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Communications of the Association for Information Systems

ESTABLISHING THE PRINCIPLES OF INFORMATION SYSTEMS TEACHING

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ABSTRACT

The interdisciplinary nature of information systems (IS) presents significant challenges for IS teachers. This paper examines the nature of the IS teaching task. It asks: what are we trying to achieve as IS teachers? What are the characteristics of IS and what might these tell us about how we should be teaching IS? What is the nature of the multiple role of the IS teacher? Where do our curricula come from and how do we integrate research and teaching? Since IS has no unified theoretical foundations, unlike the computational mathematics which underpins computer science, identifying principles on which information systems teaching should be based is difficult. By identifying some of the various roles which IS teachers adopt, this paper seeks to define some overarching principles that should drive IS teaching. Teacher's roles include theoretician, practitioner, priest, counsellor and evangelist. Each of these roles suggests principles for teaching IS. The paper also suggests the key importance of networks of communication in establishing the basis of IS teaching.

Keywords: Information systems, teaching, principles, curriculum

I. INTRODUCTION

A key feature of IS is its multidisciplinary content involving a variety of reference topics and approaches (Benbasat and Weber, 1996; Banville and Landry, 1989). IS consistently draws upon concepts and material from diverse subject areas and has a role in most other disciplines (Baskerville and Myers, 2002). It derives its problems and solutions from fields ranging from management, sociology and social psychology to formal logic and relational algebra (McBride, 2003). The emergence of IS as an authoritative field of study developed from an early recognition to combine social and technical areas of 'soft' (behavioural) and 'hard' (mathematics) aspects of the discipline (Davis, 2000; Mingers and Stowell, 1997). The approach to IS teaching therefore

clearly requires an emphasis upon critical thinking, within theory and practice, to engage and challenge students given this diversity (Kock et al , 2002; Robey, 1996).

The subject of IS is frequently regarded as practical where the outcome of a systems implementation is applied and of course appropriate. However, subject content and the problems discussed in classrooms may be derived from theory or practice and the problems of industry may indeed be led by conceptual models indicating relevant solutions (Tomei, 2003). All disciplines, for example medicine and law, require attention to both practical and intellectual considerations – practice alone is not paramount. Even though our students come from commercial backgrounds, and frequently adopt prescriptive notions of pragmatism, the importance of critically evaluating problems in generalized contexts is extremely valuable. IS practice may iterate through IS theory to inform upon better commercial solutions which again require constant and critical assessment.

The theoretical frameworks we teach students must therefore augment practice. Our teaching is reflected in competitive environments as well as the classroom. Hence the IS teacher must be a practitioner, theoretician and inter-disciplinarian. This paper considers many of these challenges and begins with a perspective of some of the conflicting issues involved and subsequently proposes approaches for IS teacher consideration.

The discipline of IS contains a number of opposing forces that the teacher must combine:

Analytical and Discursive. IS demands both descriptive studies and analytical studies. The development of an IS, for example, requires a storytelling and discursive approach to identifying systems requirements, in which the clients and developers develop stories as is done in extreme programming, or define problem areas descriptively, as is done in client-led design. It also involves an analytical approach where business process are broken down into clear logical steps. The tension between these quickly becomes apparent in any commercial development.

Certainty and Uncertainty. Mathematical computation, the foundation of computer science and hence system development demands certainty. Processes must be clearly defined as 'either, or'. There is no room for vagueness. Even fuzzy logic involves defining a series of probabilities and them carrying out a process of defuzzification in order for the computer program to run. Computers have no room for uncertainty. However, business processes and the organisation within which information system reside are beset by uncertainty derived from the complex organisational relationships and human interventions. In teaching this may lead to arguments with students who demand 'the answer' where, unlike mathematics, there is no one right answer to any IS problem.

Social and Technical. IS encompasses the social and the technical, facing both people problems and technology problems. This demands a lot of students in, for example, strategic information systems planning, where extensive knowledge of both the technology and technical options, and the business processes and organisation are required before reasonable strategic decisions can be made.

Specialist and Public. It should not be forgotten that IS, as an academic discipline is both in the realm of the expert and the amateur. Most homes have PCs and most people know something about using the Internet. Furthermore, unlike pure disciplines like philosophy or physics, IS has direct and immediate impacts on people and society. The IS teacher must be sensitised and aware of both the specialist aspects and the public concerns and demands.

These dichotomies make the definition of IS and its teaching a significant challenge. It may be too easy for the IS teacher to be tossed about in a sea of change, driven by changing trends. Therefore there is a need for the IS teacher to have some principles in mind to enable her to steer a straight path through the differing demands of industry and academia, the plethora of supporting disciplines and the conflicting demands inherent in what should really be described as an inter-discipline.

Fundamentally, academics need to engage in relevant scholarship in order to undertake and perform the complex and demanding integration with industry through knowledge acquisition, application, development and transfer. Boyer (1990) presents these challenges, as follows;

- scholarship of *discovery* - the idea of research and its dissemination;
- scholarship of *integration* - which involves making connections across the disciplines and placing the specialties in a larger context
- scholarship of *application* - which goes beyond the application of research via commercial consultancy and considers the contribution to knowledge
- scholarship of *teaching* - which both educates and entices future scholars by communicating significant knowledge

Teaching is a process of investigation and communication where a systematic contribution to knowledge is achieved through the integration of theoretical and practical activities. IS academics therefore should be learning innovators and problem solvers working at the cutting edge of their fields but sympathetic to teaching issues. This paper firstly examines the goals of the IS teacher, a series of roles are then established which suggest some principles for IS teaching. This further leads to a discussion of curricula development and definition.

II. GOALS OF AN IS TEACHER

The goals of an IS teacher do not significantly differ from those of any other teacher. Since the actual technical subject matter is in such a state of constant change, a short-term focus on teaching the current methodologies and fads cannot be justified. We must provide IS students with social and technical frameworks, themes and patterns which will enable them to work in a variety of organisational, technical and social situations. These frameworks of the mind will acts as hooks to enable students to make sense of changing technology. They may be seen as scaffolding to support the student in developing their own understanding of relevant technology and technique. The frameworks should address organisational principles as well as technical principles. They may be considered as minimalist structures on which students may improvise.

> **Principle 1**: *Establish a series of generic frameworks or patterns in your teaching that can applied to changing technologies and business practices. Derive these bottom-up from observing practice and top-down, drawing on theories across disciplines.*

We should be developing generic long-lasting skills. For example, in programming, our focus should be on good practices, programming structures and principles. A programming course needs to use standards, structures and patterns which will establish good practice. No programming course should focus on the detailed technical problems and work-arounds for a particular piece of system software. We should avoid teaching hacking. We should be iinculcating good habits, encouraging students to think in a structured manner - understanding and effectively applying encapsulation, for example.

> **Principle 2**: *Identify and teach the minimalist structures of IS.*

This principle is intended to alert the students to the complexity of IS whilst recognizing the fundamental principles involved for means of clarity and communication. We must reduce the definitions of IS and their associated uncertainties to a series of easy to understand concepts.

> **Principle 3**: *Draw out the generic from the specific and communicate principles and habits that can be applied across many IS technologies.*

We should be providing context and developing a holistic and global view. This will include understanding the organisational context of systems development, highlighting global and ethical issues, and explaining the context of the public use of the Internet. Often practitioners are so focused on the details of the process and technology they fail to understand the context and reasons for their activity and consequently fail to successfully implement the IS.

> **Principle 4**: *Always explain the context for any technique or practice. Push the student's thinking outwards.*

Both students and practitioners tend to absorb new trends and technologies without critically appraising their value and benefits and indeed the validity of the claimed benefits. For example, the rhetoric around business process engineering was promulgated by academics as well as practitioners, without attempting to critically analyse the truth of commercial statements about BPR, or to understand its underlying philosophy and ancestry, or to critically evaluate whether it ever achieved what it was supposed to. The IS academic must raise questions about technologies and industry trends, evaluate them and encourage their students to apply critical and independent thinking. We should be sensitising students to the problems and issues that IS raises so that they have the critical tools and faculties to make reasonable decisions about the validity of a particular theory, idea or method.

> **Principle 5**: *Seek to question the use of techniques and theories which are offered to you as an IS teacher. Develop your own frameworks for evaluating the claims associated with new techniques and the value of theories. Educate your students in critical thinking. Ensure that industry and academic practice is questioned and evaluated.*

III. THE ROLES OF AN IS TEACHER

The IS teacher may be seen as taking a number of roles simultaneously. Each of the following roles intercalates to produce a well-rounded IS teacher:

TEACHER AS THEORETICIAN

A major problem with IS and its practice is the apparent lack of any theoretical foundations. This theoretical lack leads IS practitioners to chase transient theoretical trends. The teacher must derive theoretical frameworks from both social and technical disciplines and show how theoretical frameworks, whether structuration theory or object-oriented concepts, provide lighthouse beacons in an environment of stormy and unpredictable technological progress.

Theoretical analysis is important to provide both guiding principles for further work, sensitising devices for students and practitioners, scaffolding to support the generation of personal theories and plausible explanations for observed IS phenomena which are sense-making. We would suggest that the interdisciplinary nature of IS debilitates against the discovery or formation of any overarching theory. Rather than developing some utopian monolithic theory we should seek to derive both theory and metaphor from as wide a variety of disciplines as possible. A proliferation of theories will be beneficial to IS. Indeed, no idea or theoretical perspective will be incapable of improving IS knowledge. IS practitioners should not be restricted by unbreakable rules. This may involve proceeding counter-intuitively and avoiding 'lock-in' to particular theories or popular trends. Indeed, ‘Given any rule, however ‘fundamental’ or ‘necessary’ for science, there are always circumstances when it is advisable not only to ignore that rule, but to adopt its opposite’ (Feyerabend, 1993).

Theoretical frameworks will: provide foundations for future knowledge; underpin good practice; provide points of reference within an environment of rapid technological progress and support the linking of the academic with the practical. Classically IS has drawn on sociological frameworks. In particular structuration theory and actor-network theory have proved popular. However, theories from psychology, philosophy and biology support IS by providing an understanding of motivation and metaphors for understanding both the social and technical mechanisms underlying IS. Theories and ideas may be drawn from management literature. For example, the theory of scripting, initially developed in psychology was then applied in computer science (Schank and Abelson, 1977) was subsequently used in service management studies to analyse service interactions (Hubbert et al, 1995) and then applied back into information systems (McBride et al, 2003). In addition, consideration, again from the psychology literature. has frequently been given to cognitive mapping principles as an aid to systems understanding (Hackney and Pagano, 2000).

> **Principle 6**: *Read widely in other 'reference' disciplines. Seek to expose students to a variety of theoretical frameworks from different disciplines which may inform IS.*

TEACHER AS PRACTITIONER

There is a long tradition of teachers leading by example. The student watches the teacher practice and learns by example. We should consider ideas of apprenticeship, workshops and guided practice. Gabriel's proposal for a Master of Fine Arts in Software Engineering (Gabriel, 1995) provides an example of such a model of teaching, as does the MA in Creative Writing at East Anglia. Gabriel's proposal for a fine arts degree in software engineering involves lectures and discussions on topics concerning the fine art of software engineering, presentations in the evenings, workshops on student's selected project and collaborations between students and lecturers

There is also a long tradition within universities that the teacher leads by example. IS is a practical discipline, with skills to be learnt and applied to produce both technical artifacts and social outcomes within organizations. Without a practical understanding of the commercial problems associated with IS, both teaching and theoretical reflection become difficult and may be somewhat artificial. Academic IS draws on practice but provides the environment to reflect on that practice. IS is perhaps analogous to medicine where the teachers are generally practitioners and students must learn by watching the teacher and working along side the teacher in the ward and the operating theatre. Practical experience injects currency and industrial relevance into teaching. Professional knowledge and practice at the hard edge of IS colours teaching (Kawalek et al, 2001).

This need for practical experience and the development of research questions from that practical experience raises difficulties for PhD students who move straight from their studentships to teaching IS. Since IS is inherently embedded in practice we would suggest that there is a need for such teachers to take time to work in and experience industry. IS teachers should experience some IS consultancy, track industry practice and observe practitioners in action. There should be a steady dialogue between the full-time practitioners and the teachers.

> **Principle 7**: *Cultivate your practical experience by working in industry, connecting with industry practitioners and developing industry-based material.*

TEACHER AS PRIEST

The IS teacher acts as a gatekeeper of knowledge. We define what is worth knowing. We interpret and teach the jargon of the IS priesthood. We permit students to the inner circle of IS practice. As such we need to be careful about what we teach. Does our curricula content represent long-term IS concepts and sturdy foundations, or are we just taking up the latest fad? For example, was there any justification for the effort put into teaching business process re-engineering?

Similarly, for example, should we teach extreme programming (XP)? If we are considering doing so, do we simply adopt industry practice and teach that or do we raise critical questions about XP?

As IS teachers, we should ask:

- What is XP?
- To what extent is it hype?
- Who is applying it? What are its critical outcomes?
- Why has it emerged and what is it trying to achieve?
- What are its advantages and disadvantages?
- How does it fit into our knowledge-practice base?

- What is its long-term value?
- How do we challenge it with theory?

Extreme programming involves little documentation and the treatment of source code as the only necessary reference. XP provides no software specification, no separate design and testing phase and no formal reviews or inspections. Forward looking design which structures programs so that later change is easier is prohibited. The value of such practices does not get questioned. Extreme programming is linked to the patterns movement and a particular group of programming gurus. Critically, it may be seen as a reaction to the disenfranchising of the programmer through structured management practice, quality practices and outsourcing. It also has a clear philosophical grounding in chaos and complexity studies, ideas of emergence, post-modernism, and eastern philosophy.

The IS teachers role as a priest is to interpret such practices, apply critical analysis and determine whether new industry practice should be taught and how. IS teachers should be interested in promulgating standards and interpreting of jargon and/ language. Our role is one of director of studies, pointing students to the core principles, identifying sources, and validating industry claims. Furthermore, as a priest, the teacher may create stability through identifying and teaching fundamental principles.

> **Principle 8**: *Always apply critical thinking to the selection of topics and sources*.
>
> **Principle 9**: *Seek to interpret jargon*.

TEACHER AS COUNSELLOR

IS teachers need to highlight their role as counsellors. Listening is as important as teaching. Such a counselling role is particularly important in project supervising. Counselling is important in providing technical and managerial direction. This will involve acting as a sounding board for the student to explore their understanding of IS concepts. Through this process, the IS teacher guides the student to the most appropriate knowledge sources and to the best understanding. It is important to note that the student generates the ideas, decides on the direction and takes that direction. IS counselling must not be prescriptive, but rather enabling so that the student can recognise the right approach to an IS problem and adopt their own mode of critical thinking. Counselling is necessary to avoid a dependence on the instruction and ideas generated by the IS teacher.

> **Principle 10**: *Always seek to provide a learning environment where the student comes to her own understanding of IS, and generates her ownership of principles and practices for herself.*

TEACHER AS EVANGELIST

As an influencer of students, we need to be promoting new ideas where we think they are critically valid. This may involve reducing their complexity such that the principles can be understood and the importance of the concepts grasped. For example, if viewing IT as a Service industry is practically and theoretically important, then we should be advocate such a mind-shift and promote such ideas in the classroom and industry.

As an evangelist, the teacher is deriving material from sources and recommending it to students. Thus the teacher must be in touch with both research and practice and must transmit enthusiasm and commitment to the students. The evangelist is totally convinced of the absolute importance and rightness of the principles he is espousing. His single goal is to get students to accept and practice what he believes and practices, to transmit belief concerning what are the right principles and practice.

> **Principle 11**. *Make sure you believe the principles you are teaching and transmit that belief to students.*

IV. DERIVING IS CURRICULA

The roles of theoretician, practitioner, priest, counsellor, and evangelist are influenced and influence curricula development. In such a changing subject, curricula should be evolving to reflect changing techn0ology and practice. Research and consultancy must be reflected in teaching. Furthermore, this should not be a one-way process. Ideas generated from discussion with students and from student projects should influence research. We would propose a circle of influence in which teaching both informs research and is informed by research (Gorgone et al, 2003; McBride and Wood-Harper, 2002). This circle of influence provides an important way to develop curricula and test it. Teaching influences research, but research ideas may then be tested by considering whether they make sense to students.

Such a circle of influence may be threatened by teachers who have no time to research and researchers who can't or won't teach. Real or virtual walls which separate teaching and research are damaging to both. Indeed, it has to be considered whether the RAE exercise itself has had a divisive effect on the research - teaching link.

> **Principle 12**: *Research and practice should directly feed into teaching through case studies and the application of new theories.*

> **Principles 13**: *Expect teaching to generate research ideas*

The development of curricula inevitably involves defining what is in and what is out (Alavi and Carlson, 1992; Culnan, 1987). This is a process of framing, involving defining individual ideas, concepts and technologies which are clearly distinct and dissociated from each other. The boundaries are defined by separating some concepts from others. Such inevitable framing carries the risk that significant concepts or areas of practice are excluded and black-boxes created from the wrong concepts. A discipline may seek to be unrelated, independent and unattached from other disciplines, if only for research assessment purposes. For an inter-discipline such as IS, framing may result in a loss of richness and depth. However, complete framing is not possible. There will inevitably be an overflow of ideas from IS into other disciplines and from other disciplines into IS (Lucas, 1999).

Callon (1999) suggested that, 'any entity is caught up in a network of relations, in a flow of intermediaries which circulate, connect, link and reconstitute identities'. In IS teaching terms, our allegiances to practice and theory derive from the networks we connect to. It we move exclusively in systems theory networks, our teaching may be driven by soft-systems ideas; if we move in object-oriented academic and practitioner networks, our teaching will be coloured by the patterns movement and the ideas of Christopher Alexander. Thus these practitioners and academic networks drive IS curricular development but also serve to restrict curricula development, to lock IS into particular grooves and to select a subset of theories such as structuration and ANT which may gain currency, not necessarily thorough their explanatory power, but through the power and status of the actors and networks in which they are promulgated. In order to develop the IS curricula, teachers must seek to widen their networks. This may involve mixing membership of academic and industrial networks, not attending the same conference every year, developing connections to networks outside IS such a philosophical networks, organisational studies groups and so on. Inevitably, curriculum development will involve inscribing meaning to IS concepts and defining learning pathways. Curriculum development also involves defining black box concepts which may be simply taught.

> **Principle 14**: *Expand the range of academic and practical networks you move in as a stimulus to curriculum development and innovation*

Finally, it should be noted that the shape of IS curricula is significantly affected by the networks with which IS teachers connect. If those networks are small, or limited to academia or industry, then the development of IS curricula will be inhibited. Good curriculum development may require IS teachers to expand their networks, including industry and academic networks. The acceptance of ideas in IS which are then incorporated into the curricula, is driven by actor networks, in which

ideas are inscripted and may eventually become black-boxes which are taught throughout syllabuses without reflection on why they should be taught.

V. CONCLUSION

A common denominator for all the previous aspects of teaching is the need to focus upon encouraging innovation and creativity within the theory and practice of IS. The design and implementation of strategic applications which will improve business performance or deliver service enhancements requires innovation and creativity. The recognition and development of these systems require an 'artistic flair' which is not normally associated within IS teaching. Indeed as IS teachers we need to be aware of the artistic and creative elements of our discipline. Good design and good IS requires creative skills. IS teachers should seek to augment the student's innate intuition and to restrict teacher tendencies towards demanding prescriptive solutions. Students should be encouraged to nurture their common sense and to articulate and engage in self-centred educational activities. There should be an acceptance by teachers that there is a finite boundary for material that can be taught but an infinite exposure to learning in the right circumstances. The teacher should provide the outline guidance to enable a 'spark to cross the gap' which illuminates the student experience and formulates a lasting creative expression. Lessons may be learned from the other teaching programmes which specialise in stimulating innovative ideas, such as creative writing or fine art. Students working independently or in teams could develop and present a portfolio of options relating to an organisational IS problem and hold an exhibition of defined artefacts.

Approaches to IS design have historically been through formal methodological techniques which require significant analytical thought. Systems design is tempered with this view, in the practice and teaching of, for example, the Rational Unified Process (RUP). More recent approaches, such as suggested in various agile development methods, consider the value of more extensive discourse within application development situations where a more informal narrative with stakeholders appears to offer the best prospect of a successful application. This again needs to be reflected in IS teaching that soft personal skills are as equally important as formal logic and mechanistic procedures.

Another critical feature of this aspect of teaching is the value of education over the functionality of training. Training is convergent and prescriptive and is contained within a well defined timetable and presented as a final solution to a specific problem, i.e. developing skills in JAVA script. Conversely, education should be generalisable and not referenced to one specific industry context. It should provide for critical and challenging thinking outside of normalised practice. Perhaps one of the most damaging features of the Internet is the proliferation of consultancy 'solutions' to any organisational issue. Students should be aware of the pure hype surrounding these products and the claimed value of their implementation. The notion that academics do not work in the 'real world' is therefore also contested as they have the privilege of determining an holistic picture of these environments away from a narrow consultancy, indeed solely practical, perspective.

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