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The Design and Standardisation of Engineering Curricula in the Context of Globalisation*

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Engineering curricula play an important, if not the crucial, role in the education process of professional engineers. One of the important aspects of engineering education is the design process of new curricula, which poses many opportunities and challenges, and has to be based on a sound foundation of science and education principles. In this article, the authors endeavour to explore, air and address the impact of globalisation on engineering education and the importance of curriculum development in engineering education, including the methodology used, as well as the key issues associated with this process. Also, difficulties experienced in this process, problems encountered with different educational structures, the need for the standardisation of engineering curricula, as well as the necessity for a global curriculum that would be able to remedy the existing critical situation, are presented and discussed in this paper.

INTRODUCTION

A comparative study, comprising thorough reviews and analyses of the existing engineering education systems used in various countries worldwide, indicates that there is a multitude of approaches towards the development of curricula, their structures and contents. The examined models of curricula exhibit significant differences in the structure of education, content materials, duration of courses and methods employed in the teaching/learning processes. Most of the efforts in research and development activities concerning contemporary engineering education are presently concentrated on multimedia and the application of the Internet in the teaching and learning processes. It is believed that this is at the expense of the fundamental matters in engineering pedagogy, such as research into the development of modern curricula in engineering education. The ever-pervading globalisation has also placed new demands on modern engineering curricula so that engineers, who are capable of performing their professional activities throughout the world, can be cultivated in engineering education institutions.

Although much has been achieved in this area of academic endeavour, comprehensive studies are required in order to devise, develop and implement modern curricula in engineering education that would satisfy the ever-changing needs of professional education, as well as the challenges currently faced in personal development, especially in an era of pervading globalisation of all facets of human life, like the life-style, technology used, production processes and practices, availability of education and others. This is especially important when taking into account such critical factors and issues as the political system, religion, language, history, tradition, culture, customs, etc.

GLOBALISATION

Globalisation, coupled with the rapid expansion and the ever-changing science and technology, is forcing corporations and educational institutions around the world to think and act globally. The effect is real and felt across all nations. It has already altered the way people work and conduct business in the global market.

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Also, the impact of globalisation has already had a profound effect on the educational sector. It places new demands on higher education institutions around the world to review the effectiveness of education and training of technologists, in particular the engineering profession. As a result, many higher education institutions are either discussing, or are in the process of making radical changes to the engineering educational systems.

Some of the changes include modernising, revamping and transforming educational materials and policies to meet the international standards, offering qualifications that are internationally recognised and produce graduates with global potentials.

This is happening because the world is moving towards globalisation, and more and more people are now seeking work outside their home country. This is especially true of the engineering profession as engineering is fast becoming a global profession.

It is estimated that one million Australians are living and working abroad. This may seem like a small figure for large countries, but it is a significant number for a relatively small nation like Australia, as this represents about 5% of the total population.

These are just some of the immediate challenges that educational institutions face today.

Having said that, this raises two important questions. The first is: what is globalisation? Whereas the second question is: what are the main driving forces of globalisation?

A Definition of Globalisation

Hallak states that: *globalisation is, in fact, a combination of the free exchange of goods, services and capital* [1]. It is not a new phenomenon as historical evidence suggests that globalisation has existed for quite some time. According to Hallak:

> *It dates far back in history, with the development of international trade, (the* Silk Road, *the* villes-monde *of the Middle Ages). During the second half of the 19th Century, it was highlighted by the Industrial Revolution as a consequence of colonial exploitation. The continuous modernisation of the international exchange process during the 20th Century and its ratification through international agreements, for example, the General Agreement on Tariffs and Trade (GATT) of 1947, has maintained and given pace to an increasing globalisation of society* [1].

The Driving Forces of Globalisation

Furthermore, Hallak believes that this trend has accelerated in the past few years due to three essential factors, namely:

- *The extent of the economic freedom*;
- *The increase in technological innovation*;
- *The interdependence between these different dimensions* [1].

Globalisation and its Impact

Globalisation has prompted discussions among engineering educators to address and consider the issue of establishing compatibility, comparability and the standardisation of qualifications in education and training systems, and, more importantly, to obtain international recognition for their qualifications.

Why has this become a major concern for educational institutions? Hallak points out that, due to the worldwide spread of the labour market, it has had two consequences:

> *Firstly, the need to compare competencies: how can a company compare a diploma? How can it be sure that certain training has instilled a certain skill? Secondly, the race for excellence: the competition between educational institutions is very likely to intensify and promote the search for the best quality* [1].

Moreover, globalisation is also demanding universities to produce graduates with appropriate skills to compete on a global scale. The type of graduates that are produced is very much dependent upon the education and training system.

An alarming report in *The Australian* revealed that 100 of the top national companies are critical of the current education and training system not being able to produce graduates with the appropriate job skills and that *this failure is choking creativity and limiting Australia's competitiveness in the global market* [2]. Moreover, it has been found that:

> *Many companies noted that education and training systems were not providing graduates with the technical skills appropriate to industry innovation needs. For example, a number of companies noted that university engineering graduates were not skilled*

in simulation techniques that were being increasingly used throughout business [2].

In addition, new education and training systems must develop and equip engineering graduates with the essential global skills to enable them to function and compete globally. The specialised global skills will vary between the different engineering disciplines. However, the general global skills should remain the same, irrespective of the discipline. The most obvious global skills would include spoken and written fluency in foreign languages, appreciation and acceptance for other cultures and customs, as well as an understanding of the laws, professional code of ethics and business practices.

Finally, Hallak suggests the following:

... the traditional task of higher education in producing the cadres of society should be revised in order to address the new demands and challenges generated by globalisation [1].

RESPONDING TO THE CHALLENGE OF GLOBALISATION

FEANI states that *One important trend has been towards the creation of new courses and qualifications at the level of technologist or technician engineer, in a wide variety of fields* [3].

Others believe that a total transformation of the entire engineering curriculum is deemed necessary in order to meet current global demands.

The restructuring of engineering curricula is one issue to consider but, according to the European Federation of National Associations of Engineers (FEANI), there are other issues of concern confronting higher education institutions. Some of the immediate challenges facing educational institutions today include, but are not limited to, the following:

- Tackling the problems of nomenclature;
- Identifying basic standards in engineering education, most noticeably within Europe because of the diversity of national practices and laws governing each country;
- Establishing standards of professional engineering qualification across different countries;
- Licensing and registering the engineering profession, particularly those who have obtained their qualification in a foreign country;
- Resolving the issue of the mutual recognition of engineering qualifications/certifications [3].

The Design of Engineering Education Curricula

Grayson emphasised the important role of a properly design curriculum in producing quality engineering graduates by stating that

... the effectiveness of recently graduated engineers and technician is very much dependent upon the curricula followed during their education and training [4].

Thus, the design of engineering curricula is a critical process in education and often the task is either not carried out satisfactorily or done with very little thought or consideration.

Grayson also highlights three important factors to be considered in designing engineering curricula. These include:

... the educational content, the role of graduates upon completion of their education and training, and lastly, the skills and knowledge obtained upon graduates' completion of their education and training [4].

Moreover, Grayson states the following:

... the design of a curriculum is not an easy task, particularly for a developing country that lacks the basis of existing curricula designed to meet its local needs and conditions. It is often unsatisfactory to copy exactly a curriculum that exists in another country. Moreover, the problem of achieving this task is further exasperated by the lack of adequate human, technological, educational and financial resources [4].

This is in tune with the authors' belief that a global curriculum in engineering may be a viable solution for institutions in developing countries.

There are other external factors noted by Grayson, which may further impinge on the development of any educational system, such as *religion, language, history, tradition, culture and philosophy of life, and the government* [4]. Various other problems experienced by academics in developing countries, regarding engineering education, have been extensively explored by Bordia [5].

Pudlowski and Rochford have recognised that *most engineering curricula exhibit a lack in their* *creators of the understanding of educational concepts and principles* [6]. Moreover, Pudlowski also noted that *such curricula seem to be developed with an apparent neglect of all the important steps, which need to be undertaken in the curriculum development process* [7].

In his extensive analysis of this problem, carried out much earlier, Grayson recognises the fact that:

> *engineering educators have paid little attention to sound principles of curriculum design, except in the most general and intuitive sense, the procedures they have followed have been relatively successful* [4].

The Globalisation of Different Educational Structures

According to the publication produced by FEANI, there appears to be very little – or a lack of – consistency found on the structure of the technical education systems in producing graduates from the three main professional categories found in the member countries of FEANI.

The three categories are as follows: C (*conception engineer*), L (*liaison engineer*) and E (*execution technician*) [3]. It is the existence of different educational structures that the recognition of foreign qualifications becomes a major problem for many countries (Tables 1 and 2 summarise the scientific education of technical professions in categories L and E, respectively). With the existence of so many different educational structures, it is no wonder that there is so much confusion prevailing in the higher education sector. This problem can be simplified by forming some basic standards between countries.

This problem is further complicated by a variation in the terminology used to define the meaning of an *engineer* by member countries. It is not only the structure of the educational system and terminology used that differ, but the authorities also vary considerably from member country to member country. The authorities, to some degree, play a critical role in the budgeting and financing of higher education institutions and, in most cases, have some say on the overall structure of the curricula.

A Comparison of Engineering Curricula Structures

Figures 1 and 2 compare the scientific education for technical professions in category C (*conception*

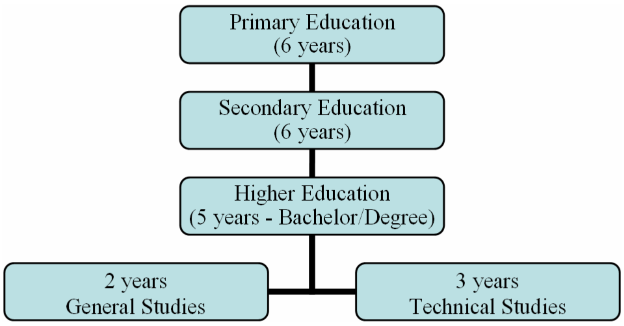

Figure 1: The scientific education of technical professions in category C (*conception engineer*) in Belgium [3].

Table 1: A summary table of the scientific education of technical professions in category L (*liaison engineer*) [3].

Country	Course (years)	Standard Requirements
Finland	4 years or 3 years (if one passes a final secondary examination)	First 2 years basic courses (eg mathematics, physics, chemistry, language); First 2-3 years general vocational courses (eg engineering, etc); The last 2 years specialised vocational education; The final year general education (eg economics.
France	2 years	Majoring in one of the special branches (eg civil engineering, etc).
Luxembourg	3 years	72% scientific subjects (mathematics, physics, mechanics, electricity and statics); 18% general educational subjects; 10% practical education.
The Netherlands	4 years	50% general and science subjects (eg mathematics, physics, chemistry, mechanics); 50% practical education.

Table 2: A summary table of the scientific education of technicians in Category E (*execution technicians*) [3].

Country	Course (years)	Standard Requirements
Luxembourg	4 years	22% science subjects (eg mathematics, physics, chemistry, mechanics); 60% practical training; 18% general subjects.
The Netherlands	4 years	50% science subjects (eg mathematics, physics, chemistry, mechanics) and general subjects; 50% practical training.
United Kingdom	Scientific secondary education of 4 O-level subjects followed by a 2-year sandwich course;	Upon completion, the candidate receives an Ordinary National Diploma.
	Technical secondary education of 4 O-level subjects followed by a 2-year part-time course;	Upon completion, the candidate receives an Ordinary National Certificate.
	Technical secondary education of 3 O-level subjects followed by a 3-year part-time course.	Upon completion, the candidate receives a City and Guilds Certificate.

engineer) between Belgium and the United Kingdom (UK). It can be observed that there is a remarkable difference between the two systems. It seems that the education system in Belgium is very straightforward. It is similar to the Australian model except that most of the degree programmes offered in Australia are completed within four years, as opposed to five years.

In order to become an engineer in the UK, a student must first complete the scientific education required of a chartered engineer. This can be undertaken in various ways and it all depends on the number of *ordinary* and *advanced* level subjects obtained at the secondary education level.

Upon the successful completion of the scientific secondary education, a student can continue along the following paths:

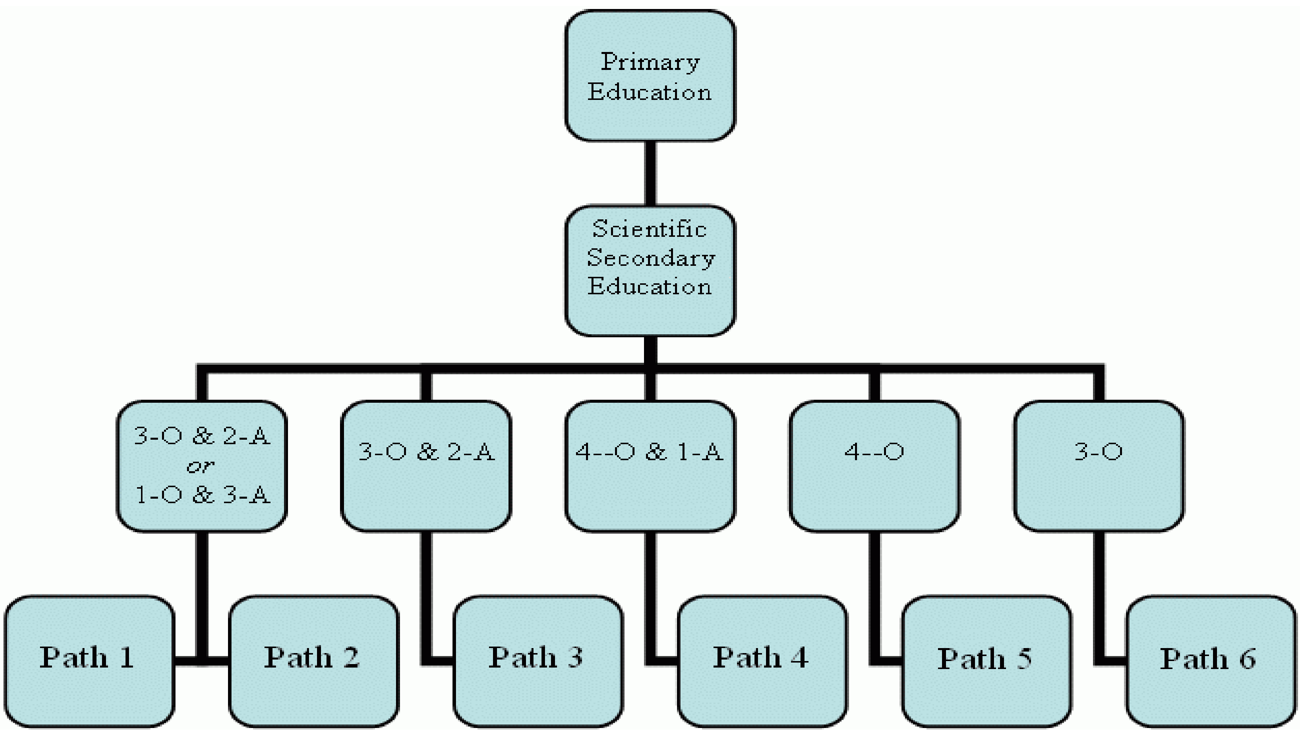

Figure 2: The scientific education of the technical professions in category C (*conception engineer*) in the UK [3].

- Path 1: three years full-time study at a university;
- Path 2: four years integrated sandwich courses at a university;
- Path 3: four years study at a polytechnic with sandwich courses;
- Path 4: three years sandwich courses at a polytechnic or colleges to obtain the Higher National Diploma (HND):
  one year of study for the second part of the examination of the Council of Engineering Institute (CEI);
- Path 5: two years part-time study in a college to achieve Ordinary National Certificate (ONC):
  two years part-time study to obtain the Higher National Certificate (HNC);
  one year of full-time study for the second part of the CEI examination or study for the first part of the CEI examination;
  one year of study to complete the second part of the CEI examination;
- Path 6: three years part-time study in a college to obtain a City and Guilds Certificate:
  one year part-time study to obtain a City and Guilds Full Technological Certificate;
  study for the first part of the CEI examination;
  one year full-time study for the second part of the CEI examination [3].

It can be said that the system to become an engineer in the UK is very different to that of other countries in Europe. Firstly, it is much more flexible and, perhaps, not as straightforward when compared with Belgium, and more complex when compared to other systems. It offers more than one gateway for students to enter the engineering profession and to obtain chartered engineering status. Once again, depending on the number of *ordinary* and *advanced* level subjects chosen at the secondary education level, a student can complete the scientific education required of an engineer within the minimum of three years.

It should be emphasised that it is not only the educational content that varies from country to country, but also the practical training of engineers. The practical training is in the range of four months to two years for class C and class L professional technologists. The practical requirement of class E professional technologists is much longer and usually the two years of practical training is expected of this group. It can be concluded from this study that there is a lack of standards in the education and practical training of professional engineers in various countries.

It was suggested that laying down the general criteria is one way to approach the problem of establishing standards and finding that common element in the education of professional technologists in the various countries of Europe [3]. An alternative suggestion, put forward by the authors, would be to develop a global curriculum in engineering education. This would be one logical approach to addressing the issue of standardisation in engineering education. A global curriculum is basically a common model that can be easily adjusted to suit local needs of a country and be utilised by countries in Europe and abroad. The issue of achieving standardisation is not the sole reason why a global curriculum should be developed, as there are other benefits of a global curriculum; this has been discussed in depth elsewhere [8].

Design of a Global Curriculum for Environmental Engineering

These two methodologies could be used as the basic guide in the design of a global curriculum for environmental engineering. In this particular case, since the inception of the undertaken project, it has been decided that this new system will be designed from scratch, which means it will not be built upon any existing system. However, the development of this new curriculum will require a comprehensive review and an examination of the existing systems in environmental engineering in order to obtain a better understanding of the current state of the art, as well as the present problems. In this project, a comprehensive review and analysis of global accredited environmental engineering programmes have been undertaken and is being used as an important reference point.

This involves an assessment of educational outcomes of the system, with such fundamental goals in mind as the following:

- The level of acquired knowledge;
- Necessary skills;
- Job requirements;
- Necessary professional customs and habits;
- Desirable attitudes, etc [7].

The desired educational outcomes largely determine the content structure. In other words, the subject matter is chosen on the basis of the professional profile of the engineer or, in this particular case, the environmental engineer.

The project also utilises Bloom's Taxonomy's six levels of cognitive domain, as shown in Figure 3, in order to help build a professional profile. This helps to identify the job specific knowledge, understanding and skills related to the environmental engineering profession [9].

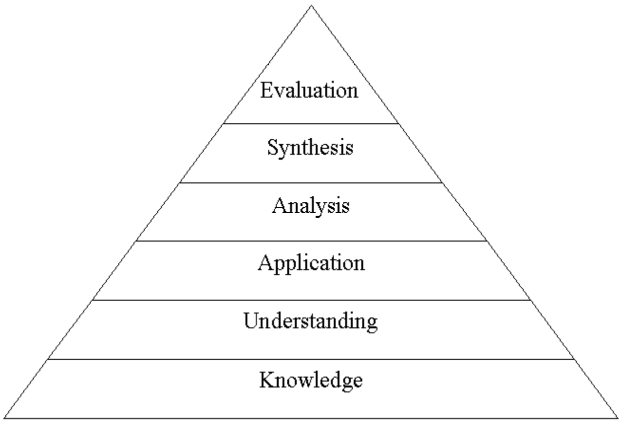

Figure 3: Bloom's Taxonomy: six levels in the cognitive domain.

Bloom identified six levels within the cognitive domain [9]. These are as follows:

1. *Knowledge:* remembering, memorising, recognising and recalling of information;
2. *Understanding*: interpreting, translating, describing in one's own words, the organisation and selection of facts and ideas;
3. *Application*: problem-solving, applying information to produce results and the use of facts, rules and principles;
4. *Analysis:* subdividing in order to show how it is put together, finding the underlying structure of communication, identifying motives and the separation of a whole into its component parts;
5. *Synthesis*: creating or designing a product and the combination of ideas to form a new whole;
6. *Evaluation*: making value decisions about issues, resolving controversies or differences of opinions and the development of opinions, judgements and decisions [9].

Definitions of Curriculum

Grayson defines curriculum as *the organised set of content and activities that a school/institution utilises as the basis for educating students* [4]. Whereas Roebuck described curriculum as *the complementary relationship of a syllabus and its related teaching and learning processes* [10].

The Methodology for Curriculum Design

A general methodology with logical steps has been devised to help in the design of school curricula. Figure 4 shows the general approaches in a methodology for curriculum design [4].

According to Grayson, there are three major stages in designing a curriculum and these are detailed below.

Stage 1: Problem definition:

- The analysis of needs for a technical workforce;

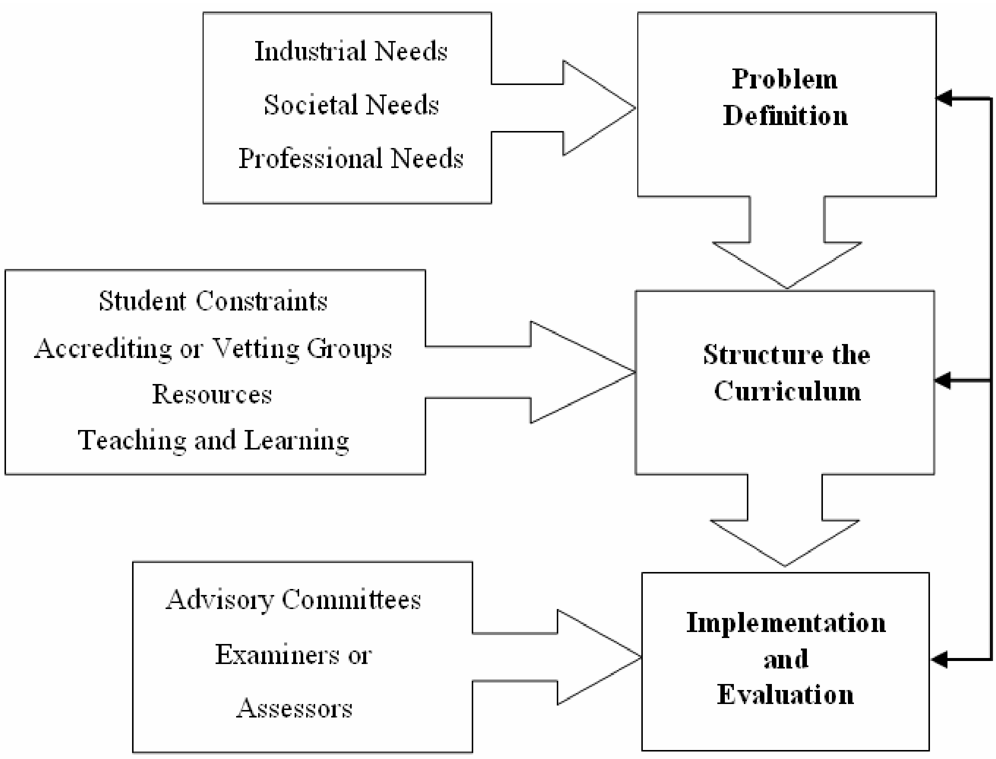

Figure 4: General stages in a methodology for curriculum design.

- The identification of qualification profiles or characteristics in terms of skills, training and knowledge that the graduate is to possess;
- The identification of education/occupation linkages to assist in the development of engineering personnel with the desired skills and attributes. This is achieved by analysing the engineering positions in various sectors of the economy in order to provide information regarding the skills, knowledge and competences needed for the range of engineering occupations; in this case, environmental engineers [4].

Stage 2: Structuring the curriculum:

- The selection and structuring of the content material.

Stage 3: Implementation and evaluation of the final curriculum:

- The validation and evaluation of the curriculum as it is implemented and used [4].

A more specific methodology, known as the *Modelling Method*, which has been used in science and engineering for many years, has proved to be extremely efficient in planning a modern curriculum. This methodology has a wide practical application in engineering education, particularly in the development of novel curricula and educational structures.

Figure 5 shows an educational modelling flowchart that is essentially built upon a theoretical and practical model [7].

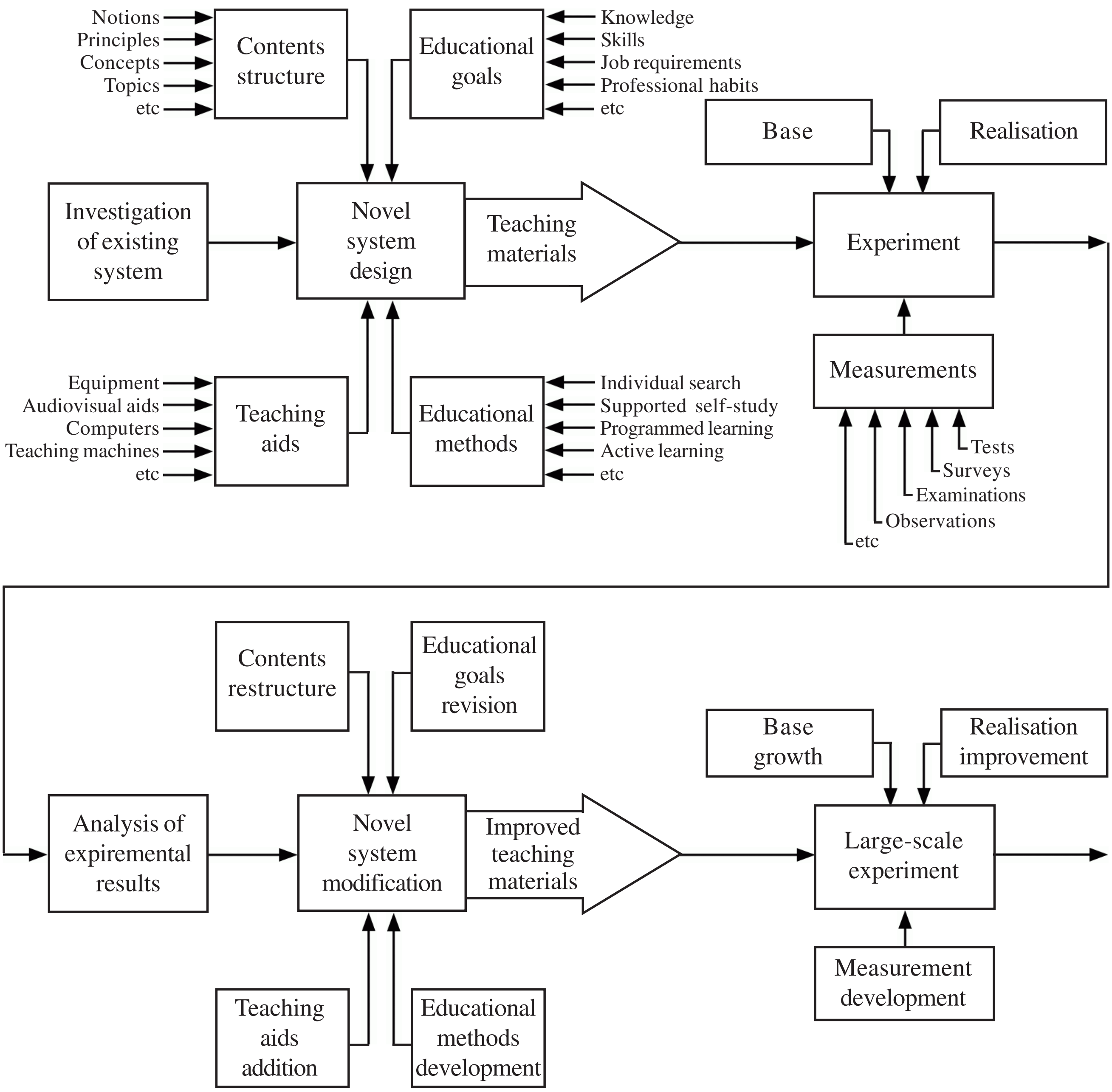

Figure 5: Educational modelling chart [7].

The Modelling Method

This educational method used in the design of novel systems consists of the stages elaborated on below.

Stage 1: Investigation of an existing system:

- Analysis of the subject's content (notions, principles, concepts, topics, etc);
- The identification of educational goals (eg knowledge, skills, job requirements, etc);
- The assessment of teaching aids and its effectiveness (eg equipment, audiovisual aids, computers, etc);
- The assessment of educational methods and outcomes (eg individual search, supported self-study, etc).

Stage 2: Experimental phase:

- The measurement of the effectiveness of the novel system (teaching material, content, educational goals, teaching aids, educational methods, etc) through the use of surveys, test, examination and observation, etc.

Stage 3: Analysis of experimental results:

- The most valuable experimental results are obtained in a natural experiment, eg in a classroom environment. A simple experiment can be carried out using an experimental group and a control group to obtain the required quantitative and qualitative results.

Stage 4: Modification of the novel system:

- The restructuring of contents;
- The revision of educational goals;
- The addition of teaching aids;
- The development of educational methods.

Stage 5: Large Scale Experiment:

- The measurement of the improved teaching material (including revised content, revised educational goals, etc).

Stage 6: Design of the final product [7].

CONCLUSIONS

There are many important points that need to be kept in mind when developing any engineering curriculum. The first relates to the content or subject matter, especially regarding the proportions of the curriculum time to be allocated to non-technical content, science content and technical engineering content, and deciding which content is basic or optional in any engineering curriculum.

The second issue relates to the skills formation, especially the proportions of curriculum time devoted to the development of professional skills, science skills, technical engineering skills, non-technical skills, etc.

Also, when designing modern curricula, special care should be taken to ensure that the professional profile of an engineering graduate reflects the *global* and not regional market, due to the increasing globalisation of engineering education, as there is no such thing as an engineering curriculum dependent solely upon the regional context.

A summary of engineering educational systems used in the past in selected countries has been discussed by Grayson [4]. He begins by presenting the different general educational system that exists in each country and then moves on to more specific discussions about engineering education, particularly the differences in the structure of education, content materials, duration of course and teaching and learning methods that existed among the various countries [4]. Clearly, from the review carried out by Grayson, there appears to be very little uniformity of engineering curricula that existed in the past.

Another review undertaken by Johari shows that similar results existed between various engineering education models from a contents' perspective. It was found that technical contents ranged from 58-90%, and non-engineering contents ranged from 10-42%. With the exception of the USA engineering education model, all other models are structured with stronger emphases on the technical/engineering content [11].

The same disparity is also noted with today's engineering curricula, especially in the field of environ-mental engineering [12]. It seems that this disparity can be remedied by offering a global/ unified curriculum in environmental engineering education.

The additional benefits provided by offering a global curriculum have been mentioned elsewhere [8]. There appears to be general support for the development of a global curriculum in environmental engineering education when taking into account the data collected from a survey of global engineering educators [8].

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BIOGRAPHIES

Dianne Q. Nguyen graduated with a Bachelor of Applied Science, majoring in chemistry and environmental management, from Deakin University, Australia, in 1994 and completed her Masters in Engineering Science (Research) at Monash University, Australia, in 2000.

She has spent some time working in research laboratories before entering academia. Since December 1995, she has been with the UNESCO International Centre for Engineering Education (UICEE) in the Faculty of Engineering at Monash University, Melbourne, Australia. She is currently a Research Fellow and finalising her PhD in environmental engineering education.

Her special research interests include environmental engineering, engineering education, sustainable engineering, global education, curriculum analysis & design, statistical analysis, research methods and women in engineering. Also, she has external interests in Web design and programming in Java and Javascript. In her spare time, she enjoys doing high impact aerobics, tae-box and reading. Her hobbies include fashion, shopping, computers, travelling, playing music and watching movies.

Her awards include: UICEE's *Women in Engineering Education Scholarship* (1997-2000); the UICEE Silver Badge of Honour for her contribution to engineering education and to the operation of the Centre (1998); the UICEE Diamond Award (first place) for a distinguished contribution in delivering an outstanding paper to the *Global Congress on Engineering Education* (1998); the UICEE Silver Award (fourth place) at the *8th Baltic Region Seminar on Engineering Education* (2004); and the UICEE Diamond Award (first place) at the *9th UICEE Annual Conference on Engineering Education* (2006). Also, she is a recipient of the prestigious *Australian Postgraduate Award* (Oct. 2000 - Oct. 2003); Departmental Award (Oct. 2000 - Oct. 2003); Monash Travel Grant (Oct. 2001).

She has served on several national and international engineering education conference organising committees. She has already published close to 50 conference and journal papers.

Ms Nguyen is the current Treasurer of the International Liaison Group on Engineering Education (ILG-EE).

Zenon Jan Pudlowski graduated Master of Electrical Engineering from the Academy of Mining and Metallurgy (Kraków, Poland), and Doctor of Philosophy from Jagiellonian University (Kraków), in 1968 and 1979, respectively.

From 1969 to 1976 he was a lecturer in the Institute of Technology within the University of Pedagogy (Kraków). Between 1976 and 1979 he was a researcher at the Institute of Vocational Education (Warsaw) and from 1979 to 1981 was an Adjunct Professor at the Institute of Pedagogy within Jagiellonian University. From 1981 to 1993 he was with the Department of Electrical Engineering at The University of Sydney where, in recent years, he was a Senior Lecturer.

He is presently Professor and Director of the UNESCO International Centre for Engineering Education (UICEE) in the Faculty of Engineering at Monash University, Clayton, Melbourne, Australia. He was Associate Dean (Engineering Education) of the Faculty of Engineering between 1994 and 1998.

In 1992, he was instrumental in establishing an International Faculty of Engineering at the Technical University of Lodz, Poland, of which he was the Foundation Dean and Professor (in absentia)(1992-1999). He was also appointed Honorary Dean of the English Engineering Faculty at the Donetsk State Technical University (DonSTU) in the Ukraine in 1995.

His research interests include circuit analysis, electrical machines and apparatus, implementation of computer technology in electrical engineering, software engineering, methodology of engineering education and industrial training, educational psychology and measurement, as well as human aspects of communication in engineering. His achievements to date have been published in books and manuals and in over 300 scientific papers, in refereed journals and conference proceedings.

Professor Pudlowski is a Fellow of the Institution of Engineers, Australia, and of the World Innovation Foundation (WIF). He is a member of the editorial advisory board the *International Journal of Engineering Education*. He is the founder of the Australasian Association for Engineering Education (AAEE) and the *Australasian Journal of Engineering Education* (AJEE), and was the 1st Vice-President and Executive Director of the AAEE and the Editor-in-Chief of the AJEE since its inception in 1989 until 1997. Currently, he is the Editor-in-Chief of the *Global Journal of Engineering Education* (GJEE) and the *World Transactions on Engineering and Technology Education* (WTE&TE). He was the Foundation Secretary of the International Liaison Group for Engineering Education (ILG-EE) (1989-2006) and is currently its Chairman .

Professor Pudlowski was a member of the UNESCO International Committee on Engineering Education (ICEE) (1992-2000). He has chaired and organised numerous international conferences and meetings. He was the Academic Convener of the *2nd World Conference on Engineering Education* and the General Chairman of the East-West Congresses on Engineering Education. He was General Chairman of the *UNESCO 1995 International Congress of Engineering Deans and Industry Leaders*, and General Chairman of the *Global Congress on Engineering Education*, to name a few.

He received the inaugural AAEE Medal for Distinguished Contributions to Engineering Education (Australasia) in 1991 and was awarded the Order of the Egyptian Syndicate of Engineers for Contributions to the Development of Engineering Education on both National and International Levels in 1994.

In June 1996, Professor Pudlowski received an honorary doctorate from the Donetsk National Technical University in the Ukraine in recognition of his contributions to international engineering education, and in July 1998 he was awarded an honorary Doctorate of Technology from Glasgow Caledonian University, Glasgow, Scotland, United Kingdom. He was elected a member of the Ukrainian Academy of Engineering Sciences in 1997. In 2002, he was awarded the title of an Honorary Professor of the Tomsk Polytechnic University, Tomsk, Russia, and was appointed an External Professor at Aalborg University, Aalborg, Denmark.

10th Baltic Region Seminar on Engineering Education: Seminar Proceedings

edited by Zenon J. Pudlowski

The successful *10th Baltic Region Seminar on Engineering Education* was conducted at the University of Szczecin, Szczecin, Poland, between 4 and 6 September 2006. The Seminar attracted participants from 18 countries worldwide. Just under 40 papers have been published in this Volume of Proceedings, which include an informative Opening Address about the UICEE European Headquarters and its involvement with European engineering education, plus various Lead Papers. All of these published papers present a diverse scope of important issues that currently affect on engineering and technology education at the national, regional and international levels.

The paramount objective of this Seminar was to bring together educators from the Baltic region to continue dialogue about common problems in engineering and technology education under the umbrella of the UICEE. To consider and debate the impact of globalisation on engineering and technology education within the context of the recent economic changes in the Baltic region, as well as the increasing importance placed on fostering students' entrepreneurship skills, were also important objectives of this Seminar. Moreover, the other important objectives were to discuss the need for innovation in engineering and technology education, and to establish new links and foster existing contacts, collaboration and friendships already generated in the region through the leadership of the UICEE.

The papers incorporated in these Proceedings reflect on the international debate regarding the processes and structure of current engineering education. They are grouped under the following broad topics:

- Opening address
- New trends and approaches to engineering education
- Specific engineering education programmes
- Simulation, multimedia and the Internet in engineering education
- Education and training for engineering entrepreneurship
- Innovation and alternatives in engineering education
- New developments and technologies in engineering education
- Quality issues and improvements in engineering education

It should be noted that all of the papers published in this volume were subject to an international formal peer review process, as is the case with all UICEE publications. As such, it is hoped that these Proceedings will contribute to the international debate in engineering education and will become a source of information and reference on research and development in engineering education.

To purchase a copy of the Seminar Proceedings, a cheque for $A70 (+ $A10 for postage within Australia, and $A20 for overseas postage) should be made payable to Monash University - UICEE, and sent to: Administrative Officer, UICEE, Faculty of Engineering, Monash University, Clayton, Victoria 3800, Australia. Please note that sales within Australia incur 10% GST.

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