Enhancing Student Learning Outcomes through Hypermedia-Based Learning: Has Theory and Research Been Applied Effectively

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Information Technology is playing a more and more important role in our everyday lives, and is being used increasingly in teaching and learning. For decades there have been theoretical explorations and considerable research efforts supporting a change in teaching and learning from the traditional paradigm of passive transfer of knowledge, towards a notion of teaching and learning which emphasises such notions as student-centred learning, active learning, student empowerment and higher levels of learning outcomes. Research has argued that the use of information technology offers much in relation to achieving the new paradigms of learning. This paper will examine the application of the research and theoretical explorations of the new paradigms of learning in relation to information technology use. A critical analysis of hypermedia-based on-line learning systems has been undertaken, with the results indicating that the application of previous research and theory has been inadequate in achieving enhanced learning outcomes. Adoption of information technology use has been driven by initial excitement, novelty and hopes of greater efficiency rather than careful and considered application of research towards pedagogically sound and enhanced teaching and learning. The paper concludes with a model for the application of relevant learning theory to hypermedia-based learning systems.

Introduction

Educators today are moving towards the use of more and more information technology in their teaching. This move, although a natural development in the evolution of educational technology, is currently being forced upon educators through pressures of greater efficiency and cost-effectiveness of education. Similarly, peer pressures in relation to innovation and novelty in teaching are leading to the constantly increasing use of information technology. Quickly, on-line courses, multimedia courseware and other such modes of learning are becoming an expected norm rather than an oddity.

The identification of benefits and enhancements to learning through the use of information technology has been a focus for much recent educational research and the associated literature. However, it is apparent that a number of serious deficiencies exist in relation to the research. Firstly, there are various problems in relation to the nature of the research, and secondly, the practical application of research findings. One main problem which has been identified in relation to the nature of educational research in this field is the lack of curriculum context. This refers to the fact that most research is simplistic and atomistic, failing to make explicit the notion of what entails good learning (Atkins, 1993, p.335). Moreover, throughout
the literature is found a general tendency towards a lack of method and penchant for the support only of anecdotal evidence. Typical of this problem is a study whereby the adoption of various different navigation systems in interactive multimedia is supported only by preliminary observation of students (Brickell, 1993). Further, even with a growing amount of research which examines the innovative use of new information technologies, its application in practice has not been sufficient.

This paper explores some of the problems which we are facing as we turn to adopt more and more information technology in our teaching. Three main areas will be explored here. Firstly, I will present a brief overview of what a significant amount of research has said in relation to the notion of enhancing learning through the use of one contemporary information technology - hypermedia. Then, using a case study of a typical on-line course, I will illustrate how educators are failing to adequately apply the research. This case study will offer a review, similar to that for a journal article or book review, which offers some constructive criticisms of an existing course. The paper will conclude with a formal model which places the notion of information technology within a systems-based approach to the enhancement of teaching and learning. This model has been used effectively in practice to focus the attention of the educators on identifying and achieving desired learning outcomes, and tailoring the use (or the choice not to use) information technology in education.

**Information Technology and Enhancing Learning**

Even though much research has examined how a particular information technology may be used in effective teaching and learning, it would be a largely futile task to decree that there is the perfect information technology for a particular learning situation. The most pertinent finding of a period of literature review and meta-analysis of research in this field has been the conclusion that the use of information technology is subordinate to several other elements of the teaching and learning process, and the use of an information technology will be no means guarantee a better learning outcome.

The traditional perception of education emphasises the transfer of information from lecturer to student, rather than any notion of a process of students’ learning (Jones and Jones, 1996, p.83). During the last few decades though, much theoretical and associated applied research has explored the notion of learning. Indeed, a significant body of evidence suggests that we need to become much more concerned with how students learn, rather than merely what or how much they learn (Newble and Cannon, 1995, p.151). The fields of cognitive and developmental psychology have been the forum for much research in relation to the process of learning, even though the top-down approach of deriving practical benefits deductively from theoretical explorations has been brought into question throughout the literature. Regardless of this problem, the last few decades have seen a marked increase in the examination of teaching and learning in higher education from an applied theoretical perspective. It has been argued strongly that theory still has much to offer the cause for improvements in teaching and learning in higher education, especially in regards to achieving higher order learning outcomes (Biggs, 1989, p.7).

The examination of the process of learning has yielded a much greater theoretical understanding of the process of student learning. A review of the literature has found general consensus in identifying a trio of elements which modulate student learning, namely student characteristics, teaching characteristics and the learning environment. Further, the literature also identifies the ways in which the characteristics of teaching and learning environment can influence the students’ characteristics, also with the learning environment influencing the characteristics of teaching. Synthesised, these factors can be demonstrated in the model found in *Figure One*. 
Figure One: Model of Student Learning

The model in *Figure One* illustrates the various modulating factors which influence the learning process and ultimate learning outcome. This leads to the position that no theoretical exploration of learning can claim to be comprehensive without reference to all three modulating factors, and their possible interactions. Moreover, the model illustrates that educators must take into account these factors in their teaching, in order to facilitate the best learning outcomes for the students.

The facets of enhanced learning summarised in *Figure One* must form the theoretical framework for the adoption of information technology use in higher education. Other factors such as greater efficiency, increased flexibility and increased enrolments with larger student to staff ratios are current driving forces behind the adoption of information technologies in teaching. However, whilst these outcomes might be valid, it is only within the framework of enhanced teaching and learning that information technology use should be adopted. Therefore, put simply, the use of information technology must not sacrifice learning, but rather be used to enhance it and hopefully achieve higher order leaning outcomes.

The utility of information technology use in achieving quantitatively better outcomes has been demonstrated in the literature (e.g. Atkins, 1993), however, throughout the literature examples have been cited whereby it can also contribute to general qualitatively better learning outcomes. Through the use of information technologies, learning can be placed in a social, realistic and self-directed environment, and furthermore in a manner which is exciting and motivating for students (Harper and Hedberg, 1997). Information technology can also provide a context for learning that supports a problem-based active mode where cognitive conflicts arise and a deeper understanding of material results (Kennewell, 1994).

An examination of current applications of information technology in higher education shows that they can all too easily fail to achieve enhanced learning. Often the development and application of information technology based courseware involves nothing more than the translation of a textbook or series of lectures into an electronic format. Whilst this may lead to improvements in the areas of flexibility, accessibility and efficiency (see Tinkler, et al., 1994, p.53), it certainly does not automatically lead to enhanced learning. More importantly such uses of information technology merely serve to reinforce the dominant paradigm of the passive transfer of propositional knowledge.

Many current CDROM and on-line learning systems present material in an attractive multimedia format, yet do so in a didactic fashion which promotes only surface level processing of information. Even with hundreds of thousands of dollars spent in the development of such devices, they are little more than multimedia textbooks and at best
show few improvements from the behaviouristic learning machines of the 1960s. Similarly, associated assessment usually reinforces the adoption of a surface level approach through the reinforcement of simplistic recapitulation of facts already presented to the learner in a pre-digested form within the 'learning system'. However, it is apparent that there exists an exciting potential for effective use of information technology in higher education, in a manner which does enhance teaching and learning. Specific higher order learning outcomes can be promoted and developed specifically through the use of certain information technologies.

In relation to the student characteristics which modulate learning, information technology can be applied to promote higher level learning outcomes through the setting of tasks which require higher levels of student participation in the learning process, and which engage students in deeper levels of information processing and assimilation. Traditionally this type of student engagement has been achieved through a more active, problem-based mode, and the various forms of information technology available can effectively provide for the adoption of such a mode.

Existing information technologies such as the Internet, multimedia CDROMs, CDROM catalogues and on-line databases provide an unfathomable amount of information at the fingertips of students. With access to such systems educators can integrate research, information gathering and information manipulation tasks into their courses. These tasks facilitate the development and honing of associated skills which are essential learning outcomes in a society where information is such a powerful currency. Similarly, it is easy and potentially extremely effective to use such systems to facilitate the development of critical thinking, analytical and information evaluation skills. In relation to the model in Figure One, these learning outcomes can be facilitated through active and problem-based modes of teaching, utilising the information rich environments of the appropriate information technologies. Furthermore, the learning task can be shaped to facilitate the adoption by the student of metacognition and heuristics, within a deep approach to information processing, illustrating the interaction between the various elements of learning.

Other existing and readily accessible information technologies such as email, email listservs, newsgroups and synchronous text based communication programs can quite obviously be used to produce the higher learning outcome of enhanced communication skills. Moreover, they can be seen to facilitate the adoption of collaborative modes, where students must actively engage with the content, again leading to deeper levels of processing and thus higher order outcomes such as durable, transferable knowledge and the construction of personal meaning.

The adoption of appropriate modes of assessment is another essential part of the effective adoption of information technologies in higher education. Research has shown that an overload of work and an assessment process which rewards reproduction of content promotes the adoption of a shallow approach to learning (Dart and Clarke, 1991, p.318). The use of self-testing devises in some existing on-line learning systems has been particularly bad in relation to the rewarding of the reproduction of content, and remains an area of concern which is relatively easily rectified.

From this overview of some of the promising applications of information technology in higher education, we find that those that are effective adopt a largely non-didactic mode. More explicitly, they can be seen to promote and adopt a number of the theoretical requirements for good learning as summarised in Figure One, leading to the potential achievement of higher order learning outcomes. It is evident that these applications of information technology can only succeed when they are driven by a broader context of enhancing learning. Thus the best examples of research in this field are examples not only of research into information technology use, but also good examples of educational research.
Hypermedia Based On-Line Learning Systems

Research into the use of hypermedia-based on-line learning systems has yielded considerable understanding of how they can contribute to the enhancement of teaching and learning. Hypermedia is most commonly known through the World Wide Web, where it forms the basis for all "web-pages". Hypermedia has been seen to offer forms of information representation which is similar to the associational knowledge storage of our human cognition (Kearsley, 1988, p.23). Burbles (1996, p.23) discusses how hypermedia can be used to effect qualitative improvements in learning, through the mode of rhizomatic information representation, learner exploration, and the types of knowledge construction this facilitates in the learner. Furthermore, within an effective hypermedia learning environment, the learner becomes not merely the reader of the text, but more like the author, actively constructing knowledge through the various links and associations they choose (Bolter, 1991). This has been seen to engage the learner in the learning task to a much greater degree, thus facilitating a deeper approach to learning, and higher order learning outcomes (Jacobs, 1992).

Research has been presented in which hypertext has been shown to enhance the students metacognitive awareness of the learning task, (Jacobson, et al., 1996, p.155), a process which has previously been shown to be an essential element of enhancing learning (Bransford, 1979). Similarly, the notion of situated learning has been associated with the use of hypermedia, referring to the benefits arising from learning which occurs in a meaningful and relevant context (Reushle, 1995, p.151). Hypermedia has also been used to effect in the development of problem-based learning, where the student can be more actively involved and engaged in the learning task, itself another mode for facilitating higher order learning outcomes (Pennell and Deane, 1995).

From this brief overview of some of the major research findings we can see that hypermedia has the potential to affect some real enhancements to learning. However, we must keep in mind that by merely including a hypermedia component in a course, or converting a traditional course into an on-line hypermedia format will not automatically result in these enhancements. It is only through a careful and holistic examination of the learning situation, and the use of the technology in certain modes of teaching and learning, that these outcomes can be realised. An example of current hypermedia-based learning systems is now explored in order to examine to how this valuable research is typically being ignored.

A Typical On-Line Course "M292 - Energy in Society"

The most common use of a hypermedia-based learning system is that of an on-line course. One such course, M292 - Energy in Society, is a semester length subject offered in an external mode as an Internet-based on-line course. The course was developed and offered by an Australian university, and has been suggested that it contributes to the quality and effectiveness of the University's teaching and learning through the use of Internet services.

This particular university is currently pushing the notion of Internet-based delivery, and offers staff, through a Teaching and Learning Centre, considerable support in preparing a course for an on-line mode. A comprehensive guide has been developed and, as its major focus, sets out a step-by-step process for creating an on-line course. This process is as follows:

- organising course content
- framing course aims and learning objectives
- designing learning activities
- encouraging interaction
- deciding on assessment
- providing study support
- organising administrative information

The linear and simplistic sequence for creating and on-line course, given here, does provide an intuitive and approachable process for even the most technologically wary educators. However, whilst the process outlines the major steps in converting a traditional lecture and tutorial framework into an on-line structure, there are some major shortcoming of this model. Significantly, this process does not include any notion of an iterative approach to curriculum development, and within the linear sequence the notion of student learning outcomes are subordinated to the course content. Moreover, even though more active and interactive approaches to learning are alluded to, by making these secondary to the overall course content, a largely didactic mode is still inadvertently entrenched. This is evident in the particular course being examined.

The on-line course was built using a template developed by the Teaching and Learning Centre in order to establish a common structure for on-line delivery of courses from the university. This design template was developed in relation to relevant literature, and its individual elements initially involved a strong pedagogic rational (Brown, 1997, p.115). The template structure allows for a strip on the left hand side of the screen to remain a static navigation tool, and thus the substantive elements of the course appear in the rest of the screen. This utilises the existing “frame” facility of HTML, the "hypertext mark-up language" used in building Web pages and other form of hypermedia. Below is found the index page of the course, which illustrates the frame-based template structure.

![On-Line Course Index Page](image)

Figure Two: On-Line Course Index Page
The index page for the course, as seen in the image above, outlines the materials and facilities available to the student through the on-line course. From this page students are able to access information and help relating to both the course itself, and the use of the on-line learning facilities. The main page which forms an interface to the actual on-line course is the study schedule page, shown below.

**Figure Three: On-Line Course Study Schedule**

The study schedule provides an outline of the whole course, and supplies links to individual pages for each topic. This itself highlights that the course is run in tandem with traditional lecture-based modes of delivery, and entails a simplistic conversion of a traditional course into an on-line course. This goes against considerable research which emphasises that the use of information technology entails a completely different approach to teaching and learning. As Dolence and Norris (1995, p.3) suggest, realignment to the needs of an information age requires more than an superimposed increase in the use of information technology. Furthermore, whilst new technologies can be used to replicate traditional forms of teaching, their importance is that they can be used in quite new and different ways, and can support modes of learning not available through the traditional techniques (Bates, 1997).
If we examine a typical topic, we can see just how the on-line mode supports little more than the passive transfer of declarative knowledge. The screen-shot below shows *Topic 25 - Energy and the Environment*, the first topic for the 13th week of the course.

**Figure Four: On-Line Course ~ Topic 25**

The topic as outlined here is much the same as if it were delivered in a traditional lecture based mode. There is a brief outline of the topic, suggested readings, a hypertext link to the topic notes and a series of rather simplistic questions, designed to do little more than test the students ability to recall information from the readings and notes. The screen-shot below shows the Topic Notes.
The Topic Notes, consist of a single long page of text, graphs and tables. The section above shows approximately one tenth of the page, and is typical of the Topic Notes for the course. Whilst the notes are concise and clear, providing the student with the prescribed content, they do not apply any of the research into the use of hypertext explored above. Nowhere in this course is the facility for hypertext to represent and store knowledge in a non-linear and association manner utilised. Neither are the notions of exploratory learning, nor active knowledge acquisition utilised.

Each week, the student is expected to read and absorb the notes in a linear fashion from the top of the page to the bottom of the page, then, with the information from these notes and additional reading, complete the specified questions. Therefore, we see that the course facilitates a shallow approach to learning by presenting information in a 'final' form. Desired higher level learning outcomes, such as understanding, result from deeper levels of cognitive processing and refer to the acquisition of knowledge that is meaningful, and that can be abstracted and transferred. Therefore, understanding relates to the development of knowledge about the intentional content of material, rather than the material itself (Marton and Ramsden, 1988, p.279). It is evident that this course does not attempt to enhance learning by offering material which must be cognitively constructed, analysed and actively engaged with, but only supports traditional passive transfer of information. Similarly, this main element of the course structure fails to take advantage of the research findings in relation to situated learning. Whilst the learning environment is on-line, and does include some links to external Internet-based resources, it fails to adequately integrate these links.
into the course structure, and does not include any truly meaningful and relevant elements to the learning process.

The template strategy, which forms the structural framework of the course, does attempt to provide for active and collaborative modes of learning through the inclusion of an on-line discussion forum (Brown, 1997, p.118). However, if we examine the on-line forum utilised in this course, the café-chat, we see that it can offer little towards the promotion of such modes of learning. The screen-shot below illustrates the discussion forum.

Figure Six: On-Line Course ~ Discussion Forum

The screen-shot above, shows how this on-line discussion is limiting. Each new contribution is written in isolation of the other contributions, and is added below the most recent contribution. This screen-shot is admittedly taken from a trial of the learning materials, and includes both comments from the students, and comments from visitors to the site. However, even when such an on-line discussion is operating in a designated learning situation, it does not facilitate a great deal of on-line communication or collaboration, but a linear and rather static set of isolated comments. Thus the notion of a discussion is quite far removed from what can be achieved without the use of technology, or even with better applications of web-based information technology.

In summary, this hypermedia-based on-line learning environment fails to apply the great deal of valuable which has shown the possibilities for enhancing learning though the use of information technology. There are several good elements of this on-line course: it is clear, concise, easily navigable and attempts to integrate discussion into the course. However, in essence it merely converts a traditional course into an on-line mode. The course is linear,
and through a rigid set of materials and time constraints, it is by no means learner centred, or allows for enhanced learner control. Further, the course materials fail to apply the benefits of hypermedia use through the development of non-linear associational knowledge bases. The learning facilitated here is not active, problem-based or situated, and through the use of an ineffective ‘discussion’ interface, fails in its attempt to provide for collaborative learning and social negotiation of knowledge.

This example has been chosen as it represents a typical example of how information technology is being used in higher education. Even with the backing of a dedicated Teaching and Learning Centre, and the use of a template strategy, this example shows that it is possible for curriculum developers to fly in the face of quality research, and produce an largely ineffectual on-line course. Though to only offer a criticism, without suggestions for improvement, would not be particularly useful, thus I will now proceed with a few points for consideration.

**Alternative Learning Spaces**

It is possible to create effective on-line learning sites that can promote enhanced learning without losing the benefits of efficiency and cost-effective delivery. Indeed, in the above example, the framework for such outcomes has been established. Here I will outline a few considerations that need to be addressed in the effective creation of hypermedia-based on-line learning systems.

The overarching, and most difficult, requirement is a subtle shift in the focus of the educators. If our task was as simple as transferring a rigid and pre-defined set of information to the learner, then the above course is well designed. However, it is intuitively obvious, and constantly discussed in the literature, that education is so much more than this. Therefore, we must shift our focus from the narrow sites set on the transference of information, and widen our scope to include a much wider range of learning outcomes. These can encompass the realms of knowledge, skills, and affective domains. In one of the most influential works on contemporary higher education, Ramsden (1992, p.ix) challenges the prevailing view that lecturers need not be concerned with the theory of education. It is strongly suggested that the calls for quick fix practical solutions should be ignored, and rather teachers should be encouraged to come to understand the process of learning, and explore their own methods for achieving the broadest scope of learning outcomes.

However, there can be offered a number of more technical requirements, as well as modes of approaching technology use, that facilitate enhanced learning through hypermedia-based on-line learning systems. Firstly, the presentation of information within the on-line learning environment must take advantage of the information representation and association facilities inherent in hypermedia. Thus *knowledge bases* should be developed which allow students to navigate the realm of information relevant to the subject. Therefore, instead of the linear and pre-digested information representation seen in the example above, information is presented to students in a manner which allows them to construct their own meaning through exploration and engagement. This builds on the work in the field of constructivist learning theory, and is perhaps the most important, yet least utilised, potential of hypermedia and web-based learning.

Secondly, the notion of the *social construction of knowledge* must be embraced, and *student communication and collaboration* must still form an element of the course structure. To this end computer-mediated-communication can be utilised (though hopefully to a greater degree than found in the above example) as well as other modes of teaching and learning. Examples of these other modes include collaborative project based work or peer assessment. With sufficient emphasis placed on the interactions of students, information
technology can assist greatly in student communication and collaboration, especially when compared with the traditional modes of distance delivery.

The emphasis of an active mode of learning is another feature essential to achieving the potential of on-line learning systems. Again, the exploratory learning facilitated through the use of knowledge bases, or collaborative project work, are both examples of an active approach. This mode is largely irrelevant to the technology itself, and illustrates how it is not the technology itself, but how it is used, which determines the quality of teaching and the facilitation of enhanced learning.

Another factor that can assist in enhancing on-line learning systems is the notion of situated learning. This involves placing the learning within a real-world context, and students are thus engaged in activities that are meaningful beyond the immediate learning environment. On-line technologies can easily facilitate such an approach, through links to external sources of information.

These elements of information technology use can be brought together in various combinations to form learning activities that can facilitate truly enhanced learning. Taking the above example of Topic 25: Energy and the Environment, it is relatively easy to formulate a somewhat better example.

Firstly, the on-line topic notes should be transformed into elements of the knowledge-base for the subject, where associational links between information facilitates exploratory, active, and constructivistic learning and increases learning engagement with the subject matter. To this end, these topic notes should be broken into subsections, built around each conceptual element. Then hyper-links should be built into the knowledge base in a manner that adheres to both the inherent conceptual links, as well as in relation to intuitive links a student would be expected to make. This process, when applied to each of the individual topics, will result in a rather amorphous, non-hierarchical, and non-linear collection of information. Then, to gain maximum educational benefit, some form of navigational features should be included, such that students are guided to some degree in their exploratory learning. Such features could include different coloured text for links to sites within the knowledge-base, and for those to external sources of information. A site-map, which may describe the network of links and associations, would be of considerable benefit. Similarly, a simple index, which provides links to individual concepts, would enable students to return to the week's topic area, when their exploratory learning process leads them into areas that are 'off-task'.

The second simple improvement to this example of an on-line course would be through the further development of the specified learning tasks. Moving away from the simplistic questions which amount to nothing more than comprehension and replication of read information, a more active and collaborative mode should be adopted. As significant research has shown, a learning environment where knowledge can be socially negotiated and situated in relevant circumstances should be provided for the students, in order to facilitate enhanced learning. In this instance, some form of collaborative project would be a useful addition. An example of such a project might be the development of a draft environmental policy for minimising environmental degradation from the country's energy industries. Here students would be able to work and research together, on a topic that is probably relevant to their future employment in both content and context.

One of the most pressing conclusions, and one which should be emphasised, is that it is not the technology that drives improved learning, but rather it is the whole process of teaching and learning. As seen in the proceeding critical review, and in this brief overview of some tangible suggestions for improvement, the same technology can be used towards vastly different learning outcomes. The technology should be nothing more than an element in a
systematic conception of the learning process, which begins with a vision towards a set of enhanced learning outcomes, and proceeds with an understanding of the complexity of teaching and learning. This is by no means a new concept, but it is one that has been subsumed beneath the excitement and hype of technological innovation.

Whilst the ideas presented here, in this exploration of how research can be practically applied to the development of on-line learning environments, are not themselves new, they are certainly not being put into practice on a sufficiently broad scale. The reasons for the lack of application of the research may be manifold, and most probably include the pressures of time constraints, lack of instructional design staff, and a lack of accessible and clearly understandable literature that explores the notion of enhancing learning through the use of contemporary information technology. Moreover, one of the most pressing issues is fact that the focus on learning is being sacrificed to both perceived economic ‘constraints’ and the constant quest for technological innovation. There is an explicit need for a simple re-evaluation of what we are attempting to achieve through technology use, and a directed and systematic approach to technology use which incorporates notions of enhancing learning, evaluation and iterative curriculum development. Accordingly, revisiting systems theory may provide a useful framework for the effective integration of information technology into higher education.

**Systems-Based Approach to Information Technology use in Higher Education**

During the 1960s and 1970s the notion of systems began to be used throughout the sciences and quickly the idea of systems penetrated everyday language and the jargon of the mass media. Indeed, the ubiquity of the term is apparent in the fact that it is difficult to find synonyms for the entities to which we now refer so promptly as systems. Systems thinking attempts to make sense of the world by examining sets of elements which together form wholes, in turn examining properties of the whole rather than properties of connected parts (Checkland, 1981, p.3). Systems thinking is a means of approaching problems, and involves the exploration of a set of entities as a dynamic and interacting arrangement rather than a static aggregate (Kramer and de Smit, 1977, p.13). Therefore, systems thinking is predominantly an analytic tool, used effectively to make sense of the unique properties of a complex domain through an exposition of its elements, structure and functionality.

Systems thinking quickly pervaded the domain of teaching and learning theory, and the notion of *learning systems* emerged. The general process of education involves a large number of decisions on behalf of the educator in order to promote learning. It has been argued that such decisions should be made in a systematic and goal oriented manner such that teaching is a planned activity based on continuous feedback about progress towards each learners’ goals (Wong and Raulerson, 1974, p.3-4). Accordingly, a systems approach to learning attempts to bring systematic knowledge of the learning process to bear on instruction, and provides the necessary means for achieving the desired outcomes of the course (Gagne and Briggs, 1979, p.18-20). The model shown below describes a learning systems approach to instruction.
Figure Seven: Systems Model of Learning

There is a significant and serious disparity between desired learning outcomes of higher education, the theoretical foundations of enhanced learning, and the explored and unexplored potentials of information technology use in higher education. Accordingly, there exists a pressing need for some holistic and systematic guidance for the educator in effectively implementing the use of information technology in higher education, especially in light of the current hype and ubiquity of information technology developments.

In this context, a revision and further application of systems theory to educational practice poses a viable and highly useful solution. In essence, the main elements of systems theory can be extracted and applied to the formation of a model for effective practical implementation of information technology in the higher education setting. These major facets include the manner in which include systems thinking represents a means of approaching problems, involving the exploration of a set of entities as a dynamic and interacting arrangement rather than a static and its application an analytic tool, used to make sense of the unique properties of a complex domain through an exposition of its elements, structure and functionality.

The formal model below, is primarily derived from the synthesis of somewhat disparate theoretical domains. It forms a flow chart or schematic map for effecting learning enhancement through appropriate and directed use of information technology. As introduced above, this form of model owes much to the notion of instructional systems which came to the fore in the 1960s and 1970s. However, unlike the largely prescriptive and didactic instructional systems which originally emerged from this period, the model offers a systematic flow chart at a resolution which provides the educator with the autonomy to shape the learning process.
This novel application of systems theory to the higher education setting provides the desired structure and guidance to assist in the effective implementation of information technology use. The major characteristics of systems theory which have been applied to the model are as follows:

**Holistic**

The model presents a holistic representation of the higher education setting. It reflects the many relationships which exist between the various elements and phases of teaching and learning, and acknowledges that there is more to enhanced learning in higher education than can be expressed in a fragmented description of these elements.

**Non-Linear**

The model does not attempt to pre-define a sequential process for integrating information technology use into higher education. Instead, the model utilises a systems approach which maps the relationships between the elements involved. This allows educators to enter the system at a relevant point and explore the system as a non-linear whole.
Iterative

The model makes explicit a number of elements where an iterative process is involved. Thus at several stages the system requires the educator to stop and reflect on the relationship and interactions between elements of the system. This calls for reflection by the educator and is represented by a loop in the schematic map. The heuristic notion of reflection on teaching and learning is essential to the achievement of enhanced learning. Furthermore, recent literature has expressed that one of the major benefits of the introduction of information technology use into higher education is in relation to its impact on increasing such reflection. Indeed, specific reflection upon, and closer examination of the understanding of effective learning has recently been highlighted (e.g. Taylor, et al., 1996).

Differing Levels of Resolution

The model allows for different levels of resolution to emerge from within the system. Whereas the original explorations of learning systems largely failed to accommodate such changes in perspectives, this model embraces the notion of sub-systems, or interconnected systems. An example of this can be explained in relation to the element of the system which calls for exploration of the relevant facets of the learning process. Here the educator can adopt a finer resolution and another systems-based model becomes relevant. For instance, the model developed by Biggs and Collis (1989), as shown in Figure One gives a highly effective overview of the relevant aspects of the learning process. This model can be utilised as a useful sub-system of the broader system developed here.

Similarly, there exist a number of useful references in relation to the utility of certain technologies and media in education. These can be utilised to provide a higher level of resolution to the element of this system whereby an appropriate information technology is chosen and adapted. A number of taxonomies of educational media have been offered with the development of systems whereby a learning situation or outcome is matched with the use of certain media (e.g. Gagne and Briggs, 1979, ch.10; Gowans, 1972, p.5-7; Romiszowski, 1984, pp.65-70; Wong and Raulerson, 1974, pp.43-48). However, it seems inappropriate to be prescriptive in this area, especially if the acknowledgement is not made to the complexity of the learning situation. The lack of such taxonomies in recent literature highlights the relative futility of such a task in the current climate of continual development of technology based learning systems.

The focus of this formal model is most definitely placed on the learning outcomes, with information technology use seen as an effective and appropriate means to the ends of higher order learning outcomes. This research strongly calls for the calculated introduction of existing forms of information technologies into a course, rather than the development and implementation of novel and closed technology-based learning systems which offer a largely didactic mode. However, the model does not attempt to be prescriptive in dictating the ‘correct’ use of a certain information technology in a certain instance for a certain learning outcome. Rather, the model shows the generic system involved in choosing, adapting and integrating information technology use into a course, from the explicit focus of enhanced learning. Further emphasis of this notion is essential in the field of higher education. Put quite simply, the above systems-based model offers educators a tool with which to approach the enhancement of teaching and learning.
Conclusion

This paper has shown a number of the common pitfalls and shortcomings of the current push towards information technology use in higher education. Many who believe in the use of information technology are prone to loosely integrate it into their courses merely because information technology has been shown to enhance learning in some situations. Moreover, there is a pervading assumption that qualities solely in the computer medium itself are responsible for changes in teaching, learning and assessment (Snyder, 1996). This position has been labelled technological determinism and has resulted in over zealous moves towards the adoption of information technology in higher education.

These major problems facing the rapid introduction of information technology into higher education require some focus. There has been a significant amount of which has examined how information technologies can enhance learning, yet this paper has illustrated just how easily this research can be disregarded or ill-applied. Therefore, there exists a need for a model, or tool-kit, such that all educational practitioners can examine and understand how their courses can, or can not, benefit from information technology use. The successful integration of information technology into higher education is a multifaceted issue, and the complexity of the situation calls for an approach which can integrate these individual facets. A technique for the understanding of, and effective operation in, complex situations is known as systems theory. This paper has offered a viable working model for a systems-based approach to the integration of information technology into higher education. It is hoped that this model will assist educators in the adoption of information technology towards the end of enhancing learning.
References


