Ecological Models and Information Systems Curriculum

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INTRODUCTION

To those of us involved in research and teaching in information systems (IS) it is clear that curriculum innovation and change is complex, and anything but straightforward. The amount of control that individual IS academics have over the curriculum varies between universities. In some cases there is complete control over curriculum content, whereas in others just control over delivery with content determined externally. This chapter concentrates on the former situation but still has some relevance to the latter. All curriculum innovation is complex (Fullan, 1993) due to the involvement of a large number of human actors, but in information systems curriculum change this is particularly so due to the need to consider the part played by such non-human actors (Latour, 1996) as the technology itself.

We will argue that if you want to understand *how* IS curriculum is built, you need to use models and metaphors that relate to how people interact with each other, with the environment, and with non-human artefacts. One such approach is provided by the ecological metaphor described in this article in which we argue that systems of education may be seen as ecosystems containing interacting individuals and groups. The interactions between these will sometimes involve co-operation and sometimes competition, and may be interpreted in terms of these forces along with mechanisms for minimising energy expenditure. In this article we will examine the application of this metaphor to curriculum change in information systems.

## BACKGROUND

Models of Curriculum Development

Nordvall (1982), building on the work of Havelock (1969, 1971), identifies several models for curriculum change that he suggests all have relevance, in the higher education context, at the subject, course, and institutional levels. These are:

- research, development and dissemination models;
- problem solving models;
- social interaction models;
- political and conflict models; and
- diffusion, linkage or adaptive development models (Tatnall, 2000).

Models of change based upon a process of research, development and dissemination (RDD) are probably the most common way of attempting an explanation of the process of curriculum development (Nordvall, 1982). In models like this, relying on logical and rational decisions, curriculum change depends on the use of convincing arguments based on programs of research. A rational and orderly transition is then posited from research to development to dissemination to adoption (Kaplan, 1991). These could then be considered as "manufacturing models", as they follow a fairly logical and straightforward mechanical approach with one thing leading directly to another and do not allow for or consider other influences such as those due to human interactions. If we were to accept a manufacturing model like this then we might expect some curriculum outcomes to be apparent across the world:

- As research would have shown that several specific programming languages were much more widely used and better to teach than others, all courses requiring programming would use just these few languages, and there would be no arguments regarding the best language to teach.
- As research would show the advantages of object-oriented methodologies all computing courses would teach only these and ignore other approaches.
- The content of courses around the world would be designed to achieve similar goals and outcomes, and contain similar content.
- Research would show the ideal method of teaching computing concepts and issues and classroom delivery of content would be moving towards this researched ideal. Everyone would then use these ideal delivery methods.

Figure 1. Research, development, diffusion and dissemination models

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Research →	Development →	Production →	Dissemination →	Adoption
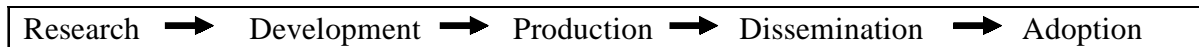
It is easy to illustrate that these predications are not borne out, in fact, as programs of study show wide variance within any given country and around the world. Many different programming languages and development methodologies are used, and a wide variety of techniques are adopted for classroom delivery. Some innovations seem to be accepted worldwide, but many are accepted only locally. Here, We will provide an alternative model that we believe better explains how IS curriculum is actually developed.

Metaphors and Models

Before proceeding however, we need to caution the reader on the limitations of models and metaphors. The dictionary describes a metaphor as a term "applied to something to which it is not literally applicable, in order to suggest a resemblance" (Macquarie Library, 1981, p. 1096). Metaphor are useful, not in giving a literal interpretation, but in providing viewpoints that allow us to relate to certain aspects of complex systems.

We contend that most curriculum models and metaphors are too simplistic to allow a useful view of a curriculum development as a complex system involving human and non-human interactions. In this regard, the ecological model offers two main advantages:

- A way of allowing for the inclusion of complexity.
- A new language and set of analytical and descriptive tools from the ecological sciences.

AN ECOLOGICAL MODEL OF CURRICULUM CHANGE

In ecology organisms are seen to operate within a competitive environment that ensures that only the most efficient of them will survive. In order to survive, they behave in ways that optimise the balance between their energy expenditure and the satisfaction they obtain from this effort. These two key principles underlie the discipline of ecology, which is concerned with the relationship of one organism to another and to their common physical environment (Case, 2000; Townsend, Harper & Begon, 2000). Habitat, ecological niches, and the exploitation of resources in predator-prey interactions, competition, and multi-species communities (Case, 2000) are all important considerations in ecology.

We have argued (Tatnall & Davey, 2002, 2003) that these ideas correspond to the process of curriculum development in that an educational system may be seen as an ecosystem, and that the interactions within this can then be analysed in terms of ecological concepts such as competition, co-operative behaviour and niche-development. Curriculum change can be interpreted in terms of mechanisms for minimising energy expenditure and decisions that individuals make about whether to co-operate or to compete.

In information systems curriculum development we should thus look at all the factors, both human and artefact, to see which could be expected to compete, and which to co-operate to become part of the surviving outcome. A non-human stakeholder such as a development tool or methodology must co-operate with the environment, compete successfully, or die out. This may mean a new curriculum element becomes incompatible with an old element and so replaces it. Alternatively it may mean that two new design tools can be used together, or that a particular curriculum element is compatible, or perhaps incompatible, with the desires and interests of a particular faculty member.

Ecological metaphors have been used in areas other than biology and IS curriculum change. An ecological framework has been used quite successfully in other areas including mathematics curriculum (Truran, 1997) and a study of the effects of violence on children (Mohr & Tulman, 2000). Ecology as a framework tells us to expect progress of a task through co-operative or competitive behaviours of the animate and inanimate factors in the environment. A factor that cannot compete or co-operate is inevitably discarded.

Ecosystems and Complexity

An ecosystem contains a high degree of complexity due to the large number of creatures and species living in it, and to the variety of interactions possible between each of these. The "ecosystem" represented by the curriculum in a university information systems department contains (at least) the following "species": lecturers, researchers, students, professional bodies, university administrators and representatives of the computer industry. The "environment" also contains many inanimate objects relevant to the formation of the curriculum, including: computers, programming languages, textbooks, lecture rooms, analysis and design methodologies, networks, laboratories, programming manuals, and so on.

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