Role Models and Environmental Education:
The Good, The Bad, and the MIA

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Students 'know' that learning about communication, sustainability, social issues, even environmental issues, is "not very important." They know this because many, perhaps even most, of their engineering professors do not pay much attention to these things; they know because learning about such things means picking up a couple of courses outside of the engineering faculty as part of their 'complementary studies' requirement. "Besides," says one student, "I've never seen anyone deal with these things during work experience." Other students in the group not their heads in agreement. "Yeah," says another student, "and companies aren't going to hire 'tree-huggers' anyway."

Many faculty members still maintain that, except for environmental engineering specialties, there isn't time or space to fit environmental/sustainability issues into already densely-packed courses. Some maintain that these are issues for attention after students complete their basic education. In any case, to quote one faculty member, "Sustainable development has nothing to do with engineering" (apparently it's a "policy issue").

We disagree. In fact, we believe that we are all already teaching students how to respond to environmental/sustainability issues. It is said that talk is cheap; nonetheless, it's not without effect, and what is left unsaid can be as important as what is spoken. Further, even if people doubt what you say, they'll believe (and learn from) what you do. Whether we recognise it or not, all of us are role models — for better or worse. And what we ourselves model in the classroom is as important, perhaps even more important, than what we hold up as other examples to our students. It is essential that we become more self-aware and reflective practitioners.

This paper considers some of the ways that we, as 'role models' in the classroom, do and could impact students. The context for our discussion is environmental education in a broad sense, inclusive of ecological, social and economic 'environments', or what some people consider the three 'legs' of sustainable development. We believe engineering education should facilitate development of students' knowledge, attitudes and skills in ways which are attentive to these environments and that this task is not exclusive to environmental engineering specialisations. The paper provides examples of some good and not-so-good role model behaviours, and identifies areas where better or more role models are needed. The paper also includes suggestions for identifying, supporting, encouraging and/or developing role models (ourselves included!) of the environmental engineer and engineering educator of the future.
INTRODUCTION

We need to be clear from the outset: this paper is about environmental education in a sense which includes the triple bottom line so eloquently advocated by John Elkington [1], incorporating ecological, social (and cultural and political), and economic ‘environments’. However, this paper is not about the role of GIS and environmental modelling in the conservation of biodiversity, nor the role of human perception in modelling the response to the route of a new freeway, nor the role of economic theory in modelling the long run. These topics are important in their own right, but in this paper we are concerned with human role models: with practising what we preach.

OUR STARTING POINT

Our starting point in this paper is that there is more to life in engineering than the Technical Rationality model would have us believe. According to this model, professional practitioners solve problems by manipulating known techniques to achieve particular ends within known constraints. Many now acknowledge, however, that this model only holds for routine or recognisable situations and, therefore, that the Technical Rationality model is radically incomplete. For new or unique problems, Schon [2] argues that the professional practitioner’s process is much more artistic in nature and requires, and is enriched by, reflection during and after solving the problem. In Schon’s epistemology of reflection-in-action, the practitioner’s stance is particularly poignant. Schon argues that the practitioner’s values and views are, and should be recognised as, necessary and unavoidable part of the solution-generating process.

Of most interest to our argument in this paper is Schon’s [3] description of the culture of the reflective practicum: the environment in which skills and culture are transferred from practitioner to student:

A reflective practicum must establish its own traditions, not only those associated with project types, formats, media, tools, and materials but also those embodying expectation for the interactions of coach and student. Its traditions must include its characteristic language, its repertoire of precedents and exemplars, and its distinctive appreciative system. And the last, ... must include values and norms conducive to reciprocal, public reflection on understandings and feelings usually kept private and tacit. (p. 311-2)

This begins to reveal the importance of being explicit about a whole range of approaches, experiences and values that the educator brings to the situation -- in short, the educator, as an entire practising professional, is a potent role model. This principle of the significance of role models in the educational process has been espoused more recently by Candy [4].

Whether in primary, secondary, further or higher education, there seems to be little doubt that learners are influenced by example as much as, if not more than, by precept. In other words, the examples set by teachers or lecturers are often decisive in influencing how learners actually behave. (p. 13)
This position was based in part on the results of an Australian study [5] which investigated the contribution of undergraduate education to graduates developing a predisposition towards lifelong learning. The authors considered the curriculum (structure and content), teaching and assessment methods, and availability, nature, and use of student support services. The actual behaviour of academic staff was shown to be far more influential than all the official documents and institutional rhetoric in determining student attitudes towards lifelong learning.

We believe this finding can reasonably be extended to incorporate not just attitudes toward lifelong learning, but also to attitudes and values in general, and, in the context of this paper, to the views and values our students develop about the roles and responsibilities of engineers regarding sustainability or, if you prefer, a triple bottom line model of environmentalism. In the next portion of this paper we turn to an explication and examination of different role models that we have cast as “the good, the bad and the MIA.”

ROLE MODELS

The Bad … (violating -- or not even talking -- the talk)

It's a very hot and dry day. Water restrictions have been in effect for three weeks and warnings that the reservoir is dangerously low have been in the news everyday. Next door a man is washing his car. Children play gleefully in the water streaming down the street from the open hose.

On another street someone has mixed several gallons of a toxic pesticide solution. After spraying the trees there’s quite a bit left over. No longer needed, more than a gallon of the solution is poured down a storm drain decorated with yellow fish.

The individuals described here are not what we would call “good models.” For many of us, stories such as these are quite distressing: ‘we’ wouldn’t do such things. Perhaps we would not; but what about our behaviour in the classroom? with students, colleagues and peers? Are they beyond reproach? In our view, bad practice in the context of this paper is that which perpetuates the technical rationality myth and not only ignores, but also discounts the existence of any other modus operandi. We also consider poor models to be those who perform actions which are incompatible with substantive and process principles of sustainability. We have no intention of identifying particular individuals; instead we include some stories and a series of untraceable anecdotes and we are sure you could add some from your own experience.

When asking for feedback on preparations for an interactive session with chemical and environmental undergraduate engineering students on professional ethics, the lecturer was told in no uncertain terms that a colleague was already ‘covering’ ethics: 1 hour in a 4 year program was deemed sufficient.

A brave new first year subject was trying to expose budding students to professional engineering practice. An academic needed to make an announcement to the first year class, so she asked the lecturer in charge, who happened to be the dean of the faculty, if...
she could visit the class on a particular day. The dean’s response: ‘Well, I don’t expect
there’ll be many people there - it’s just the lecture on ethics that day’.

Underlying message: Ethics isn’t a high priority for engineers and, therefore, it’s okay to miss a
lecture on ethics.

We’ve provided an example of “Faculty Talk” about sustainability earlier in this paper
(“Sustainable development has nothing to do with engineering; ... it’s a policy issue.”) but it’s
not only what individual faculty say that is important. The curriculum overall sends an implicit
message. A number of studies have been undertaken to investigate engineering curriculum and
practicing engineers’ knowledge and skills related to the environment and sustainability.
Curriculum analyses, revealing an absence of significant kinds of content, have resulted in such
conclusions as “the next generation of engineers is not in a good position to make a significant
contribution to the development of a more sustainable way of life” ([6] p. 825); that “current
engineering curriculum is not compatible with sustainability.” ([7] p. 14) and is “not well suited
to providing the broad foundation . . . needed by today’s engineering students.” ([8] p. 2690). In
sum, that sustainability issues and principles are less than well represented in current
undergraduate engineering education programs.

The message: Environmental and sustainability issues are not sufficiently important to warrant
much attention in engineering.

We will finish this too-familiar litany with one publicly reported case. We choose this case not
out a desire to shame the institution, but rather to praise it for taking the difficult step of inquiring
openly and honestly about local practice, and trying to deal with the answers. It is, therefore, a
case that, while revealing some “poor models”, also provides a good model of openness to self-
examination.

In an ethnographic study of first year engineering [9], lecturing staff were asked whether
they were familiar with Gender in the Engineering Curriculum [10]. This booklet, which
was distributed nationally to all engineering lecturing staff, is a very user-friendly guide
on such issues as non-discriminatory language and gender-inclusive teaching. Of the 7
respondents, 2 were aware of the guidelines, but were not implementing them. The
remaining 5 said they had not seen the guidelines, and furthermore, declared that they
would not implement the guidelines even if they were aware of them.

It is a challenge to develop a culture which celebrates diverse ways of thinking when this is the
nature of the existing foundation values.

Missing in Action …(not walking the talk)

Last week you went to a workshop on sustainable development. It was a pricey
affair but you figured the event was too important to miss. Your workshop
package was filled with papers (all single-sided) and glossy brochures. There
wasn’t a recycling box in site. Refreshments were served in single-use plastic and

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Yesterday you heard someone talk about the importance of talking to one another, of open communication, of multi-stakeholder processes and public-involvement. It was a lecture; no opportunity for questions or discussion.

The Missing In Action cases are probably the most plentiful: situations where the rhetoric is grand, but the action is non-existent or inconsistent. Our earlier discussion of curriculum may in fact fit just as well as an MIA case. Certainly there has been lots of ‘talk’ about the importance of integrating environmental and sustainability principles and concepts into engineering curriculum. So far, however, it seems that talk is pretty cheap.

In a recent survey of all environmental engineering degrees currently offered around Australia [11], only about half of the respondents specified the concept of sustainable development as an important principle which was taught within the degree program. It is difficult to understand how environmental engineering could possibly avoid the concept of sustainability.

The Institution of Engineers, Australia (IEAust) released its Policy on Sustainability in 1994. The section entitled Need for this Policy states:

Those who practice engineering need to recognise that failure to achieve ecological and resource sustainability will have significant adverse consequences for the economy and society, and that actions to achieve sustainability will involve changes to the economy and society, including changes to engineering practice.

Now, almost 4 years on, small, tentative steps are being taken by the IEAust - the new accreditation guidelines for professional engineering courses, released in November 1997 [12], list as one of the generic attributes of a graduate: ‘understanding of … the need for and principles of sustainable development’. We look forward to the implementation of this new policy with baited breath, and we look forward even more to similar moves in the registration process for professional engineers. In Canada, the situation is not much different. The Canadian Council of Professional Engineers (CCPE) Qualifications Board (1994) states that:

The “practice of professional engineering” means any act of planning, designing, composing, evaluating, advising, reporting, directing or supervising, or managing any of the foregoing, that requires the application of engineering principles, and that concerns the safeguarding of life, health, property, economic interests, the public welfare or the environment. (p.8).

As of 1994, the CCPE Accreditation Board has also associated sustainable development with the expectations of engineers:

The engineering profession expects of its members . . . an understanding of the effect of engineering on society. Thus, . . . they must also develop communication skills and an understanding of the environmental, cultural, economic and social
impacts of engineering on society and the concept of sustainable development. (p. 13)

The policies are good ones; they are also generally supported, at least in principle, by practitioners [13, 14, 15]. In spite of policies and much talk about the importance of such issues, various studies indicate that the rubber is not hitting the road. Let’s take communication skills as an example. In a study of professional engineers in British Columbia, practitioners stated that these skills are not well-represented in preparatory education programs [15, 16]. Similar findings resulted from two others studies (both sponsored by Human Resource Development Canada) concerned with engineers’ current knowledge and skills. One study focussed on the Canadian Pulp and Paper Industry. The report identifies communication skills, interpersonal skills, and skills for leading groups in problem solving as “skill deficiencies” among engineers [17]. The second study focussed on the Canadian consulting engineering industry. Study participants stated that engineering graduates and many practising engineers have “inadequate skills in communication, management and problems solving [and] lack knowledge of business practices in general” [18]. So, what was that about the importance of communication skills?

These are only a few examples; we are certain that you can think of several more -- they appear to be un-ending. We agree that the talk is important; it’s a starting point. However, we also need to be aware that talk is not enough. In fact, without the ‘walk,’ there will be many who will charge that it’s “all talk” and it can’t be done; if it could, we’d be doing it. Maybe we should have a new policy: “Don’t talk it if you won’t or don’t walk it.” Given the policy-to-action record at the moment, this may not help very much. Perhaps it would be more helpful to take a look at some who “walk the talk.”

The Good…(walking the talk)

Today you’re visiting a classroom where students are working together to define their ecological footprint and to find ways to support sustainable development. One group is putting together a proposal to the local municipal council to involve youth in community planning and decision-making. Another group is preparing a report on SOTA (state of the art) waste treatment technology for presentation at a public meeting on waste management; they’re opposed to the landfill and incineration options currently proposed. A parallel group is working on a comparative cost-benefit analysis of same. You learn that one group is out in the field doing flow studies as part of their stream-recovery effort. In a back corner a group of students is in the midst of a heated debate about pessimistic and optimistic views of growth and development and the kinds of changes needed.

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1 The primary study included questionnaires, interviews and focus groups with a total of 600 engineers participating.
2 The study included document review and data base analysis, interviews and focus groups with some 300 industry members, a two-round delphi analysis, a mail survey, and in-depth site visits to 15 pulp and paper operations across Canada.
3 The study included document review and analysis, interviews with CEOs, human resource managers and employers in 65 firms, focus groups (168 people including employees, engineering educators and students), a two-round delphi analysis, case studies and two round tables.
The instructor is working with another smaller group of students; they’re part of a team delivering ‘environmental engineering for children’ courses in a local elementary school. You notice a recycling center — for paper, cans, glass and organics — in at the back of the room. The walls are covered with diagrams, charts and pictures portraying various sustainable and unsustainable technologies as well as life cycle analyses; you find working models on counters and various kinds of simulations on the computers. Some of the examples around the room come directly from projects with which the instructor has been involved.

Does this story excite you? Are you intrigued? Delighted? Inspired? These are the kind of heartfelt responses that may signal connection with a “good” model. In the context of this paper, good role models are people who demonstrate sustainability values by example and action; their behaviours match their ideals. Our focus in this section is on role models who manage to integrate the best of the rhetoric into their teaching in a manner which explicitly lives out the values inherent in the rhetoric, and, by example, encourages others, students in particular, to do the same. The story above is not a fantasy tale; it is a report of what is currently happening, in total or in part, in certain classrooms and in various ways. We hope the following examples both encourage and inspire you.

In 1995, a course on engineering and sustainable development was launched as a required course for all undergraduate civil engineers at one Canadian university (How’s that for walking the talk?). The course has evolved and the current version requires students to do more than learn principles and concepts in theory. Among other things, they are required to analyse their own behaviours in terms of sustainability principles, calculate their personal ecological footprints, conduct life cycle assessments of products they use, examine various kinds of moral issues, their own needs and values in terms of consistency with sustainability, and develop plans of action and guidelines for increasing the congruence of their actions with the imperatives of sustainability. Students recognise that this course is a lot of work but also say “it’s worth it” and such things as “[it’s] the first course I have taken in a long time that required me to think and express my opinions and I must say I really enjoyed the course.”

Following on from a life cycle analysis project and role plays which are based on development activities and are designed to elicit particular ethical responses, first year engineering students are asked to write a reflective essay on the connections they see between engineering, sustainability, and ethics [19]. The essay, which is worth 30% of the subject, is assessed against four equally weighted categories: grammar; justification and argument development; personal input; and personal reflection. This subject routinely receives student feedback like: "makes you think about issues that you wouldn’t normally. Issues that all engineering students should be thinking about" and "Ethics/sustainability exercise gave me a chance to have a clear view of where I stand. I got a lot out of it. Really enjoyed it!"

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4 Both a web-based version (developed by Crofton in 1997) and a face-to-face version are offered.
SUMMARY & GUIDELINES: MORE PROACTIVE ROLE MODELS PLEASE

We need to become more reflective practitioners; we need to learn more about the ways we are or are not ensuring that students and practitioners acquire the knowledge and skills needed to more adequately fulfil the professional responsibilities of engineers. And we need to take action based on our learning. We believe that there are some terrific role-models in engineering education. We also believe that we need many, many more of them!

How do we identify potential role models? Look for people who:

* examine themselves and their practices;
* are open to investigating the practices of others;
* are willing (even eager) to engage in and contribute to discussions and planning for integrating sustainability into engineering curriculum;
* are experimenters and risk-takers willing to step “outside the box” in terms of education practice;
* interact with students and colleagues in ‘genuine’ ways;
* are already trying to link their engineering work to the world at large;
* in sum, are “walking the talk.”

And how do we become more effective as teachers and role models? The preceding provides some direction. Here are a few more suggestions:

* learn about, and test for yourself, the effectiveness of different kinds of approaches to teaching and learning;
* use a variety of methods and approaches to facilitate learning -- yours, your students and your colleagues;
* talk to others about what you and they are doing to integrate sustainability issues into courses and programs;
* provide support to colleagues who are trying to walk the talk; let students, administrators and other colleagues know that you value their work;
* bring “real world” cases of SOTA projects into the classroom;
* have a colleague visit your classroom and give you some feedback on your teaching and the observed learner responses;
* take an honest and critical look at your curriculum; find ways to ensure that sustainability issues are addressed wherever possible;
* persist, don’t resist.

These are only a few suggestions; the real test is in our individual and collective action. We hope that more of us will dedicate our efforts to ensuring that students and colleagues acquire the knowledge and skills that will enable engineers to more actively and effectively contribute to achieving sustainability. And we look forward to “walking the talk” with you along the way.
REFERENCES


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