‘Food for engineers’: intellectual property education for innovators

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Abstract: *Intellectual property competence can assist individuals and organizations to capitalize on opportunities presented by accelerating developments in the knowledge economy. Engineers translate ideas into concrete solutions, which are frequently useful and commercially valuable, if the intrinsic intellectual property has been identified and protected. Professional bodies are beginning to acknowledge the importance of intellectual property competence as an enterprise skill for new graduates. Universities must rethink undergraduate curricula to enhance students’ entrepreneurial skills and widen participation, while research strategies must take account of the growing fuzziness of disciplinary boundaries. Where faculties are expected to deliver to new agendas, despite shrinking resources and an overcrowded syllabus, self-managed learning activities work with assessment strategies to achieve new independent learning outcomes.*

Keywords: *intellectual property; engineering; education; curriculum; self-managed learning*

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Individuals and organizations can capitalize on opportunities presented by accelerating developments in the knowledge economy if they increase their intellectual property competence. Governments have begun to promote school-level intellectual property education, hoping to minimize the pernicious traffic in counterfeit electronic leisure products and inculcate in young people respect for the awesome power of the computer to copy, adapt and distribute materials. Engineers work with ideas, which they translate into concrete solutions. Their innovative solutions are frequently useful and commercially valuable, but only if someone has identified and protected them as intellectual property. Professional bodies are beginning to acknowledge the importance of intellectual property competence as an enterprise skill for new graduates. Universities must rethink undergraduate curricula to enhance students’ entrepreneurial skills and widen participation. Self-managed learning activities work with assessment strategies to achieve new independent learning outcomes. At the same time, university research strategies must take account of the growing fuzziness of disciplinary boundaries. Faculties are expected to deliver to new agendas, despite shrinking resources and an overcrowded syllabus.

This is an interesting moment at which to consider how undergraduates in non-law disciplines can enjoy an opportunity to learn about intellectual property rights.

IPRs and innovators

Intellectual property rights (IPRs) are the response of national and international legal regimes to translate intangible new, original, innovative ideas and creations into marketable commodities. Increasingly students expect to study and pursue their careers in an international community, and on graduation they need to be equipped with an awareness of the implications of trading beyond their native shores.

Owning intellectual property implies positive and negative rights. IPRs offer an incentive to be inventive and creative, providing rights owners with an exclusive right for a limited period to market goods and services. IPRs are key intangible assets of public and private enterprises, but they can present controversial ethical issues – for example, they underpin music companies' expectations of income generation while at the same time threatening music listeners' expectations of listening to music for free.

Professor James Boyle, speaking in March 2003, said:

> We need to bring together the programmers and the web publishers, design artists and the film makers and the people who are computer scientists and the entrepreneurs and say '[intellectual property] is affecting you and you ought to be thinking about how it's affecting you'…. This is something in which we have to educate people. There's no single strategy, we should substantially change the way we look at intellectual property. (Boyle, 2003.)

Kaplan and Kaplan, US patent attorneys and academics who include intellectual property in their university engineering classes, suggest that:

> IP knowledge is important for engineers: engineers should try to understand IP basics to protect their creations. Also, IP searches can indicate the growth of different engineering fields. Furthermore, the proper use of IP promotes the progress of a field. Engineers should become familiar with the basics of the three traditional IP areas: copyrights, trade marks and patents. They should know which IP rights are needed to protect their creations. All of the students have reported that they enjoyed the information and will use the material in the future.
>
> The best result came well after the completion of the course. Ms W returned to thank the professor. Apparently she impressed an interviewer with her knowledge of IP and received an engineering position because of it! (Kaplan and Kaplan, 2003.)

Yo Takagi, Executive Director of the World Intellectual Property Organization, said:

> In view of the expanded role of IP in knowledge-based economies and societies, it is increasingly important to teach IP to students who do not have a legal background. (Takagi, 2004.)

IPRs pose challenges, risks and benefits to any operation. If IP is to deliver its true worth to an organization, the value of IPRs needs to be understood in many different contexts, including buying, selling and investment (see Figures 1 and 2). Most companies will not now undertake a new venture without a thorough analytical IP plan. In the commercial and business world, the development of new tactics and strategies for the deployment of intellectual property rights to commercial advantage has been identified as the next corporate challenge on the battlefields of the knowledge economy (Rivette and Kline, 2000). Take the example of IBM: its patent portfolio gives the company the freedom to do what it needs to do through cross licensing. It gives it access to the inventions of

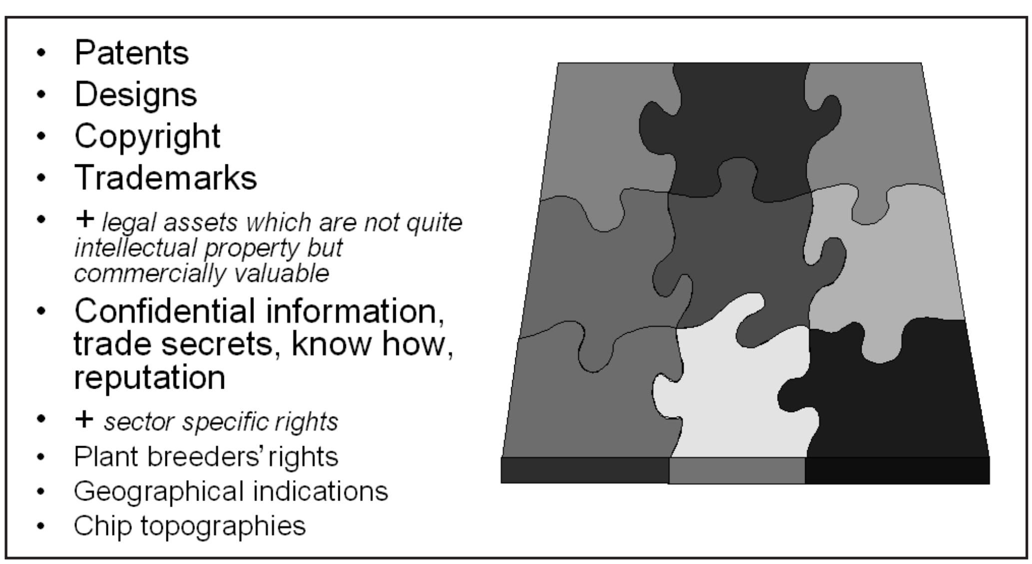


Figure 1. Intellectual property rights are worth most if seen as a 'bundle of rights'.

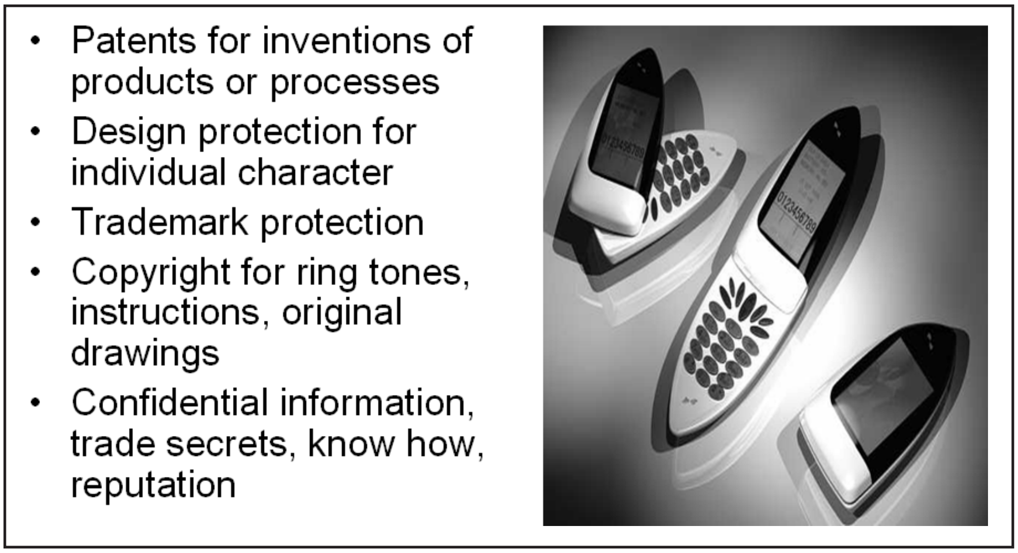


Figure 2. Consider the exploitable aspects of intellectual property rights in a mobile phone.

others that are critical to rapid innovation. Access is far more valuable to IBM than the fees it earns from its thousands of active patents – about $2 billion per year (Bessen, 2003). Survey evidence finds that many other firms obtain patents in order to 'block competitors'. Some firms, rather than licensing carefully chosen individual patents, interact over entire portfolios. Firms in the semiconductor, electronics and computer sectors license entire portfolios for a technology field, including patents for which they have not yet filed applications.

Baumol (2004) divides inventions into two polar categories: revolutionary breakthroughs and cumulative incremental improvements. Most inventions are somewhere in between. Research by the US Small Business Administration supports that idea: it found that

> . . . most of the revolutionary new ideas of the past two centuries have been – and are likely to continue to be – provided more heavily by independent innovators who essentially operate small business enterprises. (SBA, 2003.)

Baumol (2004) suggests that large companies will tend to specialize in incremental improvements to avoid the risks of the unknown that the revolutionary breakthrough entails. Revolutionary breakthrough is most often left to the small or newly founded enterprise, which is unlikely to enjoy the benefit of in-house IPR professionals.

Since an engineer from her or his first day at work may be required to sign agreements concerning disclosure, development and ownership of IPRs, it is important to hit the ground running. Engineers are exposed to and create a company's proprietary and confidential information. They need to be aware of the risks and obligations in using someone else's proprietary IP. IPRs can affect engineers in all aspects of professional development, whether they are employees or running their own business.

Research has shown that in the UK as a whole there is poor engagement with the patent system, especially among small and medium-sized enterprises (SMEs) (Intellectual Property Initiative, 1998). This is not good for UK plc's bottom line. A common perception of the patent system is that it is slow, uncertain and expensive – there can be a gap of 4.5 years between filing a patent application and receiving the patent grant. A granted patent can be revoked if it does not survive a challenge to its validity. And maintaining an international patent over 20 years could cost $250,000. None of these negatives, however, justifies excluding the subject of IPRs from the undergraduate curriculum.

School-based IP education

Increasingly students starting their undergraduate studies will have been introduced to intellectual property concepts during their time at school. One impetus behind the introduction of the subject has been a growing awareness of the dangers posed to society through the purchase of counterfeit CD-ROMs and DVDs (Lakhan, 2002) and of the risks associated with computer copying.[1] Many national Patent Offices, having recognized that school children are a vulnerable and captive audience, are working on ways to make them IP-aware. The Australian government's IP Australia Innovat*ed* is such a resource.[2]

The UK Patent Office introduced its 'Think Kit' with great success.[3] Within a few months of its release in March 2003 it was taken up by 51% of schools. It is envisaged that it will contribute to the delivery of the national citizenship curriculum. Development of the 'Think Kit' could be linked to the European Union's intellectual property enforcement directive, which in its earlier versions[4] looked set to require member states to encourage IP awareness campaigns to educate the public on the risks and problems associated with piracy, counterfeiting, rights and obligations linked to online content usage and infringement.[5] The proposed directive drew harsh criticism on the basis that it could restrict civil liberties and impose sanctions. The final version of the directive[6] refers to publication of intellectual property infringement decisions as a useful contribution to public awareness,[7] although it has dropped specific reference to education.

A second influence on school-level IP education is the increase in emphasis placed on technology, design and enterprise studies. In Japan, intellectual property education in schools is emphasized because 'knowledge about the protection and utilization of intellectual property rights is important to every citizen in order to ensure that Japan establishes for the 21st century a society based on creative science and technology' (Japan Patent Office, 2001). The Japanese Patent Office sets out a programme that will include teacher education and the production of appropriately engaging free-of-charge IPR text books, as well as promoting invention through public libraries and museums.

Even those students who have not been introduced to IP concepts at school are aware of IPRs. They are actively engaged in downloading and sharing music files; they proudly display rip-off designer-label garments. It is difficult to escape discussion of copyright infringements in, for example, *Harry Potter* derivatives. There is growing publicity about the exploitative practices involved in producing designer-label sportswear. Thoughtful students may be engaged in campaigns to make patented pharmaceuticals more freely available to treat disease in the poorer countries or against genetic modification in crops and animals.

Why is it so difficult to include IP in the curriculum?

School-based IP education initiatives are commendable and are to be encouraged, but they do not address the need to provide a basic competence in IPRs to graduates, especially those embarking on careers that will involve the creation and use of intellectual property. Professor Bill Hennessey (1999), writing at the Franklin Pierce Law School, suggests that there are three barriers to the inclusion of IPR in the non-law curriculum:

- the engineering curriculum at most engineering and technical institutes is very concentrated and focused on acquisition of the knowledge and professional skills students need to become licensed engineers;
- professional engineering organizations do not require an understanding of intellectual property as an area of knowledge within the engineering discipline; and
- there is a lack of faculty members who are qualified to teach the subject.

This last point is supported by research undertaken at Curtin University (de la Harpe *et al*, 2000), where staff responses to requests to teach non-core professional skills included:

- 'I shouldn't have to teach this.'
- 'I don't know how to teach this.'
- 'If we had decent students in the first place, I wouldn't need to teach this.'

The students, however, do not present a barrier. Once they understand the link between IPRs and commercial exploitation, they respond positively to intellectual property classes, particularly when the examples and case studies used relate to their own practice (Kaplan and Kaplan, 2003; Soetendorp, 2002).

The UK Engineering Council has recently published UK-SPEC, which details the standards for registration as a Chartered Engineer.[8] For the first time these include the expectation that engineers, engaged in the creative and innovative development of engineering technology and continuous improvement systems, will have the ability to secure the necessary intellectual property rights.[9]

Expecting graduates to wait until they start their careers to learn about how IPRs operate in the workplace leaves them vulnerable (see Box 1).

Box 1. The price of ignorance.

A few years ago a final-year student wrote to an international low-price furniture manufacturer describing his innovative project, and invited the company's support. The company replied that it did not work with students. Six months later his item appeared in the company's catalogue. In four years of an engineering product design course, no-one had flagged up to the student the importance of confidential disclosure. A patent agent recently commented, 'What I suspect is incontrovertible is that the more aware of the basics, the less likely engineers are either to throw away valuable assets for themselves or their employers.'[10]

Feedback from academic engineers

In 2003 I attended engineering education conferences in Europe, Australia and Japan. Once delegates discovered that I was an intellectual property academic, rather than an engineer, they pursued me in the coffee breaks and offered me drinks in the bar. They were anxious to discuss the status of their own intellectual property, but most had not thought it worth mentioning IPRs to their students.

My paper (Soetendorp, 2002) asked why engineering undergraduates were *no*t given an opportunity to learn about intellectual property, and included a short questionnaire to provide feedback for further discussion (see Table 1). The qualitative reasons given for not teaching intellectual property implied an aversion among engineering academics to getting involved in it. The reasons given included:

- 'It is no one person's responsibility.'
- 'It would be seen as a "soft" subject rather than "hard" engineering.'
- 'Awareness is not there yet.'
- 'It's only a matter for those in industrially related research.'
- 'It's a subject that ought to be taught by experts.'
- 'If a colleague really wanted to teach it, maybe time would be found.'
- 'There are more important things engineers need to know about: standards, safety, etc.'

Most reasons given for not including IP teaching were grouped around the following perceptions and bear out the suggestions of Hennessey (1999) discussed above:

- the syllabus is too crowded;
- academics are reluctant to teach an unfamiliar topic; and
- knowledge of IPRs is not an explicit benchmark or accreditation requirement.

Where the syllabus for a course is crowded, it is important to acknowledge the primacy of core strands. The prime intended learning outcome for a civil engineer *must be* to design a bridge that will not collapse. Safety and standards are the most important elements of an engineering programme. The 'crowded syllabus' claim begs the question of whether ways cannot be devised to broaden student expertise without eating into precious classroom contact time. If the syllabus really is crowded, and there is no IP specialist available, can non-core aspects, like IPRs, be shoe-horned into the students' learning experience?

Dr Rob McLaughlan is an engineering academic engaged by the Australian National Occupational Health and Safety Commission to work on a project to design an engineering resource package. It will integrate the non-core subject of occupational health and safety into the undergraduate syllabus (McLaughlan *et al*, 2004). McLaughlan observes that there is no well-established pedagogy for the diffuse integration of this non-specialist education into the engineering curriculum. The development of such a pedagogy would help higher education institutions to develop students' capacity in these fields in a more integrated and intentionally connected way than is currently done.[11]

Learning and teaching initiatives

Some engineering academics are deterred from including IP topics in their syllabus because they suspect that students may experience learning difficulties in studying a subject from another discipline. This would result in lower assessment

Table 1. Questions put to delegates at engineering education conferences in Australia, Japan and the UK, 2002.

Question	Responses
Do you consider IP awareness to be an enterprise skill?	Yes, 85%; No, 15%.
Does IP feature in your undergraduate course content?	Yes, 25%; No, 57%; Not sure, 18%
If the answer to the above question is 'yes', in which module is it taught?	'Management'; 'Professional Practice'; 'Innovation'; 'Law'
At which level is it taught?	Level I or Level H (second or third year)
Who teaches IP awareness?	Specialists; law faculty members; engineers; not sure
How many (contact) hours are students expected to spend on IPRs?	Responses ranged from one hour to 30 hours
What resources are used?	Government publications; lecturer's own; not sure
Is IP awareness assessed (formatively or summatively) and, if so, how?	Responses included: part of a written assignment; exam question; probably not
If the answer to the above question is 'no', is it because: (a) the syllabus is too crowded? (b) engineering academics are reluctant to teach an unfamiliar topic? (c) IP is not an explicit benchmark or accreditation requirement? (d) other reasons?	(a) 29% agreed; (b) 31%; (c) 22%

grades, which would reflect negatively on the work of the engineering faculty in the institution (Dodridge, 1999). This has not been the case at Bournemouth University, the author's institution, where the Design Engineering and Computing Faculty has noted no disparity between marks scored for IP exam questions and questions on other aspects of professional practice.[12]

If an engineering faculty can be persuaded to accommodate a credit-bearing unit, or part unit, in IPRs, there are several ways in which material can be taught and assessed. Hennessey (1999) identifies five styles of intellectual property law teaching:

- the case method;
- the problem-solving method;
- the simulation model;
- the clinical method; and
- the doctrinal method.

Each may be appropriate, depending on the time available to deliver the unit, the background and level of the student, and the intended learning outcome for the course.

The *case method* involves students considering an IPR issue by reading an actual decision in which legal principles have been applied. It is an appropriate method to use with a postgraduate group taking a credit-bearing unit, where the expectation is that the students will undertake additional IP law reading in support of classroom (or equivalent online) activity.

I have used the case method with a small group of postgraduates in a patent law unit on the Intellectual Property Management MA course at Bournemouth University. Both the students and I were nervous as to how the group, with different undergraduate experience, would respond to the exercise. The group comprised a diverse range of disciplines including law, business, science and technology. In the early stages of discussing the case, the lawyers explained legal terminology while the science people were able to explain aspects of the technological subject matter. The business-oriented students could look from a business perspective at why the two parties were in dispute, rather than choosing to settle out of court. It was a refreshing encounter from which all group members went on to engage with more confidence with the legal principles of the case.

The *problem-solving* model provides an opportunity for effective classroom activity that can be adapted for groups at any level, in credit-bearing units or 'brief encounters'. I have enjoyed the feedback of students who, knowing nothing about IPRs, have engaged in animated discussion of why the companies Windsurfer International and Tabur Marine[13] found themselves locked in a courtroom battle. Asking the students what they would have done in the situation led to thoughtful contributions. Once students had considered the business aspects of the case, they were more receptive to learning about the patent law aspects (see the worked example shown in Figure 3).

The *simulation method* can be used effectively with non-law students, particularly if it relates directly to the core discipline content of their course. For example, students can be presented with a low-technology, simple patent specification and encouraged to write a specification for their own innovation. Where the tutor has patent expertise, she or he can mentor the student through the drafting process. Alternatively, a local patent attorney could be invited to play the mentoring role. Students who have had hands-on experience of drafting their own patent application, however simple, learn the importance of being able to describe their work in the language that will make future encounters with patent advisers much easier, possibly shorter and slightly cheaper.

I have used the *clinical method* to beneficial effect both for students of intellectual property law and technology students whose course does not include an IPR unit (Soetendorp, 1996). Intellectual property law students work with technology students to give 'professional' IPR advice on the technology students' project work. The technology students get practice in articulating their technical innovation in a way that makes sense to a professional adviser. They benefit from dialogue with the intellectual property student and receive a copy of the law student's written assignment documenting his or her legal advice. The intellectual property student is encouraged to look holistically at the portfolio of IPR exploitation potential in the innovation and gains simulated experience of client work.

Writing the advice letter, with a supporting appendix of legal authority, is an important element of the law students' summatively assessed assignment work. The participation of the technology students is formatively assessed.

The *doctrinal method* is least appropriate. It does not encourage the students to appreciate the continual evolution of intellectual property law, nor is it designed to equip them with knowledge of where to access up-to-date information at the appropriate level.

Two additional examples illustrate how different universities have approached the design of effective learning experiences for non-law students, using traditional legal education tools. First, at the Hong Kong University of Science and Technology engineering students use a standard law faculty teaching tool, 'The Student Moot Court' (Lee, 2002). The Moot Court debates reinforce students'

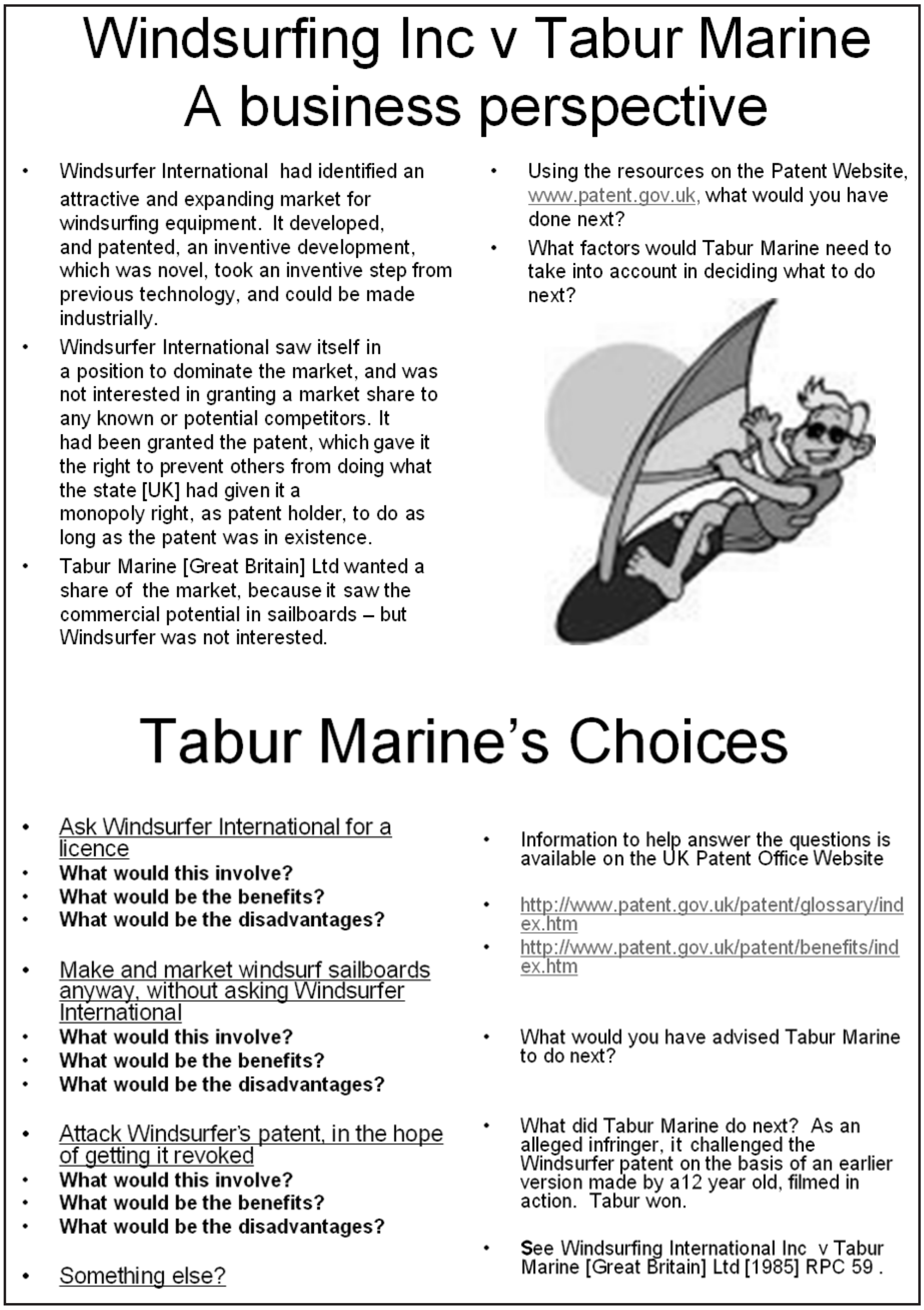


Figure 3. Example of the problem-solving approach to IPR teaching.

understanding of intellectual property concepts and reinforce analytical, verbal and reasoning skills. Second, at the Massachusetts Institute of Technology a licence negotiation role-playing exercise gives computer science students at the start of their course the opportunity to participate in a simulation of an intellectual property licence negotiation.

In all the above examples, the non-law students are presented with a learning activity that relates to their core discipline and offers meaningful engagement with IPR principles and concepts. They have all been designed by academics with intellectual property expertise and delivered on courses whose organizers have acknowledged that the study of IPR issues is sufficiently important to justify the allocation of time to it. Hopefully, such courses will become increasingly common.

The Japanese government sees IPR competence as key to increasing international competitiveness of industry and stimulating the economy. It passed legislation in 2002[14] that required universities and similar institutions to promote education and learning on intellectual property. Four Japanese universities have been tasked with researching IP education at four stages: school, undergraduate, postgraduate and lifelong learning.

The Osaka Institute of Technology is required to research the undergraduate stage.[15] It has identified a human resource need for 'para-intellectual property professionals' with an understanding of science, technology and intellectual property management. It has recently received government approval to run a four-year undergraduate programme that covers:

- the fundamentals of intellectual property;
- related areas in engineering;
- venture creation and industrial management;
- intellectual property prosecution;
- intellectual property management;
- intellectual property strategy;
- international legal affairs;
- internship in the intellectual property department of a large company, or with an intellectual property attorney;
- preparatory research; and
- thesis research.

The Osaka Institute is well aware that the degree in intellectual property will not address the issue of integrating IPR teaching in the undergraduate non-law disciplines. It will, however, be interesting to monitor the influence of an IP department operating outside a law school and working in close collaboration with science and technology faculties. Professor Tanami at the Osaka Institute acknowledges the difficulties imposed by the absence of an established pedagogy for the inclusion of IPR in the non-law curriculum. He points out, though, that there is insistence from Japanese government and business that such a pedagogy should be developed.[16]

The idea of intellectual property education as part of the undergraduate experience is gaining ground. In May 2003 Philippe Busquin, the then EU Commissioner for Research, said

> The Commission is proposing the objective that all students in science, engineering, or business studies receive at least basic training on intellectual property rights and technology transfer. (EC, 2003.)

The UK Engineering Council has just completed a review of its standards for the training and registration of Chartered and Incorporated Engineers, with the publication of UK-SPEC.[17] For the first time, the threshold standard of competence and commitment for a Chartered Engineer will include an ability to 'secure the necessary intellectual property rights'. This is a breakthrough, which hopefully will influence academic curriculum designers to include opportunities for undergraduates to develop IPR awareness and competence.

Self-managed learning opportunities

A crowded syllabus may mean that there is not much time for *teaching* students about IPRs. It does not follow that there will not be any time for students to *learn* about IPRs.

Engineers, like most academics, justifiably express a reluctance to stand in front of their students to teach unfamiliar topics. But is it essential to be an expert to create an effective student learning experience? It is easy to use ignorance as a justification for keeping rigidly within disciplinary guidelines, when ignorance can in fact be a valid starting point for facilitating learning.

Kerwin (1993) and others have identified the importance of starting from ignorance in the context of medical education, arguing that the information explosion in medicine demanded an alternative to 'rote-memorization'. They use the 'ignorance paradigm' to promote a questioning approach in their students, rather than the tendency to receive knowledge uncritically, assuming that professional performance involves mastery of what is known of the subject. As Samuel Johnson said, 'Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information on it.'

Witte (1994) explains that the response to the 'ignorance paradigm' from professional philosophers has been lukewarm: 'They're too busy working on epistemology, the theory of knowledge, when really ignorance is much more interesting.' We are frequently challenged to learn from our ignorance (see Box 2).

Box 2. Learning from ignorance.

When a client company requested a law school to provide a short course on IPR for its employees working on embedded software, the request was accepted, despite the fact that the IPR team was not exactly sure what 'embedded software' was. Before proceeding to design the short course, the team commissioned a one-hour tutorial from an expert in electronic engineering. He was able to pass on sufficient understanding of the rudiments of embedded software for the team to contextualize its IPR teaching. The participants enjoyed the course sufficiently to commission a second one.[18]

Malcolm Knowles (1984) has developed theories of the way in which adults, as opposed to children, learn. He makes the following assumptions about adult learning:

(1) adults need to know *why* they need to learn something;
(2) they need to learn *experientially*;
(3) they approach learning as *problem-solving*; and
(4) they learn best when the topic is of *immediate value*.

Undergraduates are adults. They appreciate *why* they are being introduced to IPRs and they are motivated to learn about intellectual property because it is relevant to their future careers.[19] Getting students to undertake tasks that engage them with Website resources will give them the necessary *experience*. Students' resourcefulness should not be underestimated: they are usually well able to respond to IPR *problem-solving*, bringing skills from their core disciplines. Integrating the students' self-managed IPR work into the assessment strategy of the course satisfies Knowles's requirement that the learning should be of *immediate value*.

Academics without intellectual property expertise can guide students to manage their own learning in this area. By linking independent learning outcomes with assessment strategies, using appropriate resource-based learning activities, students can be motivated. The UK Patent Office and European Patent Office Espacenet Websites[20] are intended for use by IPR lay-people. They are well designed to answer questions and provide all the necessary information to understand how the IPR system works. They are user-friendly and 'free at the point of consumption'.

As Kaplan and Kaplan (2003) acknowledge,

> Engineering professors are known to give projects, but not many incorporate IP into their project requirements. References are sometimes required, specifically references to copyrighted material but rarely are patent or trademark searches required for projects. This is a disservice to engineering students.

It does not require IPR expertise for an engineering student's project work assignment to require a brief report which includes evidence that she or he has:

- searched the appropriate patent databases;
- retrieved the necessary information; and
- applied the findings to the project.

Through preparing that brief section of the report, the student will have achieved the intended learning outcomes, which could include, among other things, the ability to:

- locate and compare patent documents;
- identify the stages of applying for a patent; and
- evaluate appropriate intellectual property protection.

Independent student learning outcomes should be drafted to include IPR awareness and competence (see Rowntree, 1981, for a fuller discussion). Activities can then be devised that give the student an opportunity to gain the relevant knowledge. Assessments should be designed to enable students to demonstrate what they have learned. If the engineering academic feels unqualified to assess that part of the report summatively, then it could be formatively assessed. The completion of the IPR evidence would be compulsory, and assessed on a completed or not completed basis.

Simultaneously, students acquire skills that will be increasingly relevant to their future careers. As engineering becomes more knowledge-based, value will be placed on an active ability to acquire and apply knowledge rather than a passive tendency to wait to receive it.

Learning outcomes, learning activity and assessment strategy should work in harmony. Setting the appropriate level of outcomes is a unique activity for each programme. It needs to be done in the context of the discipline, taking account of the prerequisite knowledge and skills of the students, the time allocated to delivery and the complexity of the topics being taught (Byles and Soetendorp, 2002). If a course team lacks intellectual property expertise, it will be useful to call in the help of an intellectual property academic or practitioner to sit down with the technologists to draft outcomes and activities, and explore possibilities for assessment (Byles and Soetendorp, 2002).

The UK Patent Office's Website has been praised by lay people and IPR professionals alike for its comprehensive content and ease of access. It has great potential as a resource for self-managed learning activities and assessment exercises (see Figure 4). Similar resources are provided by other national patent offices, including the Australian government's IP Australia site.[21]

Different learning outcomes, activities and assessments are appropriate for different levels of student. Figures 5–7 present examples that relate to the three stages of undergraduate study. They use the UK Patent Office and European Patent Office Espacenet Websites as the teaching resource and are designed to be effective on courses for which there is no intellectual property academic to manage students' learning of IPRs and little time to devote to the subject.

P~atent~ O~ffice~ www~ebsite~ !

- For an introduction to the different intellectual property rights [IPRs], go to http://www.patent.gov.uk On the home page, click on 'click here for help choosing' [http://www.patent.gov.uk/newcomer/index.htm]
- Work your way through the introduction. It should take about 10 minutes
- You might find it useful to click each of the buttons: Trademark, Copyright, Designs, Patents. In each of those, click on 'What is a Trademark', 'What is a Copyright','What is Design', 'What is Patent'.
- In developing your project you will be involved in the creation of IPRs.
- If you are on placement, or an intern, you may be asked
- What do you know about IPRs? or
- Can you offer any initial advice about what your employer should do about its IPRs?
- How would you respond?
- ……………………..
- In 3 – 5 bullet points, identify the maximum number of IPRs that could apply to the work you will doing
- AND
- What you would advise your employer to do next with regard to securing the rights in the work you are doing?

Figure 4. 'POwww!' – a self-contained exercise using the UK Patent Office's Website as a resource.

Note: This exercise has been used at Bournemouth University as a stand-alone introduction to IPRs on courses in which there has been no other IP tuition. Stduent's feedback has been positive, with comments such as 'By the way, this was very useful! Thank you.' and 'I would advise the company to research into all the IPRs by going on to the Patent Website and also to take part in the exercise we have just done, because many companies will be surprised with what is protected and what is not.'. The tutor commented, 'I was asked a few questions which I could not answer, such as "Is such and such a design/trademark?". I never knew the answer, so was no help! I liked telling them to look it up!'

- **Learning outcome**:
- Students will be able to identify the potential intellectual property rights in their work
- **Learning activities**
- **Read the sections** 'what is a patent/design/copyright/trademark' on the Patent Office Website
- **Reflect on whether their work** is capable of achieving patent protection, design registration, trademark registration, and copyright
- **Assessment activities**
- **Prepare a memo identifying** which IPRs are appropriate to their work [n.b. remind the students that the rights are not mutually exclusive], including a relevant patent, design or trademark registration
- **Write a report of** all the potential intellectual property rights in the mobile phone

Figure 5. Working with level C (first year).

- **Learning outcome**
- Students will be able to explain how to protect the intellectual property rights in their work

- **Learning activities**
- Complete the Level C activities. Select the most significant intellectual property rights relevant to their work
- List the steps recommended to patent, register a design, register a trademark, using the relevant Patent Office Website page

- **Assessment**
- Choosing ONE registered right, **compute** how much it would cost to protect it in the UK for the full term.
- **Write a memo** advising what intellectual property protection is available cost free?
- **Write a review** of an everyday product, e.g. Dyson vacuum cleaner; Nokia phone etc and [in small groups?] **catalogue** the patents, and/or design registrations and/or trademarks using 'Search our Records' sections of www.patent.gov.uk

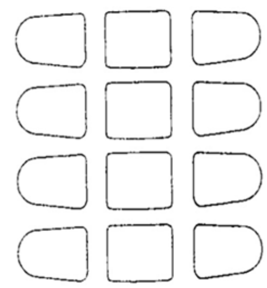
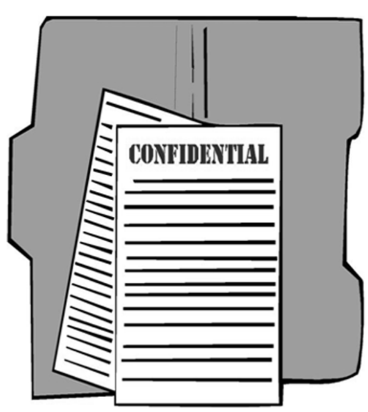


Figure 6. Working with level I (second year).



- **Learning outcome**
- Students will be able to decide the appropriate procedures to ensure their intellectual property rights can be secured

- **Learning activities**
- **Complete** the level C learning activities
- **Retrieve** examples of at least ONE patent application/design registration similar to their work, using 'Search Our Records' in the Patents, Designs and Trademark sections of the Website

- **Assessment activities**
- **Draft** 5–10 bullet points on 'confidentiality' in the laboratory/design studio/workshop (see AURIL Handbook of Intellectual Property Management http://www.patent.gov.uk/about/notices/ipguide.pdf)

- **Write a memo** 5–10 bullet points detailing the procedures necessary to prepare a patent application.

Figure 7. Working with level H (final year).

Using transdisciplinarity to promote IPR education

The final section of this paper suggests some ways in which intellectual property academics might collaborate across faculties to generate opportunities for cross-disciplinary teaching, research and consultancy.

Internationally, governments' higher education agendas are bringing radical changes to universities. These changes are having a significant impact on traditional approaches to academic research. The classical or liberal model of the university, which was based on the transmission of a received body of knowledge from teacher to student (Nowotny *et al*, 2002, p 3) is disappearing. 'Massification and democratization mean that universities are no longer so intimately associated with the production of scientific and professional elites' (Delanty, 2001). These significant changes offer opportunities to forge collaborative cross-faculty partnerships which could undertake applied industry-oriented research that would produce transdisciplinary knowledge, which Gibbons *et al* (2000, p 3) identified as Mode 2, in contrast to single-disciplinary knowledge (Mode 1).

Gibbons *et al* suggest that Mode 1 knowledge may be produced as the result of research conducted in the absence of a practical goal, while Mode 2 knowledge is intended to be useful to someone, whether in industry, government or society. Mode 2 knowledge can be produced by coalitions of academics working across disciplines – within the university or with external partners in industry and commerce.

In the context of intellectual property, if IP academics could appreciate the value of sharing their subject with non-lawyers, and engineers would welcome the inclusion of IPR competence in their syllabus, there would be benefit to both disciplines:

- Engineers would know how to build safe bridges *and* how to exploit their innovative techniques of building bridges safely.
- Lawyers would have a clearer understanding of how the law impacts on their clients' business interests.
- Law and engineering academics would be able to develop opportunities, separately and together, to conduct transdisciplinary research and pursue knowledge transfer opportunities that would enrich their teaching.

Simulating inter-professional encounters in the real or virtual classroom would enhance the professional practice of the participants. Such encounters help break down the walls between traditional, highly specialized functions and lead to more fluid forms. This is happening with increasing frequency in the world of work: research and development alliances in large global enterprises can involve engineers working with different professions, each bringing its own expertise to complex problem-solving. But the blurring of disciplinary boundaries is happening very slowly in universities (Gibbons *et al*, 2000, p 93).

Dr Theodore Zeldin is a contemporary philosopher and historian, who researches interdisciplinary relations at work. He asked an engineer how long it would take to teach him to be an engineer. 'Three months' was the reply – not to be a real engineer, but to understand engineers' language and their problems, to learn the essence of the way they think (Zeldin, 1998, p 53). He suggests (p60) that the term 'social exclusion' includes all those whose mind-set is confined to a single profession, and asks 'what new kind of education or training will not just slot students into pigeon hole careers?' Employers want flexible, multi-skilled graduates who are open to learning and equipped to respond to the rapidly changing nature of the workplace. Students do not have a problem with that.

It is not easy to set up transdisciplinary institutional structures in the academic community, where a sense of disciplinary identity is the norm. Engineers must be able to design a bridge that will not collapse, lawyers must have legal skills. But graduates in each discipline also need the capacity to cooperate with experts from other fields, to see problems in a complementary way. It is necessary to find a balance, to promote and manage both sets of abilities (Gibbons *et al*, 2000, p 93). Intellectual property has traditionally been taught as a law subject to law students in law faculties. Suggesting that intellectual property should constitute a transdisciplinary element of a science or technology programme challenges the concept that it has to be taught by lawyers.

Conclusions

Speaking at the European Patent Office's Patinnova Conference in 1990, Karl Heinrich Oppenlander, President of the Institute for Economic Research in Munich, commented,

> If a young engineer comes into contact with patent information at a very early stage, during his training if possible, he will use this source of information regularly since he will already be familiar with it.

Non-law students do not expect to become IPR experts, but they do need to know enough about it before graduating to be able to use IP resources in the future and to feel confident that they know

- where to find patent information;
- when it is time to call in an expert; and
- how to commence the dialogue with a professional intellectual property adviser.

Kaplan and Kaplan (2003) say much the same thing:

> Of all the academic disciplines, engineering may encompass most of the patentable breakthroughs, yet some engineering students are never exposed to IP education. If taught early, starting in the freshman year, and often, throughout the undergraduate education, IP education will be ingrained into the students' creative thought process. It will also give the undergraduate engineering student other options upon graduation, perhaps to study patent law or technology transfer.

Change in the knowledge economy is rapid for both students and academics. The 'threat' to non-law academics of having to include intellectual property awareness in the curriculum should be seen as an 'opportunity' to engage with a vital topic that links commercial, legal and technical disciplines. At Tokyo Metropolitan University, I was invited to give a lecture to second-year mechanical engineering students to introduce them to IPRs. The students reported back to their Dean:

Intellectual property rights – it's like food for engineers, they should have a little every day.

Notes

[1]See Bill HR 2517 to enhance criminal enforcement of the copyright laws, educate the public about the application of copyright law to the Internet and clarify the authority to seize unauthorized copyrighted works. Introduced on 19 June 2003 in the US House of Representatives.
[2]http://www.innovated.gov.au.
[3]UK Patent Office Think Kit, http://www.patent.gov.uk/about/marketing/thinkkit/.
[4]Directive of the European Parliament and of the Council on Measures and Procedures to Ensure the Enforcement of Intellectual Property Rights, Brussels, 30 January 2003, COM(2003) 46 Final 2003/2004 (COD).
[5]Article 19a of the Proposed Enforcement Directive, as amended.
[6]Directive 2004/48/EC of the European Parliament and of the Council of 29 April 2004 on the Enforcement of Intellectual Property Rights.
[7]Directive 2004/48/EC of the European Parliament and of the Council of 29 April 2004 on the Enforcement of Intellectual Property Rights (note 16).
[8]The UK Engineering Council, UK-SPEC, http://www.engc.org.uk/.
[9]UK-SPEC: *Threshold Standards of Competence*, A2.
[10]R. Gallafent, personal communication, 8 October 2003.
[11]R.I. McLaughlan, personal communication, September 2004.
[12]R. Soetendorp, unpublished document, Bournemouth University.
[13]*Windsurfing International Inc v Tabur Marine (Great Britain) Ltd*, 1985 RPC 59, CA.
[14]Government of Japan's Basic Law on Intellectual Property (Law No 122 of 2002), Articles 7, 13, 21, 22.
[15]Osaka Institute of Technology, 2003/2004, http://www.oit.ac.jp. At time of writing (September 2004), online information is in Japanese (English version is available in hard copy format).
[16]Professor K. Tanami, Osaka Institute of Technology, personal communications, September 2004.
[17]UK-SPEC, http://www.uk-spec.org.uk.
[18]Unpublished feedback from short courses on IPRs for Delphi Automotive plc, held at Bournemouth University in 2003 and 2004.
[19]UK Patent Office research project 1995–96, presented to PatLib 1996, Aberdeen.
[20]European Patent Office, Espacenet Patent Database, http://ep.espacenet.com.
[21]http://www.ipaustralia.gov.au.

References

Baumol, W. (2004), 'Entrepreneurial cultures and countercultures', *Academy of Management Learning and Education*, Vol 3, No 3, pp 316–326.

Bessen, J. (2003), 'Patent thickets: strategic patenting of complex technologies', Social Science Research Network Electronic Library, http://ssrn.com/abstract=327760.

Boyle, James (2003), 'Ideas in cyberspace', The Eversheds Lecture, Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA), London, March, http://www.rsa.org.uk/acrobat/james_boyle190303.pdf.

Burridge, R., ed (2002), *Effective Learning & Teaching in Law*, Kogan Page, London.

Byles, L., and Soetendorp, R. (2002), 'Law teaching for other programmes', in Burridge, R., ed (2002), *Effective Learning & Teaching in Law*, Kogan Page, London.

de la Harpe, B., Radloff, A., and Wyber, J. (2000), 'What do professional skills mean for different disciplines in a business school? Lessons learned from integrating professional skills across the curriculum', in Rust, C., ed, *Improving Student Learning through the Disciplines*, Oxford Centre for Staff Development, Oxford Brookes University, Oxford, pp 9–23.

Delanty, G. (2001), *Challenging Knowledge: the University in the Knowledge Society*, Open University Press, Milton Keynes.

Dodridge, M. (1999), 'Learning outcomes and their assessment in higher education', IEE *Engineering Science & Education*, Vol 8, No 4, August, pp 162–168.

Gibbons, M., *et al* (2000), *The New Production of Knowledge*, Sage, London.

Hennessey, W. (1999), 'The place of intellectual property teaching in the curricula of universities and technical institutes', online paper, Franklin Pierce Law Center, Concord, NH.

Intellectual Property Initiative (1998), *Determinants of Intellectual Property Strategy in UK Companies, Based Upon the Final Report to the ESRC*, Research Programme on Intellectual Property, http://info.sm.ummist.ac.uk/esrcip/projects/L5253023/final%20report.htm#top.

Japan Patent Office (2001), 'Nationwide promotion of intellectual property education', *Japan Patent Office Annual Report 2001*, Part 1, chapter 4, Japan Patent Office, Tokyo.

Kaplan, K., and Kaplan, J. (2003), 'Incorporating intellectual property into engineering education', paper presented at the 2003 American Society for Engineering Education Annual Conference and Exposition, Nashville, TN, 22–25 June.

Kerwin, A. (1993), 'None too solid: medical ignorance', *Knowledge: Creation, Diffusion, Utilisation*, Vol 15, No 2, pp 166–185.

Knowles, M. (1984), *The Adult Learner: a Neglected Species*, 3rd edition, Gulf Publishing, Houston, TX.

Lakhan, S. E. (2002), *Stop Piracy with Edification: Intellectual Property Education in School*, Faculty of Arts and Sciences, Harvard University, Cambridge, MA.

Lee, O. (2002), 'Engineering students' Moot Court debates the question: "Is Software Patentable?"', *Journal of Information Technology & Law*, No 1, http://elj.warwick.ac.uk/jilt/02-1/lee.html.

McLaughlan, R., *et al* (2004), *Review of the Engineering Resource Package*, CRO312, Australian National Occupational Health and Safety Commission, Canberra.

Nowotny, H., Scott, P., and Gibbons, M. (2002), *Re-thinking Science*, Polity Press, Cambridge.

Ramsden, P. (1992), *Learning to Teach in Higher Education*, Routledge, London.

Rivette, K., and Klein, D. (2000), *Rembrandts in the Attic: Unlocking the Hidden Value of Patents*, Harvard Business School Press, Cambridge, MA.

Rowntree, D. (1981), *Developing Courses for Students*, McGraw-Hill, London.

SBA (2003), *Small Business Research Summary 2003*, Small Business Administration, Washington, DC.

Soetendorp, R. (1996), 'Patent information in the academic context', *World Patent Information*, Vol 18, No 4, pp 219–226.

Soetendorp, R. (2002), 'Intellectual property rights awareness – a business enterprise skill for undergraduate engineers', paper presented at Australasian Association for Engineering Education 13th Annual Conference, Canberra, 30 September–2 October.

Takagi, Y. (2004), 'Teaching of intellectual property', paper presented at the World Intellectual Property Organization (WIPO) Arab Regional Conference on the Teaching of Intellectual Property, Dubai.

Witte, M. (1994), cited in 'UA Prof locks horns with science', *Arizona Daily Wildcat*, 1 December 1995 (http://wildcat.arizona.edu).

Zeldin, T. (1998), *Conversation*, Harvill Press, London.