities and exchange human resources. The Chemical Engineering Department at U.P., for example, is offering its laboratory for the use of faculty members of other schools. It has also been proposed that a program whereby faculty members from other schools will be sent to the U.P. department to conduct research works during summer in coordination with the U.P. staff. Because chemical engineering teachers from other schools are usually so heavily burdened with teaching load that they do not have time to conduct research, the cooperation of school administrators is greatly needed so that their faculty will have time to do research works.

For the U.P. Chemical Engineering faculty members, there is the possibility of striking an agreement with the industrial sector by which faculty members can be sent to industrial assignments where they are to work briefly and gain practical experience relevant to their field of expertise. This on-site training should complement their largely theoretical knowledge and the insights gained during these brief stints in actual field work would afford educators a more realistic approach to the courses they teach. At the same time, a contribution would be made to their continuing education. Here, one realizes the dual benefit of the proposed linkage of the academe with industry and the government.

Faculty Development

The Department is putting forward proposals for promoting faculty development. A suggestion is to actively solicit grants from different institutions (local and foreign) for faculty members

to enable them to pursue advanced training. Part of the grant can be used to create and maintain a financial base with which faculty members carrying out research work or advanced studies can be supported. The same fund may be tapped to acquire new equipment and repair existing ones to upgrade the physical facilities. Thus supported, the faculty can find ways to improve their teaching efficiency by creating new teaching aids or even writing new textbooks. The improvement of physical facilities will also contribute to teaching effectiveness. Full clerical support and availability of research assistants could free the faculty from excessive workload.

Professional Organizations

In the fundamental role of advancing the chemical engineering profession, the academic institutions can work hand in hand with professional organizations. For example, full participation in the activities of the Philippine Institute of Chemical Engineers will enable the various schools to keep abreast of the latest trends in the profession and its current state in the country. Moreover, an active link with this organization can also foster closer contact with experts in the field. Close coordination with government institutions such as the Board of Chemical Engineering and the Technical Panel for Engineering Education (TPEE) helps to keep academic institutions aware of standards in chemical engineering education.

In addition, they can conduct regular dialogues with industrial and government institutions. They can help disseminate knowledge about biotechnology, waste utilization, and other related fields in the country and serve to initiate basic and applied research in chemical engineering.

Research

In the field of research, it is suggested that, whenever possible, faculty research be integrated with student projects to ensure that the expertise of teachers are shared with students. Also, it is proposed that topics for research originate or come from the industry and government so that theses and research projects are brought to tackle on practical applications rather than on esoteric questions.

Research is an important ingredient in the development of industrialized countries. Unfortunately, Philippine national policy has not included research and development as one of the priorities. Therefore, it would be quite difficult for faculty members to perform researches if funding is not readily available. In this regard the performance on research in its true sense will have to wait awhile.

REALITIES

Starting the first semester of 1988-1989, some special features in the U.P. chemical engineering subjects have been included to encourage the students to address problems of local significance. In the chemical engineering laboratory, the students conduct experiments on unit operations and unit processes. To instill a spirit of entrepreneurship in them, practical projects such as soap-making, charcoal manufacture, biogas production, rice-hull utilization, electroplating, fibre-reinforced plastics fabrication, etc. have been included. Upon graduation, students who want to be self-employed can start a business of their own or they can be involved in some small-scale industry in the rural areas.

At the graduate level, subjects in the program are mostly theoretical and students usually question the relevance of the courses. The department has responded by offering courses of practical significance such as plastic engineering, waste utilization, and biochemcial engineering practice. The government and the industrial sector have complained that local manufacture of equipment and materials for industry is practically non-existent. This is because the users opt for imported items which are highly reliable and manufactured under strict quality control. The Department plans to include courses that will develop the skills of the students to respond to the needs of the industry. Specifically, courses will be offered wherein the students will be taught how to design

equipment particularly suited to Philippine conditions. The emphasis is on the local assembly of parts, some of which may be imported. In this case, the total cost of the equipment will be much lower than when it is imported as a finished product. The results of local researches will have priority in the choice of process design.

Creativity and Innovation

It is the faculty's observation that students are too book-dependent; they will not believe anything that is not in the books. Studying by rote leads to the deterioration of creativity and innovation. Educators should instill in their students the sense of creativity, invention, innovation, and research orientation. In this regard, U.P. plans to offer a course on creative engineering, and in coordination with the appropriate government agencies, give lectures on innovations and invite successful inventors as speakers.

The Efforts of the Department of Education, Culture, and Sports

The Department of Education, Culture, and Sports (DECS) through the Technical Panel for Engineering Education (TPEE) has a continuing policy upgrading (Note the term "upgrading" in contrast to the term "improving" used in the title of this paper.) engineering education in the country. The TPEE recommended a set of policies and standards (and enforced by DECS) which covers the different aspects of engineering education including school administration, faculty, library, curricula, and laboratory requirements. The objective is for each engineering school to align its programs to the goals and mission of the institution and the nation and to make engineering education responsive to the growing demands for manpower in the business and industrial world [4, 5].

The Concern of the Board of Chemical Engineering [3]

On January 20, 1988, the Board of Chemical Engineering held a consultative forum among the deans and heads of chemical engineering schools at the Professional Regulations Commission in Manila. The purpose of the meeting was to consult the academe on how to upgrade chemical engineering education in the Philippines. The basis of the consultation was the results of the chemical engineering board examination during the last 5-1/2 years. Those schools that performed creditably were considered good chemical engineering schools while those that did poorly were considered substandard. While the results of the board examination should not be used as the basis, they, nevertheless, showed some defects in the present educational system. Several problems and the corresponding solutions had been presented (See Appendix). Although the problems addressed were the typical problems in Philippine education in general, the task of improving chemical engineering education — a difficult task, indeed — has to start somewhere.

CONCLUSION

The severity of the problems in education in the Philippines can be gleaned from the fact that the Department of Chemical Engineering at the University of the Philippines, already considered one of the premier chemical engineering institutions in the country, is still beset with many problems. Faced with these limitations and cognizant of the deficiencies of chemical engineering education in the country, the Department, nevertheless, continues to work for improvements. The idea is to set up a model which other engineering schools can emulate. It is hoped that through the U.P. experience, deeper insights can be made into the task of improving the way chemical engineering is being taught in the country. The U.P.'s efforts, although pioneering, will hopefully open new roads to improvements and remove stumbling blocks from the course other schools now follow.

ACKNOWLEDGEMENT

Some ideas presented here were culled from the staff meetings of the U.P. Department of Chemical Engineering. We acknowledge their contributions particularly Dr. Rufino Lirag, who initiated the formulation of our goals and objectives.

REFERENCES

[1] Proceedings of the World Congress III of Chemical Engineering, Tokyo, Japan, September 1986.

[2] Proceedings of the 4th APCChE Congress, Singapore, May 1987.

[3] Minutes of the Consultative forum among Deans/Heads of Chemical Engineering Schools, DECS and PRC, Professional Regulations Commission, Manila, January 20, 1988.

[4] MECS Order No 42, s. 1985.

[5] MECS Order No. 50, s. 1986.

APPENDIX

The following are the comments and recommendations made during the consultative forum among the deans/heads of chemical engineering schools at the Professional Regulations Commission in Manila last January 20, 1988.

PROBLEMS AREAS	RECOMMENDED SOLUTIONS
I. SUBSTANDARD CH.E. GRADUATES	
A. Students	
1. Poor academic background	Improve elementary and secondary education
2. Poor mathematical/communication skills	Conduct remedial classes, possibly enlisting bright students
3. Indifferent attitude	Upgrade admission and retention standards Provide guidance counselling Encourage attendance in out-of-school seminars
B. Curriculum	
1. Relevance needs beefing up	Include biology in the basic sciences, applicable technology on a regional basis, plant visits and human behavior subjects Restore Industrial Chemistry Laboratory as a requirement Integrate review classes as part of curriculum or hold review classes in schools or through consortion of schools Strict compliance with DECS and TPEE requirements
C. Faculty	
1. Lack of proper preparation	MS in Education to be required and obtained within 3 years of full time teaching Canned programs for provincial faculties with the assistance of Manila faculties with MS degrees
2. Lack of professional development	In-plant training through linkage with Industry Attendance in convention, seminars, conferences and workshop to be financially supported Encourage membership in professional organization Full-time faculty should be engaged in research work Faculty doing research work should be deloaded

3. Low compensation rates	Present low pay scales should be upgraded
D. Resources	
Inadequate classroom facilities	Limit the number of students in a class
Inadequate library and laboratory facilities	Tax relief should be given schools on importation of books and laboratory equipment Encourage local fabrication of laboratory equipment when feasible Institute sharing scheme among the schools through Eng'g Information Network (EINET) Continue the upgrading of laboratory equipment as per TPEE guidelines Proper maintenance of laboratory equipment
II. GENERAL	
1. Lack of communication among relevant parties	Bi-annual conferences should be held among heads of schools, DECS and the Ch.E. Board under the sponsorship of PICHE
2. Decreasing interest of H.S. graduates in Ch.E. course	Hold a sustained campaign to attract bright H.S. graduates into the Ch.E. profession
3. Proliferation of substandard schools offering the Ch.E. course	Limit the number of schools offering Ch.E. course to those with adequate faculty and facilities Frequent and comprehensive ocular inspection by the Ch.E. Board of schools offering Ch.E. Review the accreditation system for schools offering Ch.E.