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Environmental Engineering Education in an Era of Globalisation*

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Engineering education institutions still grapple with the fundamental concepts and ideas related to the internationalisation of their activities and courses. Comprehensive studies concerning curriculum development and its methodology are essential in order to ensure that the main stream of academic activities is not completely lost in the process of globalisation. Research has been undertaken on a global engineering education curriculum, and a global curriculum in environmental engineering education in particular, in order to identify fundamental issues and concerns in an attempt to devise and develop a proper methodology, which would be used in curriculum development in an era of globalisation. Such research involves the definition of the fundamental body of knowledge that needs to be included in the curriculum, efficient teaching methodologies, strategies and techniques, and other important human and social aspects, which would need to be identified and addressed in a curriculum that may be suitable for use on a global scale. There are, obviously, many advantages and drawbacks of having a global curriculum. However, it is believed that it would facilitate grossly the process of accreditation of international degree programmes and the recognition of foreign qualifications on a worldwide basis, and hence the process of globalisation. Some important aspects and issues in the globalisation of education, and engineering education in particular, are presented and discussed in this article, showing the advantages and benefits coming from such a curriculum.

INTRODUCTION

Globalisation has really and truly become a reality within which we have to live and operate. However, engineering education has not, as yet, given full credence to all the opportunities and benefits that may emerge from a strong international involvement in the process of globalisation. These are reflected by the modernisation and development of economies, as well as industrial and educational infrastructures.

We live in an interconnected world where one nation is closely tied in with other nations and, indeed, to that of the entire planet and its five interconnected systems: economic, environmental, political, cultural and technological [1]. Our educational system is also part of this chain and it, too, must also adjust and adapt to these new changes in order to meet the needs of the globalised world by moving towards global education or, in this case, a global curriculum.

GLOBALISATION

The process of globalisation does not only affect the educational aspect, but also the political, cultural, economic and environmental aspects of a country.

Kiely and Marfleet refer to globalisation as a world in which societies, cultures, politics and economics have, in some sense, come closer together [2].

Giddens defined globalisation as:

> *… the intensification of worldwide social relations which link distant localities in such a way that local happenings are*

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> *shaped by events occurring many miles away and vice versa* [3].

Tye and Tye predict that the globalisation of demography, economics, politics and cultures will eventually lead to a globalisation of curriculum over the long run and suggest that there is emerging support for efforts to globalise the curriculum of our schools. However, such a process will not be easily achieved due to resistance to change within the educational sector and also because the idea of a global education/curriculum as a curriculum movement is still a new idea and very little work has been done or published in the area so far [1]. It has been observed that there is general support from the engineering community towards global education/curriculum, but it will take some time to initiate, develop and come into fruition.

Global education is both an inevitable and a necessary curricular reform. It is inevitable because our society, as a whole, is moving towards global awareness, and it is necessary because young people need to understand the world in which they live [1].

According to Tye and Tye, a curriculum based in a global perspective should engage all students in the study of:

- Humankind as a singular entity interconnected across space and time;
- Planet Earth as humankind's ecological and cosmic home;
- Global social structure as one level of human social organisation;
- Themselves as part of the human species, as inhabitants of planet Earth and as participants in the global social order [1].

The researchers believe that the study on the above can easily be attained, especially through a properly designed environmental engineering curriculum, because it is a broad study of the environmental, political, technological, cultural and human systems.

Global education is defined by Tye and Tye as:

- The study of problems and issues that cut across national boundaries, and the interconnectedness of the systems involved – economical, environmental, cultural, political and technological;
- The cultivation of cross-cultural understanding, which includes the development of the skill of perspective-taking, ie being able to see life from someone else's point of view. Global perspectives are important at every grade level, in every curricular subject area and for all people and in all professions [1].

This is only one definition given, but there are other definitions that are in use.

The Impact of Globalisation on Education

Contemporary education institutions experience a lot of difficulties in adapting to the ever-prevailing process of globalisation at a time when they grapple with diminishing levels of funding, ageing academic staff, the pressure to establish clear and efficient quality control methods, pervasive influx of new technologies, strong international competition, changes in production processes, to name only a few.

N. Grünwald, in one of his recent papers, expressed the following view:

> *Society is faced with two major challenges; the world around us is changing dramatically at an accelerating pace and nothing is considered* regional *anymore: everything has an international and global perspective. Universities cannot afford to ignore this process and have to adapt their education systems according to these developments* [4].

In the authors' view, such changes referred to here are the result of two major events: globalisation and the technological revolution.

The impact of technology on the teaching and training in engineering education has already been well elaborated on by Balagurusamy and Natesan [5].

The need for a holistic type of engineer, with skills to work across intellectual, social and cultural boundaries, is becoming increasingly evident and is being driven by, among many things, the process of globalisation [6].

Grünwald believes that the phenomena mentioned above will create totally new job markets and working conditions and, as such, require new educational policies and educational contents to be implemented. This was witnessed, for example, in Germany after the reunification of East and West Germany, where increasing trends towards globalisation and the internationalisation of production markets, communication and information, including the education market, have emerged [4].

University education today has become increasingly global and internationalised. Hence, education institutions, especially in English speaking countries, have to compete globally for student intakes [7]. The changes are real and have already impacted tremendously on institutions in Europe in the last couple of years, even more so now when new countries have

been admitted into the European Union (EU).

One of the effects of the process of European unification has been the emergence of the *Bologna Declaration*, which was released in June 1999. The underlying principle of this Declaration was to create a coherent and cohesive system of education within the *European Higher Education Area* by the year 2010, which would address such issues as mobility, transparency, compatibility and comparability in the European higher education sector.

It appears that the interpretation and application of the Declaration varies from country to country. Several works have been published, showing discussions about how individual countries in Europe have adopted the Declaration and on the different approached utilised in this process. These can be found, for instance, in an article by Hedberg [8].

Initially, there were 29 European Ministers of Education who were signatories of this document. To date, a total of 40 signatories have been recorded. The increasing number of European countries signing this Declaration is a definite indication that achieving international comparison and equivalence is high on the agenda among European nations. Also, it is a true reflection of their commitment towards greater transparency and harmonisation (not unification) of the education processes found in European universities, as well as the increased level of the mobility of students and staff [4].

The grading systems used by individual countries is another important issue that concerns the European Union [9]. It appears that devising and adopting one common grading system is a crucial task for the EU, especially in the current era of globalisation and internationalisation. This would help to simplify the recognition and accreditation processes and would make it less complicated for those studying abroad. This problem is being currently dealt with through the *European Credit Transfer System* (ECTS), which is presently used across Europe and has been initially set up for credit transfer [10].

In response to globalisation and the harmonisation of engineering education, and thus the increased mobility of engineers, the researchers propose, and argue for, a global curriculum to be developed and implemented by international education institutions. Studies are currently underway in order to design a global curriculum for environmental engineering.

Other researchers have proposed bilateral and multilateral cooperation as a vehicle to achieving international recognition, which would, basically, involve joint projects. As such, many collaborative agreements in this respect have been established, for example between India and Germany, and also France and Canada [11][12]. They demonstrate that even for those countries that have very different educational systems, it is still possible to form such collaborations.

Engineering Education in an Era of Globalisation

Engineering education, in particular, has done very little to promote global awareness, and engineering educators have yet to touch on the issue of global education. Many engineering subjects, regardless of the disciplines, are taught in isolation with a minimal global awareness and exposure, and are offered today by academic institutions. Such subjects are usually taught on their own with no reference to the economic, environmental, political, cultural, technological and global aspects. Engineering academic institutions need to adopt a more holistic approach to teaching engineering so that it will enable students to understand how engineering is related to the five interconnected systems, as well as to the global community.

There is another dimension, which is beyond the scope of the researchers' project, although very interesting and worth mentioning about, that covers research on whether the exposure of a more globally oriented curriculum to elementary or primary school students would mean less ethnocentrism, prejudice and intolerance in later years [1].

Similar studies could be conducted on engineering students in order to investigate whether a global curriculum would have any affect on students' behaviour and tolerance towards other races, and if such a curriculum would help broaden their views and understanding of the world.

A study of faculty members from a number of schools in the USA revealed that very few people had an understanding of what global education was and an even smaller number did anything to globalise their curricula. Moreover, it was found that there were no examples of international studies and no one really spoke about problems or issues that cut across national boundaries [1]. It appears from this study that there is confusion and very little is understood about global education and globalising the curricula among educators.

The engineering profession, like most of the other global professions, is going to be submitted to a global evaluation in terms of the qualities required of what a universally accepted engineer should possess from an educational point of view, and also as seen by a provider of professional services (eg industry) [13]. With many countries having various legal frameworks, requirements, local codes and procedures to govern the practice of engineering, this makes for an enormous task to define specific rules for each case to be considered [13].

In the light of the increased mobility of highly educated workers on a global level, educational institutions in many parts of the world will have to prepare them for a future in which they will, to an increasing degree, be compared not to their own country's institutions, but also to institutions in other nations [14]. The internationalisation of degree programmes can ease the transferability of academic credits for courses taken abroad and also may become a way to open doors for students from abroad [14].

Tilmans also expressed the importance of developing the mechanisms and articulation for the recognition of degrees and coursework on an international basis. For example, he gave three primary reasons for this need in the USA, namely:

- The great number of foreign students wanting to study engineering in the USA or transferring credits from a foreign university to an institution in the USA;
- The increase of US students wishing to study abroad;
- The increase of diploma mills [15].

Vroeijenstijn expresses his view that an international comparison is more important today than ever before because of the following reasons:

- Comparisons between universities: a university must assess its quality and the value of its degree;
- Student exchanges and student mobility necessitate a deeper insight into the programmes of other universities;
- Employers will ask questions about the equivalence of degrees [16].

A Global Curriculum for Environmental Engineering

Taking into account the above, the authors have taken the initiative to devise and design a global curriculum for environmental engineering. In designing such a curriculum, the authors had to consider the current problems associated with existing environmental engineering curricula, as well as all the burning issues mentioned above, such as globalisation, harmonisation, international recognition, mobilisation, etc. The research procedure and the methodology utilised in this project has been reported elsewhere, with the advantages and benefits of such a curriculum listed [17][18].

One of the most challenging tasks in the development of the global curriculum for environmental engineering is to incorporate the two key points mentioned above into the curriculum. The objectives of such a curriculum would, ideally, be to promote global awareness, global study on various issues and, ultimately, to develop one common curriculum that can be used on a worldwide basis. Such a curriculum would eliminate the need for any recognition and accreditation procedures between countries, would not restrict graduates' choices and opportunities upon entering the workforce, and would promote cross-cultural awareness and understanding within the engineering profession.

ENVIRONMENTAL ENGINEERING EDUCATION

In the wake of the widespread environmental problems and crises reported in the media, as well as the increased demands from the public, a growing interest in the environment among engineering educators from around the world has been witnessed in the last ten years or so. It has become clear that engineering educators need to take a more proactive role in greening engineering curricula, and that changes to existing curricula are urgently needed in recognition of the environment.

There were various approaches that have been adopted by engineering schools to incorporate the environment into engineering curricula. Many have started integrating the environment into traditional engineering subjects, offering more specialised environmental subjects as optional units in engineering curricula and developing environmental engineering undergraduate programmes.

To many, these new approaches and actions may be seen as positive initiatives by engineering schools to make the environment a common part of engineering curricula, in particular, with the increasing numbers of environmental engineering programmes that have eventuated over the last decade. However, there are problems with existing environmental engineering programmes that still need to be resolved. Some of the problems have been discussed and presented elsewhere [19].

Due to the impact of globalisation, as the world slowly transforms into a global economy, the researchers believe that the best alternative is to move towards global education or a global curriculum. In this study, it is proposed that one common curriculum, initially for environmental engineering, be implemented on a global scale. The principle idea is to develop a curriculum within an environmental and global perspective. It is not an easy transformation and one would expect some rejection and opposition from some engineering educators. Many would prefer to have their own programmes, particularly developed within the local milieu and context.

It is the researchers' contention that, in the long term, this would be much more feasible from an economic perspective. A common curriculum would also help overcome the serious problems of recognition and accreditation, which vary both within and between individual countries.

Environmental engineering is different from the classical engineering discipline because it is multidisciplinary in nature, covering a broad range of topics from engineering, science, economics, humanities, etc. It is not enough to take existing engineering curricula and add on environmental units, and then call it environmental engineering, which has been a common approach adopted by many engineering schools. This way may appear to be the quickest and most economical and productive way of developing a new programme, but it has resulted in many problems.

The Strathclyde Model

The Strathclyde Model was developed by an environmental education group in Scotland in the mid-1970s to develop environmental education in schools in Scotland [20].

According to this model, the following important items need to be considered in developing environmental programmes:

- The aims and contents of their programs (*epistemological factors*);
- The physical, social, political and cultural context in which it is presented (*environmental factors*);
- The age and experience of those to whom it is directed (*developmental factors*).

The objective of environmental education should include the following:

- To identify and observe more accurately the many components of the environment;
- To understand the inter-relationships and interdependence between these components and people;
- To evaluate the aims and environmental consequences of human activities;
- To act, directly and indirectly, in a manner that will ensure the maintenance of a harmonious relationship between humans and the world in which they live [20].

A description of what makes education environmental was well covered by Smyth. He gives an array of environmental topics that can be used by course designers in developing environmental programmes [21]. It would be impossible to address every single topic in detail due to the lack of space in the curriculum. One way of overcoming this problem is to evaluate the fundamental topics for inclusion in environmental engineering programmes so as to ensure that the fundamental topics are well covered in the curriculum and to give students the necessary knowledge and skills to contribute positively towards the environment without overloading the curriculum with irrelevant subjects.

Environmental engineering programmes should also be structured in such a way as to include the salient features mentioned above, but also some design units that will allow students to design environmental and sustainable processes, systems and technologies used to solve environmental problems. This is what makes environmental engineering distinctive from environmental education.

Traditional subjects with long-established philosophies still hold sway [21]. This is absolutely true, particularly in the field of engineering. Environmental engineering courses in the past have been designed to place too much focus on engineering/technical subjects and perhaps neglected the environmental educational side and global aspect in the curriculum. A well designed core curriculum for environmental engineering should be structured to include the fundamental topics from a wide range of disciplines, such as engineering, science, environmental, humanities, etc.

APPROACHES TO ENVIRONMENTAL EDUCATION

Three approaches of environmental education can be divided into the following:

- Education **about** the environment;
- Education **for** the environment;
- Education **in** or **through** the environment [22].

Education **about** the environment is to gain knowledge about natural systems and processes and the ecological, economic and political factors that influence decisions about how people use the environment. Knowledge of the interactions between natural systems and social systems is considered an essential requirement for resolving local, national and global environmental issues and for managing the environment responsibly [23].

Education **for** the environment is the exploration and resolution of the environmental issues in order to foster the values of the *New Environmental Paradigm* and to promote lifestyles that are compatible with the sustainable and equitable use of resources [23].

Education **in** and **through** is to add reality, relevance

and practical experience to learning, and to provide students with an appreciation of the environment through direct contact with it [23].

The Tbilisi Declaration

The Tbilisi Declaration, which resulted from the International Environmental Education Programme Conference convened in 1977, advocated that environmental education should:

- Consider the environment in its totality: natural and built, technological and social (economic, political, cultural-historical, moral, aesthetic);
- Be a continuous life-long process, beginning at the pre-school level and continuing through all formal and non-formal stages;
- Be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;
- Examine major environmental issues from local, national, regional and international points of view so that students receive insights into environmental conditions in different geographical conditions;
- Focus on current and potential environmental situations while taking into account the historical perspective;
- Promote the value and necessity of local, national and international cooperation in the prevention and solution of environmental problems;
- Explicitly consider environmental aspects in plans for development and growth;
- Enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;
- Relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in the early years;
- Help learners discover the symptoms and real causes of environmental problems;
- Emphasise the complexity of environmental problems and thus the need to develop critical thinking of problem-solving skills;
- Utilise diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experience [24].

The objectives of environmental education are as follows:

- *Awareness*: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
- *Knowledge:* to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.
- *Attitudes*: to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection.
- *Participation:* to provide social groups and individuals with an opportunity to be actively involved at all levels in working towards the resolution of environmental problems [24].

In this project, one of the objectives has been to define a set of attributes and skills specifically required for environmental engineers. Such important data could be useful in determining the content of a global curriculum for environmental engineering.

Goodall, in his book titled *Developing Environmental Education in the Curriculum*, offers a range of opinions and responses expressed mainly by teaches/educationalists on the relationship of environmental education to other cross-curricular themes, such as IT, music, mathematics, etc, and how environmental education can be incorporated into a variety of study disciplines [25].

In today's information economy, the pace of change and technological advances are so intense that people need to be perpetual students. To stay competitive in the global job market, people must keep updating their education throughout their entire working lives. To stay globally competitive, students need to have qualifications that are recognised by other countries in order to enable them to practice worldwide. It is believed that a global curriculum/education would simplify the process of recognition and accreditation of qualifications.

THE EVOLUTION OF ENVIRONMENTAL ENGINEERING

The name and scope of environmental engineering has changed dramatically since its first inception. The name has evolved over decades from sanitary engineering, which deals mainly with the treatment of water and sewage. It was then changed to public health engineering and, as the problems grew wider, spreading to other parts of the environment, it was then changed to environmental engineering. Sanitary and public health engineering were initially areas of practice for civil engineers.

The required areas of knowledge in environmental engineering have been subjected to periodic modifications (mostly expansion) because of the increasing intensity and diversity of human activities. Civil and sanitary engineers were the pioneers of environmental engineering once upon a time, when environmental quality concerns were limited to safe water supplies, wastewater disposal and land drainage. Formal sanitary engineering curricula were introduced as post-graduate programmes to include public health engineering, water and wastewater treatment as the primary courses, which were recommended to be taken by all graduates [26].

As concerns over air pollution, industrial wastes and solid waste grew; chemical engineers and mechanical engineers began to play a more important role in environmental engineering [27].

At the end of the 1980s, much of the education and employment in environmental engineering was expanded to incorporate soil and groundwater remediation, toxicology, risk assessment, atmospheric modelling and process design [27].

Moreover, the scope of environmental engineering has since evolved and expanded over the past decades to cover all facets of the environment, including air, soil, land, water and humans because of the increasing spread of environmental problems, public concern about the environment and environmental legislation.

Environmental engineering is said to be different from classical engineering because it is more broadly defined and because its multidisciplinary nature touches on issues that cross other branches of study, ranging from science, arts, mathematics and engineering.

Environmental engineering involves assessing, managing, preventing and controlling the impact of human activities on the environment. The environment is basically our surroundings, consisting of air, land, water, humans and all non-living and living things. Furthermore, it also entails the planning and designing of systems, equipment and technology for the management and protection of the environment. This requires that the environment be given top priority in any decision-making process.

Because of this broadness, it would be much simpler to harmonise environmental engineering education and develop a common curriculum in environmental engineering.

IDENTITY CRISIS IN ENVIRONMENTAL ENGINEERING

There seems to be an identity crisis associated with environmental engineering. One of the factors causing this problem may be the declining interest in the environment over the last few years, which, once upon a time, was one of the hottest issues in engineering. It has been generally stated that environmental engineering does not only lack identity as a discipline, but also lacks a professional identity.

The reason for the lack of identity as a discipline is mainly due to its emergence from studies in civil engineering. This is a problem because environmental engineering is view by many as an addition to civil engineering programmes and is not accepted or regarded as a separate discipline in its own right; this is probably derived from the lack of detachment from civil engineering.

Environmental engineering encompasses a broad range of professional practices that are frequently defined by applications in specific media (such as air, drinking water or soil) or by their inclusion as a speciality within other engineering disciplines, particularly in civil or chemical engineering. It appears that other engineering disciplines have established fundamental principles and core knowledge that define those disciplines, while environmental engineering still tends to be defined by the types of problems that environmental engineers work on [27].

It is for this reason that the range of professional practice in environmental engineering and the core body of knowledge required for such practice remain poorly defined. Education in environmental engineering should be grounded in fundamentals, which will prepare graduates to work on a wide range of problems in practice [27]. One of the objectives in developing this global curriculum has been to identity the fundamentals and thereby enhance its visibility in the curriculum.

There is another different type of problem that has also been raised at a recent environmental engineering workshop in relation to the identity of the profession. There was a general consensus that there is no unified voice, nor organisation, to properly represent and promote environmental engineering as a discipline to the public and to decision-makers, thus marginalising its relevance to society. This is a problem because in the absence of a unifying organisation, environmental engineers have a limited impact on issues of concern to the profession, and are unable to speak with one voice to governmental agencies, foundations or other professional organisations [27].

Thus, without the existence of such a unified organisation, environmental engineers will have no influence in the decision-making processes. The solution proposed at the workshop to resolve this issue included the following elements:

- Establishing a single organisation to represent the multidisciplinary nature of environmental engineering and also to bring together different sub-disciplines and perspectives for the cross-fertilisation of ideas and approaches to studying and solving environmental problems.
- Establishing a broadly representative environmental engineering organisation to coordinate activities that can address a host of environmental issues, to promote the development of new knowledge to solve such complex environmental problems and to anticipate emerging issues of concern in environmental engineering [27].

CONCLUSIONS

Environmental engineering has grown, expanded and evolved into quite a unique area of engineering over the last few decades. However, it still lacks identity as a discipline and as a profession within engineering in this rapid era of globalisation. The researchers propose a global curriculum in environmental engineering education with the fundamental body of knowledge be identified and developed strongly in the curriculum. The idea of the global curriculum is to harmonise environmental engineering education and to develop a curriculum that may be utilised on a global scale.

Research concerning problems that developing countries currently face in engineering education indicates that there is a tremendous need for such a curriculum and that it would be particularly beneficial there, where resources are scarce and substantial costs of higher education would have been reduced by sharing the developed courseware, software, laboratory procedures, methodologies, etc. Such a curriculum, although appearing uniformed, would still permit the introduction of local and regional issues, and would also allow the inclusion of environmentally sound policies and local programmes.

The need for, and the implications of, a global curriculum in environmental engineering education are discussed in this article, pointing out some of the benefits that would emerge from such a curriculum. Furthermore, it is believed that such a curriculum would facilitate grossly the process of accreditation of international degree programmes and the recognition of foreign qualifications on a worldwide basis. A common curriculum could avoid the problems of the multiplication of course offerings and also reduce substantial administrative overhead costs that are attributable to departmentalisation. The other advantage noted of a common curriculum is that it does not restrict the graduates' choices and opportunities upon entering the workforce [28].

The recognition at the full professional level of engineers coming from two different countries with totally different systems is a very difficult task. However, in the context of the globalisation of all human activities, particularly engineering services, it is essential that well-developed countries take very serious efforts to utilise an open-minded approach to establish the parameters that will permit the ultimate objective of international recognition to be achieved [13]. For environmental engineers to be truly recognised, being able to move freely beyond national settings and work across national borders, recognition and accreditation need to be resolved by establishing some form of standardisation and/or harmonisation in the education system, so that it fits into the global education standards. One way of achieving global standards may be through the use of a global curriculum. Moreover, there are other advantages coming from having such a curriculum: it would facilitate grossly the process of the accreditation of international degree programmes and the recognition of foreign qualifications on a worldwide basis.

It is hoped that the work presented in this article, which involves comprehensive research, the design and development of such a global curriculum in environmental engineering education, will meet a positive climate and response from the global engineering education community. Therefore, the paramount objective of this article is to elicit support from international academics for this important and timely endeavour.

As far as the professional identity problem is concerned, it has been suggested that a unified organisation be development in order to promote environmental engineering at the professional level.

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BIOGRAPHIES

Duyen 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. 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 Officer and is pursuing her PhD.

Her special research interests include environmental engineering education, sustainable development, curriculum analysis and design, 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); UICEE Silver Badge of Honour for her contribution to engineering education and to the operation of the Centre (1998); Diamond Award (first place) for a distinguished contribution in delivering an outstanding paper to the *Global Congress on Engineering Education* (1998) and the Silver Award (fourth place) at the *8th Baltic Region Seminar on Engineering Education* (2004). 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 also served on several national and international engineering education conference organising committees. She has already published over 30 conference and journal papers in the field of environmental engineering and sustainable development education.

Ms Nguyen is a member of the Environmental Engineering Society and the Australian Conservation Foundation.

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 Pedogogy 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. His achievements to date have been published in more than 300 works, including books, manuals and scientific papers in refereed journals and conference proceedings.

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 National Technical University (DonNTU) in the Ukraine in 1995.

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 boards of many international journals. He 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*, and is the Foundation Secretary of the International Liaison Group for Engineering Education (ILG-EE).

Professor Pudlowski has chaired and organised many international conferences and meetings. 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 then 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. In 1997, he was elected a member of the Ukrainian Academy of Engineering Sciences. 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.