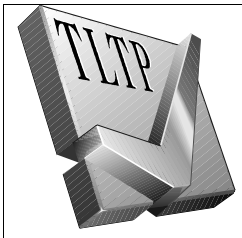

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Development of a TELRI Pedagogic model

Working document 1

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Aims of the report

Overview

The aim of this report is to provide insight into issues surrounding learning and education that underpin the project objectives. It presents a preliminary framework – a pedagogic model - for the on-going work of the project and good educational practice in general. The model particularly emphasises the pedagogic processes required for developing research-orientated approaches to learning. The report is a working document and stems from a wide-reaching literature review including educational research and practice, together with interim conclusions from the project work. The latter draws on our own experiences in as both researchers and educational developers and on evaluation of current academic practice.

Section A describes the rationale underlying the project objectives and summarises the relevant factors involved in learning processes and educational systems, which are distilled from a more detailed account of the issues described in Section B: Learning and Section C: Education. Taken together, these factors inform the TELRI pedagogic model and form the basis of the future work of the project in implementing educational technologies and disseminating effective practice. In turn, the project outcomes aim to inform the development of institutional, departmental and individual learning and teaching strategies.

Disseminating project outcomes

The report will be adapted for various stakeholders, including:

- the preparation of academic papers;
- papers that inform academic quality assurance and enhancement processes;
- staff development materials and workshops;
- information and guidance packs for academic staff, departments, institutions and national bodies.

The presentation of materials and medium of dissemination require careful consideration in order that the TELRI framework might be utilised to best effect in informing policy and enhancing quality and effectiveness of academic practice.

Working with courses in specific subject areas

Selected courses from staff in participating departments in phase 1 (Warwick & Oxford) will be mapped onto the pedagogic framework. This enables specific research-led approaches to teaching and learning methodologies to be made explicit, subject-specific differences to be recognised. From this standpoint, the evolving framework is informed by discipline-related factors assists the project to best identify where technological solutions can enhance these approaches.

Informing national issues

Through the course of recent national developments, from Dearing to the ILT[1] and from the TQEF[2] institutional learning and teaching strategies to QAA[3] and subject benchmarking, HEFCE have made it clear that these areas of enormous importance across the whole of HE. Methods of evaluating the effectiveness (and cost-effectiveness) of the TELRI approach will form an important part of this area of work.

[1] Institute for Learning and Teaching – accreditation of teaching as an HE profession.
[2] Teaching Quality Enhancement Fund – to be provided 1999/2000 to HE institutions for the development, implementation and evaluation of learning and teaching strategies.
[3] Quality Assurance Agency

Embedding a research approach to learning into curricula using technology

TELRI Project Objectives

The focus of the TELRI project is in the implementation and evaluation of technology-based learning and teaching in research-led institutions. The project aims to examine the ways in which technology is, and can be, used to enhance the quality of undergraduate courses in research-led institutions. Phase one of the project focuses on the universities of Warwick and Oxford and phase two brings in the universities of Birmingham, Durham and Southampton.

Effectiveness of technology-assisted approaches

There has been long-standing debate regarding the use of technology to enhance the learning process with limited evidence of significant benefits in educational quality or cost-effectiveness to justify the increased IT infrastructure and support realistically required. The pressures following massification, modularisation, diversification, widening access, lifelong learning, and so on, and several IT-related programmes at national level, have nevertheless driven uptake in the use of educational technologies as institutions strive to implement ICT[4] and to maintain educational quality. Uptake is not, however, a guarantee of improved quality or effectiveness in the long-term. Furthermore, many of these issues present no prevalent effect at present in universities like Warwick and Oxford, where student intake has remained of (seemingly) manageable type and number. The project is thus concerned to identify the needs of a research-led institution with respect to educational strategies and the benefits offered by ICT. This has implications for the staff who teach and the capabilities developed in the students.

Identifying and developing research capabilities

The implication of the project objectives is that the research capabilities and activities of the academic staff benefits the students attending these universities and differentiates them from students from institutions with less of a research emphasis. The project must, therefore, initially be concerned with identifying and defining specific factors associated with the undergraduate courses offered by Warwick and Oxford, as well as generic factors with respect to learning, education and the role of technology in these fields. Such factors include:

- The identification of research capabilities developed by the courses;
- The specific learning culture, education and infrastructure that such research-based institutions provide;
- The existing role of educational technologies and the possible future roles;
- The factors affecting staff adoption of educational technology.

Learning quality

The following questions are considered:

- Is there a relationship between the quality of courses offered by research-led institutions (as opposed to quality of students attracted) and the research capabilities/activities of academic staff?
- How might learning quality be defined and how does it relate to educational course quality?
- How might technology be used to enhance the quality of courses and as such the learning

[4] Information and communications technology

quality of students?

Educational quality

Higher Education institutions benefit from insight into such questions for several reasons:

- The cost of educational technology infrastructure is not insubstantial, and increasing.
- It is undesirable for learning and teaching strategies and support mechanisms to foster solely increased *adoption* of educational technology in the absence of any learning quality improvements.
- Other factors associated with courses can compensate for inappropriate use of technology. The increase in, for example tutor support or the need for computer access may not be cost effective.

Identifying existing modes of learning

In the initial period, the project had been concerned with identifying modes of learning that exist at present and where appropriate targeting these for technological enhancement. After the initial few months of the project, it was realised that a model for research-orientated approaches to learning was required. Subsequent work with departments might provides insight into the relationship between the active engagement of academics in research in their specific discipline and issues influencing quality of teaching and learning in the discipline areas.

Since technological solutions are required that fulfil specific educational purposes, in most cases within the existing courses, the project has developed a descriptive model of education and learning, which is sympathetic to and inclusive of present working practice.

Learning

The process and purpose of learning

From the discussion concerning learning that follows in section B, it is proposed that true learning is the development and conveyance of meaning. With respect to learning strategies, therefore, students need to become expert in the process of learning. This is analogous to the argument that the *meaning* of a piece of work is not in its media but is conveyed by the media. This is achieved by active material engagement and expressed by methods and protocols as vehicles to this purpose.

The learning process should be presented and practised in a way that encourages the personal formation of inter-relationships and expression of knowledge, skills and concepts, as presented in Figure 1. The purpose of learning might therefore be achieved by the development and expression of personal ideas, meaning and ultimately, the aesthetic appreciation of a subject.

One approach might be to present students with challenges that encourage them to adopt strategies that develop a deeper understanding of the subject by engagement with novel scenarios. The model presented in figure 2 shows how the TELRI approach seeks to shift the learning approaches of students from surface learning and strategy design to deep learning.
The tendency for the students to identify challenges which can be met with familiar strategies and superficial subject engagement is recognised by most academics. When actively engaged in research, the academics themselves are forced to adopt deeper learning strategies.

The learning cycle

Different components of learning, memorising, practice and reflection (Figure 1) present its own

set of learning problems. However, there appears to be an identifiable learning process, which can be represented by a learning cycle (Figure 2). It is shown that each of the learning components needs to be equally emphasised in order to develop the cycle. Deep understanding of the subject information or an appreciation of the subject is only developed when subject reasoning has to be generated by the student followed by good strategy design. Expression of these ideas then completes the cycle.

Assessment of learning

For the purpose of assessment (and feedback) of learning, it would be convenient if all learning were based on identifiable reasoning and logic, that all meaning was finite and definable and that therefore all expression of understanding was identifiable and definable. However, this does not appear to be the case. For the main part, concepts are ineffable and as such not transferable by information alone. Embedding the true nature of learning into course design can therefore be problematic for any assessment design. A danger in not doing so is that the motivation to learn inherent in "natural learning" approaches can be omitted.

Education

Learning strategies

In terms of educational systems, discussed in more detail in section C, the course culture and the assessment process to a large degree determines the students learning approach. This produces different “types” of learners, as represented in Figure 3. In terms of the assessment process, the style of assignment for example, open questions and closed questions, will determine the learning approach. This is, however only in relation to the assessment criteria themselves (appendix B). With open questions, these can promote set strategies, surface breadth of understanding, depth of understanding or creativity.

Students can have difficulty deconstructing any assignment down into achievable components and applying the required concepts. That is, they are not proficient in strategy design. Extensive deconstruction by the lecturer of the problems implied or guidance with the process may allow a broader remit for assignments.

Students often respond to a familiar assignment remit by presenting a surface breadth of understanding, which allows if not invites them to adopt learning strategies that are of little benefit later in the course or for future research activities.

Concept development and feedback

The development of concepts is directly related to the need to generate particular lines of reasoning in unfamiliar situations. This is similar to the difference between a monologue of the work and a dialogue with the work. Allowing the publishing of highly graded work can provide students with useful resource guidance and motivation. It may also provide a method of feedback where staff can see the effect this approach has on students’ work, which in turn may allow and encourage greater diversity and higher grades. For the students, this would also provide a partial demonstration of what is the meaning of the explicit learning outcomes provided.

The dissemination of good practice requires a central focus, either virtual or beneficially physical. Ideas of quality or scholarship are holistic for both staff and students and each experience adds to the personal meaning of the concept. This holds true for transferable skills or study skills where those skills transferred are either tacit or holistic. A holistic skill which can be transferred is equivalent to expertise in (each aspect of) the learning cycle. This can provide a common purpose

across disciplines and therefore a framework for learning or educational quality.

Research-based approaches

Research-orientated courses may provide a vehicle for student focused study. The proposal process of conception, information acquisition, reflection, deconstruction and expression directly maps onto the full learning cycle in both emphasis and structure. The delivery and assessment of research-orientated courses needs to be undertaken with flexibility, an appreciation of both the value of the process and the value of ideas (right or wrong), justification reasoning and purpose. It would seem appropriate for these courses to be assessed by tutors who are familiar with the culture and process of research, as is mostly the case in research-led institutions.

Technological support

Technological support for such courses may require established facilities such as publishing for both lecturers and students, structured virtual forums, help guides for set tasks, Email, feedback facilities for the tutor and so on. It is, thus, essential that the technology, course and assessment provide a cohesive system where each component is inherently dependent on the others, i.e. the educational system experienced by the students is inherently integrated. In the absence of such cohesion, development in the use of technology in courses fails to produce cost-effective and long-term change. Furthermore, success can then only be evaluated on the basis of adoption and thus improved educational remains dubious.

The TELRI approach aims to demonstrate effective practice across the disciplines by implementing learning processes into courses in the participating departments that shift the learning approaches of students from surface learning and strategy design towards deep learning.

SECTION A: Learning

1. Introduction

Although claims that "learning is the central purpose of education" [UDACE 1992] may be substantiated, it does not follow that all forms of learning are embodied by education. If ways of enhancing the quality of the educational process are to be investigated, it will be useful to specifically define its purpose and also to use the 'natural' learning process as a comparison.

Much of the work in this section is intended to provide a theoretical foundation for a learning process model. In this section the context of the educational institution is therefore absent in order to initially remove the specific context and assessment focus of education.

Learning is said to occur:
"in the mind as we react with our environment and use our powers of reason, imagination and memory". [Williams, G. 1977]

What motivates learning in an advanced society appears to go significantly beyond the Darwinian survival instinct, but this basic drive may still provide the foundation. Dawkin suggests the mechanism by which ideas propagate as fundamental to the use of human minds: "Academics are library's way of reproducing themselves."

Although learning can be seen to fulfil this survival role, higher forms of learning, such as the generation of ideas in the first instance, intellectual process development and the aesthetic appreciation of a subject must be considered of importance to learning and indeed the educational process.

'And yet the eternal forms … when devoutly contemplated, lead the saint towards the ecstatic adoration of their creator, and the artist towards their imitation in works of art, the supreme pleasure of the human mind.' [Schopenhauer 1846]

The passion for the aesthetic and creative perspective that a particular subject offers may not be definable, assessable or transferable, but still remain one of the highest states that the human mind can achieve. Learning is, if for no other reason, justified for this end. Imagine a concert where the orchestra or group is playing all the right notes (and in the right order) and the audience listen politely and applaud appropriately, but no one cares or feels anything. This represents a degenerate situation of behavioural perfection, totally assessable but totally without meaning. Whatever the learning situation, the meaning of the 'subject' will always remain one of the primary learning goals and the development of its personal meaning to an individual is the primary motivation to learn. Natural forms of learning will always have this as a goal.

All learning is initially based on the transmission and reception of information and the subsequent interpretation of that information by an individual. Since the information may take many forms and be interpreted in the mind of any individual or group in many ways, we might seek to clarify the meaning in information by two related questions:

1. In what way is the meaning in information transferable?
2. How might we measure whether the meaning interpreted was the meaning intended to be conveyed, i.e. how do you really know if you understand?

Questions of this nature have been addressed by many renowned works, which search for the meaning in language and lead to theories concerning the development of concepts.

2. Concept development.

Mental constructs determine how information is structured and interpreted. The behavioural psychologist Skinner, himself acknowledged that animals must have 'built in' constructs such as 'similarity space' otherwise they would have to generalise information to everything or nothing. These constructs form the basis for the interpretation of the information and impose a perceptual structure. Even at this pre-conscious stage the 'experience' may be culturally determined.

Image, aural and temporal information appear to be holistically interpreted by cognitively deeper constructs than for example linguistic information, due in part to their early development in humankind. Chomsky showed that the mind similarly interprets linguistic information holistically and not serially as individual words. The interpretation of information therefore appears to be in a non-linguistic form. The interpreted meaning of information is not therefore readily transposable into linguistic information for communication.

The translation of the holistic form of meaning into verbal language for communication, for example explaining in words the meaning a piece of music, art or literature is an ongoing quest. This dilemma is a recurring problem in learning.

As the higher levels in the mind develop, concepts developed during the early years of life interpret the information with an increasingly sophisticated cognitive structure. The identification of these developmental concepts is attributed to Piaget's developmental stages. He proposed that a fundamental developmental stage is the ability to form and simultaneously hold sets and subsets of characteristics in the mind. The importance of the ability to define the 'sets' will be apparent later.

The interpreted meaning of information is therefore based upon 'in-built' constructs and developmental concepts. Due to the importance of concepts on the interpretation of language, the main learning process appears to be associated with the need for concept development and transfer. In this sense, keys questions might be what are concepts, how do they develop and how are they used to interpret meaning?

Experiences, on the other hand, are inherently coherent. The conceptual interpretations of experiences are based upon coincident relationships and temporal cause and effect relationships. Higher cognitive concepts develop to provide a meaning for inconsistent situations, such as when the bell rings, only sometimes does the food arrive. Piaget states that 'intelligence is what you use when you don't know what to do next.' From Chomsky, adductive, deductive and inductive types of reasoning are considered as a description of phenomena and not the processes themselves. The process does not consist of "if, then, else" decisions, but can be superficially described that way to a first approximation.

If problems, apparently solved by verbal reasoning or logic, are in fact solved by a processes which does not readily transpose into verbal language, then learning is divided into development of the cognitive process of non verbal reasoning, on the one hand, and on the other, expression.

Basic reasoning and concept development is demonstrated with studies of the learning of birds. It has been shown that the behaviour of very young birds is to crouch every time *any* bird flies over the nest apart from the parents. In some way, the bird knows or assumes that 'not parent shape equals danger'. In this way the birds defensive behaviour is never wrong, although somewhat inefficient, The 'correctness' and therefore efficiency of the birds concept improves as they never see a hostile act of a swan shape. Eventually they crouch only in response to infrequent exotic

birds and eagles. They have seen their friends taken away by that shape. Even though the concept is sometimes not right, at least the bird is never wrong.

This form of reasoning is deeply embedded in the learning process and is one form of natural reasoning on which all learning is based, but not necessarily consciously. It also demonstrates the importance of cognitive sets and subsets in learning. A child will learn that three squares plus two squares is five squares but fail to apply this to circles. The concept of addition is associated with shape until it is shown that many shapes (and finally induced that all shapes) share the addition characteristic. In other words, the child forms a set of 'all shapes adhere to addition' or a set of 'things that addition can be applied to' which includes all shapes. The cognition defining the set assumes 'not the case' and develops a set of 'is the case'. After this set is formed, it is assumed to apply until a negation case is identified which over turns the assumption. This process of set formation followed by a general case assumption and refinement is used by all scientists. 'A thousand experiments cannot prove me right but one can prove me wrong', i.e. a general set or concept has been defined which it is assumed can be universally applied.

It is not always the case (if ever, as discussed later) that a set or concept can be explicitly defined. An example of the problem [Wittgenstein 1955]is given in the definition of the word 'game'. Is it possible to give a definition of 'a game' which does not preclude possible games in the future which nevertheless fit your 'concept' of a game? If you cannot express a definition, does this mean that you don't understand what a game is, and if you do, why can't you convey this concept?

A second related example is a number series. If you are given the number series 1,3,5,7 and you are asked to give the next member and give 9 does this mean you understand the series. (the process being understood as 'add 2 to the last number to give the next'). If the number series actually is extended to 1,3,5,7,11 (prime numbers) does this mean that you didn't understand the first series correctly?

The importance here is in the ineffability of the concepts and therefore the ability to identify the degree of understanding of a concept. Indeed what does it mean to think you understand something? The problem here is one of transposing natural reasoning into language for transmission and not the absence of the concept or any understanding. For the learner, the above situation results in a problem with the ability to know if they 'fully' understand (although it is argued that this is an illusory state). For the teacher the problem is one of how to transfer an ineffable concept and also how to check for the concept in others.

3. Language and meaning

The counter view to the proposed argument is that language is not just the expression of a concept, it *is* the concept. Similarly the meaning is *in* a piece of art and not just *conveyed* by the art. It is this view that leads to the search for meaning in language, discourse analysis and similar activities. This point is most emphatically made by 'linguistic relativism' which suggests that language has some affect on our conceptualisation. In this way language can be considered as a tool of expression and thinking. Essentially the claim is that without the language of the subject, thinking as an economist, artist or mathematician is impossible.

"A main source of our failure to understand is that we do not command a clear view of the use of our words."[Wittgenstein 1953]

This assumes of course that we think in a directly expressible language and that concepts, and therefore meaning, are by nature language based. Further, contrary to this 'linguistic relativism' argument, the interpretation of any work is in itself limited by our concepts and that the

development of these concepts is not by nature language based. If it were, you could define 'game'.

As, due to the ineffability of concepts, this appears to be the case, then is the meaning partially in the context?

Wife: I'm leaving you.
Husband: What's his name?

It would appear that the context has a substantial effect on the transferred meaning.

The meaning is partially conveyed by the linguistic context, but it is Chomsky's holistic 'image' and its relationship to other 'images' which in addition gives the words their meaning. However, it appears from the above examples that meaning is merely *transferred* by words (and other forms of language) and is not *in* the words. It is, therefore, possible to learn appropriate language expression without any, or at least limited, understanding of the meaning, significance, or the relationship to other knowledge. If for example a computer can play chess moves does this mean it 'understands the meaning of chess', or is it just following an algorithm which gives the appearance that it is playing chess? To put this in the learning context, the algorithm for play relates to learner strategy design, discussed later. For the present case, however, one might ask whether the meaning, intention or purpose present in the computer? In the general case, is the meaning which is intended to be transferred by words or actions ever fully achieved so that it can be said 'yes you understand' or 'yes I understand'?

This poses a problem for learning validation. If a student does or does not express appropriate language for a specific cultural context does this indicate or negate the possibility that the student has attained the concept or understands to a sufficient degree, and how are they to know to what degree is sufficient? Such a judgement may be more of a reflection of the cultural context.

"If the background assumptions (and much more) are not shared for example from people of a different culture or a schizophrenic or a machine, then the best parsing in the world will fail to deliver the full meaning of the sentence."[Pinker 1994]

From the preceding discussion, the validity of the use of the word 'full' is tenuous.

Whatever the specifics of this situation, the 'personal meaning' of information is directly related to the inter-relationship of other information and therefore personal concepts. Indeed, it is argued that concepts are themselves previously established relationships. That is, the nature of concepts and meaning are the same. At this stage, however, the discussion puts the personally formed inter-relationship of information at the forefront of learning methods, meaning and concept development rather than the information itself.

"Problems are solved not by giving new information but by arranging what we already know since long." [Wittgenstein 1953]

It suggests that any information which makes relationships apparent or forms relationships can extend the 'breadth' of understanding, that is, the amount of knowledge and experiences which one has to interrelate. The argument rests on the difference between being given such relationships and forming the relationship oneself. He suggested that the latter (constructivist) process is particularly conducive to problem solving.

It is later argued that the understanding of meaning goes beyond this static or given inter-relationship of information and engages with the ability for rearranging of inter-relationships.

This gives rise to a depth of understanding, the generation, as opposed to following, of reasoning, ideas, creativity and aesthetic appreciation i.e. the purpose of learning. Beyond language learning, this 'depth of understanding' and how it is enhanced, is central to the purpose of the learning process. Despite this, language learning is a significant part of learning communication and as such the process of effective language learning is considered.

4. Language learning

Changing language expression, e.g. from sexist to non sexist, in no way implies a change of attitude beyond social cultural conformation. The language adoption is clearly not the same as embodying language meaning. It may superficially appear the same if the attitude (or concept) is checked purely by appropriate language expression. Of course, this goes beyond politically correct language and relates to the demonstration or identification of any understanding of meaning. eLearners who realise that their understanding is being checked for via language expression are therefore faced with the irresistible temptation (or in some cases, lack of choice) to superficially learn appropriate forms of language expression, without the somewhat time consuming process of reflection to formulate cohesive concepts and meanings. So how can learning be explicitly related to a true development of understanding rather than language adoption.

Investigations into language learning in children with deaf parents where the parents were advised that allowing the children to watch television to 'gain access to the language' (i.e. to learn purely by transmission) showed that none of the children learned to speak English. In retrospect, this may seem obvious but the problem was that the children did not understand the language meaning and could not therefore build on this. The lack of feedback from the television also meant that there was no opportunity to engage in any meaning searching by negotiation and feedback.

The essential practice of learning by negotiation and refinement was demonstrated by an immigrant population in Central America. In spite of traditional rote learning English lessons at school, the children of vastly varied language background actually only developed a fluid common language (not the taught English) by interaction in the playground. The primary difference in activity was one of engagement and feedback as opposed to imposition and adoption. The role that language structure, protocols and mimicry have on language learning appear to be minimal. Language protocols and structure nevertheless developed in the playground patois but not as the vehicle for learning as was assumed in the formal English lessons. The existence and importance of language methods i.e. structure and protocols is nevertheless highlighted as fundamental to the language learning process, but not as the learning vehicle.

Language is filtered and understood in terms of our concepts and that information alone rarely changes those concepts. This situation is exemplified by Wittgenstein's discussion of the concept 'the sun orbits the earth' as opposed to the 'earth orbits the sun.' The information available to both concept holders was the same i.e. the sun rose and set, but the interpreted meaning remained fundamentally different. A noteworthy example of this was a survey carried out at the Massetusis Institute of Technology where students were asked where the mass increase of a tree comes from. Despite several years of lecturers the students still responded by saying that the mass increase was from the ground. The students in this case had received information over a three year period but in the majority of cases the interpretation had been based on the same unchanging concept, a case of language adoption. It would seem to be the case that the students were not even considering the underlying meaning or significance of the information.

'All our readings and re-reading, our comparisons and groupings, finally turned into an astonishingly simple picture. The students who did not get 'the point', failed to do so, simply because they were not looking for it' (Marton & Saljo 1996)

This situation is difficult for learners as they do not know what is the point (concept) to which they are trying to get. It is also unclear how the learner would know when they have "got" the correct concept. This state cannot be verified from within the reasoning system (concept) itself but importantly the truth or falsehood of a statement appears to be based on a 'deeper' reasoning system.

'It was therefore possible to write statements that referred to themselves [for example] 'This statement is unprovable.' It followed that this assertion could not be proved true, for that would lead to a contradiction. Nor could it be proved false, for the same reason. One remarkable thing about Godel's special assertion was that since it was not provable, it was in a sense true. But to say it was true required an observer who could as it were, look at the system from outside. It could *not* be shown by working within the axiomatic system.' [ref. pending]

The development and use of 'deeper' reasoning systems appears to be central to the process of learning. Furthermore, assumptions that the concepts can in someway confirm themselves within their own reasoning system are dubious.

'We have no valid reason to expect of any apparent repetition of a historical development that it will continue to run parallel to its prototype. Admittedly, once we believe in a law of repetitive life cycles…we are sure to discover historical confirmation of it nearly everywhere. But this is merely one of the many instances of metaphysical theories seemingly confirmed by facts which, if examined more closely, turn out to be selected in the light of the very theories they are supposed to test.'[Tanner M 1998]

People use language to try and communicate concepts directly but are forced into a situation of having to describe the effect of the concept on their language. When the statements are examined they are shown not to be the concept but a reflection of the concept. It is therefore problematic (for both teacher and learner) to identify the concept in the language. When using language to verify the existence of a concept the danger lies in the ability to form language strategies which superficially give the effect of a concept for a set scenario. This is another case of language strategy or language adoption.

Whilst developing the original computer algorithms, Alan Turing developed the Turing test for determining whether a computer thinks [Hodges 1983]. If you run out of ways of determining that the language output is from a computer then you have to conclude that it is thinking. Importantly the strategy for speech is central to the programmers' task of determining how the computer should respond to convey the illusion of thinking.

Whether it is a successful strategy for educational assessment or not, the ineffectiveness of a superficial language learning approach in comparison with deeper understanding has been identified as central to the problem of the educational process.

'More recently one might conclude that economists have acquired a way of looking at the world which is indelible. Even though they may not find themselves in a position where they can use their analytical techniques very consciously, their whole way of treating questions is, in fact, affected by this kind of training.' (Entwistle 1997)

5. Reasoning and understanding

As the learning validation process is followed, it is seen to be based on the subject language, protocols and underlying values. These affect what observations are considered worthy of noting and what facts are considered of relevance, that is, the sort of thing the subject considers of importance to say about the world. The relationship made between the facts presented within a statement or proposition is a reflection or example of the subject reasoning. This subject reasoning continues to be generated and used by the subject author to relate further subject statements. In this way the subject is exemplified by a focus on certain factual information and the relationship between these facts which it proposes.

By accepting the reasoning within a given authors work, an example of the subject reasoning is 'followed' and there is a feeling of understanding the author's work. Being able to 'follow' an example of the subject reasoning does not at this stage imply that this reasoning can be generated by the learner and applied to differing contexts or that the significance or meaning appreciated to a greater degree. At this stage, when the student is asked to present work which 'discusses' the authors work they will be forced to reiterate the single fixed relationship presented by the original author. The student will at this have stage no way of knowing the depth of their understanding, they just understand.

When works of other authors in the field are introduced, different perspectives and reasoning or factual relationships are experienced. Even if the different reasoning are 'followed' the student can merely broaden their knowledge or breadth of understanding. When questions which are designed to check for understanding can be approached by displaying the existence of knowledge, students can and do adopt language strategies i.e. reiterate what they know. Alternatively they may relate the two perspectives and start to see the 'nature' of the subject area. The relationship between several concepts allows comparisons and judgements to be made regarding the relative value of each perspective, 'correctness' and significance. Again the student has no way of knowing the depth of their judgement, they just have an informed opinion. If this expression of meaning is appreciated by the assessor, then the student may be encouraged and satisfied with their level of understanding.

The deeper learning process is only progressed by actively engaging with the subject material. Deeper understanding is formed by the requirement to re-structure and re-interpret information and relate ones new personal viewpoint to a novel scenario. Qualities such as creativity and insight become more important at this level in terms of being able to see possibilities within the subject framework. As the existing subject boundaries are reached then the work will become 'research'. For such work, the arguments presented become less established and possibly more contentious as a greater emphasis is placed on the ability of and expression of creative thought. Such creative thought is now based upon insight into the subject although the subjectivity of external assessment increases.

The remit for engagement can be opened up as these stages progress and the student tends towards an 'appreciation' of the subject. Unless the purpose or meaning of studying the subject is primarily functional and self orientated the learner awareness will tend towards the aesthetics of the subject.

6. Learning models

Before considering the learning process implied above, an overview of existing learning models is given. The relationship between the different models will be suggested later.

Kolb

Kolb developed categories to identify four learning styles. They are based on the nature of information/experience to be engaged and the approach of engagement, Abstract – Concrete and Active – Reflective. Some possible subject categorisation is given for context.

Reflective/Abstract	Prefer information in an organised , logical fashion and time for reflection.
Subject	Pure Science, Mathematics, Natural Science
Requires	Expert tutor
Active/Abstract	Prefer opportunities to work actively on well defined tasks.
Subject	Hard Applied Science, Engineering
Requires	Coach
Active/Concrete	Prefer to apply information to new real problems
Subject	Soft Applied, Law
Requires	Real world opportunities.
Reflective/Concrete	Prefer to be shown relationship of information with their experience
Subject	Soft Pure, Social Science and Humanities
Requires	Motivator

The learning style of students has been shown to be related to subject chosen for study but also that their learning preference is dominant irrespective of subject chosen[]

Myers-Briggs Type Indicator

This model classifies students according to their Jungian psychological types.

Sensors	Practical focus on facts and procedures
Intuitors	Imaginative, focus on concepts meanings and possibilities.
Thinkers	Decisions based on logic and rules
Feelers	Decisions based on personal and humanitarian basis.

These form the four categories of:-

Sensory Thinkers
Sensory Feelers
Intuitive Thinkers
Intuitive Feelers

Similarly, the learning style of students has been shown to be a dominant factor with respect to their study techniques or approach to the course material.[] Some correlation can be made between the two sets of classification.

Sensory Thinkers	Active/Concrete
Sensory Feelers	Active/Abstract
Intuitive Thinkers	Reflective/Concrete

Intuitive Feelers Reflective/Abstract

Eraut's six types of knowledge

Eraut categorised the types of knowledge that an individual can attain.

Situational knowledge - how people look and what they look for
Knowledge of people - relationship to others

Knowledge of practice - ability to choose course of action
Conceptual knowledge - information handling and relationship
Process knowledge - how to get things done

Control knowledge - knowledge of one's self and ones thinking

Proposed Outcome/Process Model.

To provide a basis for the proposed model three components of learning are used. These are:-

Component	Dominant question for learner
Information	What?
Cognition or reflection	Why?
Methods or experience	How?

These together with the interaction between them are shown in Figure 1. The interactions give:-

Know-How/Expression	The application of methods to produce information
Interpretation/ Breadth of understanding	The application of cognition to give understanding
Strategy Design	The application of cognition to methods to give strategy

These learning activities relate to three of Eraut's 'types of knowledge'

Know-How/Expression	Process knowledge	- how to get things done
Interpretation/ Breadth of understanding	Conceptual knowledge	- information handling and relationship
Strategy Design	Knowledge of practice	ability to choose course of action

These learning activities are represented in typical assessment by:

Know-How/Expression	Written structure etc.
Interpretation/ Breadth of understanding	Content relevance and extensiveness

Strategy Design	Logic – Originality and validity

If these learning components and activities are followed clockwise around the diagram they can be seen to describe the learning process, figure 2. These are the stages a student goes through in a cyclic manner with every learning situation.

The Eraut knowledge type which awareness of personal learning represents is 'control knowledge' - knowledge of one's self and ones thinking.

The process would start with Information and go clockwise through - Interpretation - Cognition – Strategy Design – Method – Know- how/Expression – Information.

In this way, a subject produces more information based on a reflection of the existing information. If there is little cognition or reflection then concepts do not form and the 'quality' of the information does not increase. With the cognition, the learning cycle should be considered as a spiral with the learning subjects' true purpose as the spiral progression i.e. aesthetics. The cycle does not however implicitly mention or require creativity.

In figure 2, two learning paths are shown. The surface learner, if presented with a familiar scenario can apply an established process or method directly to the new information and display a breadth of understanding i.e. a knowledge of the related facts and processes. If however the challenge requires a re-evaluation of the information and relationships in the light of a novel context or scenario, then the reasoning has to be generated by the student. In this case the cognition process is deeper and creativity and ideas are required.

The omission of creativity or ideas from the cognition process will prevent the learner from progressing their personal understanding or the personal meaning of the subject. It may be difficult to actively develop, identify and assess but the process of academic advancement and research relies upon it. As argued earlier in the text, in terms of the motivation for the entire learning process, the importance of personal and creative expression is significant. It maybe that creativity is an expression of depth of understanding or insight rather than breadth of understanding.

The learning styles of Kolb and Myers-Briggs can be seen to represent different emphasises in the learning cycle. The scales for the different classifications and learning styles have been super imposed for comparison, figure 3. The model does suggest (in conjunction with the learning styles) that the creativity of research requires a certain type of learning i.e. Reflective or Intuitive. This does not make research exclusive in this respect but this is more an indication of the complete learning cycle nature of research. The other sectors of the learning cycle can also be seen to represent the Strategic learners (Strategic Design), Active learners (Know-how/expression), Surface learners (understanding breadth) and Deep learners (Reflection/understanding depth). The deep learning is related to an 'appreciation' of the subject.

It is suggested that in terms of education, Strategy Design may be worthy of more consideration as it represents the ability for the students to select the appropriate course of action for any particular situation. The context or challenge will to a large degree determine the strategy selected. The development of inappropriate Strategy Design in students (although it is seen as appropriate for the assessment) can be mistaken for, and also cause, the absence of a concept. In some cases poor Strategy Design can result in a failure to implement the concept in the appropriate situation.

Strategy Design is also descriptive of situations where students adopt learning methods which the lecturer did not intend as either the question was of a familiar form and surface learning completes the task or inappropriate strategies are chosen. The question which Strategy Design

asks is 'if you don't know something what do you do about it next' or in terms of general learning Piaget states that 'intelligence is what you use when you don't know what to do next.'

This point most clearly demonstrates the benefit of considering the entire learning cycle and making it explicit to students by actively engaging them in a research form of activity.

7. Creativity

A general experience by researchers in any field is that 'research is 90% perspiration and 10% inspiration'. This implies that in the absence of inspiration, we could spend 100% of our time on tasks that are purely procedural. The undertaking and completion of such tasks would in no way further our understanding of a situation or subject. The production of a piece of work whether in music, art literature or science does require procedures, methods and techniques to be used. However, it has been shown that while the purpose or meaning of these tasks does not lie in these procedures or related information, they are a way of conveying the meaning.

This was discussed in the particular case of language, although the extension to all forms of expression can be reasonably assumed. The apparent subtle difference between the two stances that 'the meaning is *in* the language' as opposed to 'the meaning is *conveyed or transferred by* the language' has a fundamental effect on the approach to learning. It also has significant implications for what meaning is which it has been argued has a depth without limit, and the source of meaning. The development and expression of 'true meaning' and 'personal meaning' is the very purpose of academia. The need to practice and develop the processes of transfer and expression will never be a substitute for the very purpose of those techniques.

'A base of existing knowledge is of course required for versatility, foresight and creativity. You can't be a poet or a scientist without a good vocabulary, but definitions of intelligence that stress knowledge or memory's synaptic mechanisms really do miss the mark: they're mistaken reductionism'. [Calvin 1997]

Indeed, the emphasis on the endless adoption of established rules and methods is not only boring and meaningless to a learner, it is counterproductive to the learning process. The case for considering the works and ideas of eminent thinkers, artists and musicians will naturally never loose its poignancy. However, it may be worth reflecting on the true nature of the learning that produced these works in the first instance. The worst case for any learning process is that it adopts an ethos that over stresses the rewarding of 'knowledge or memory's synaptic mechanisms' for pragmatic reasons such as ease of validation, standardisation and assessment. In the long term this will slowly filter out the development of creativity purely because the appointed expert practitioners do not excel in this quality. Unfortunately this situation would not even be detectable when the majority of eminent works or ideas resulted in spite of the learning institutions as opposed to because of the learning institutions.

The irony of this situation is that the very process of 'seeing the possibilities within a framework' or 'challenging and furthering the boundaries of thought and expression', in some cases referred to as research, rely on this quality. Assuming this is not presently the case, how can the development of creativity of learners be encouraged?

Whatever the learning situation, if a contradiction, or novel problem is faced then the mind will generate possibilities (either consciously or pre consciously). As discussed earlier, problem solving is emphasised in the constructivist method of problem based learning. Although this is an important implementation of material engagement, the motivation for learning seems to go beyond this. In terms of pure learning, it cannot really be said that all learning results from the

need to solve problems, unless of course the problem is the inability to express, enquire or reason. Personal creativity as the expression of meaning still appears to be important in the desire to learn.

The creative process of 'finding possibilities within a framework' is obviously not going to be simple to negotiate. It does not appear to be a conscious or even a formal reasoning process, although is sometimes later explained or justified in these terms. Indeed, even the limitations of that formal reasoning are not identifiable from within that reasoning system. The reasoning system will be based on assumptions that the reasoning system itself cannot check the validity of. They are axiomatic.

When involved in novel problem solving, the reasoning associated with creativity is a similarly obscure issue:

'We use induction until the assumed rule is falsified or we did not apply inductive reasoning in the first place. Why would we 'chose' induction only sometimes, by a feel for the underlying rules? That is to say that even if a specific reasoning is used it is chosen based on a deeper reasoning system. This suggests two scenarios. Firstly, that we have pre-reasoning processes that determine what reasoning to apply and therefore how we construct our understanding of the world, or secondly, we develop our view by pre-conscious processes and that verbalised reasoning is applied 'after the fact' in order to communicate validate and justify our view.' [Penrose 1989]

Similarly:
'Logic is the science of the justification of conclusions we have reached by natural reasoning. The very reason we need logic is that reasoning is not conscious at all.' [Jaynes 1976]

This emphasis on the preconscious nature of creativity is reflected by many authors. For example:

'It is only the very unsophisticated outsider who imagines that mathematicians make discoveries by turning the handle of some miraculous machine.' [Hardy, Calvin 1997]

'If you're good at finding the one right answer to life's multiple choice questions, you're smart. But there is more to being intelligent- a creative aspect. Indeed, various answers occur to your brain some better than others.' [Calvin 1997].

In this process, two important processes are involved before the outcome or expression takes place. There is the creative process and the strategy design. Strategy design is the ability to formulate long term strategies as well as short term tactics, making intermediate moves that help set the stage for a future feat. The strategy design process is recorded by the learning process, as represented in figure 3. This process is successfully (over) emphasised by strategic learners who focus on the assessment process [Krause 1999]. The creative process, although based on an existing subject framework, involves finding the 'possibilities within that framework'.

Although it could be argued that eminent academics are not necessarily aware of their own conscious thought processes (by definition), the following statements give some basis for the existence of an illusive quality of creativity and indeed the non verbal source of reasoning. For example:

'The words of language seem to play no role in my in my mechanism of thought.' [Albert Einstein]

'I have to translate my thoughts into a language which does not run very evenly with them.' [Galton in Penrose 1989]

'There are frequently not the words available to express the concepts that are required.' [Penrose 1989]

'The essential point here is that there are several stages of creative thought: first, a stage of preparation in which the problem is consciously worked over: then a period of incubation without any conscious concentration upon the problem: and then the illumination which is later justified by logic.'[Jaynes 1976]

These quotes have been given purely to emphasise that eminent (in these cases) academics realise that the creative process is not a formal or indeed directly expressible process. Exposure to such works in music, art, literature and science, which are the product of this creativity phenomena will clearly not only provide aspirations but also a guide as to the limits of and possibilities within one's own work. Such exposure can be considered as a form of feedback particularly if specifically chosen by the learner for guidance/experience.

If personal expression of one's way of viewing a situation is fundamental to this process then a degree of freedom to choose the subject of expression may be an initial part of that process. Similarly, the emphasis the learner wishes to put on a particular aspect or mode of expression should be considered.

Other qualities of students will come into play at this point. For example, the ability to define work, organise and focus on tasks, the realisation of the necessity to understand the present situation for the topic in terms of latest and established thinking, the importance of courage to develop an informed opinion which contradicts and challenges certain views, open-mindedness, willingness to accept the personal and relative nature of concepts, the ability to consider and in some cases accept the views of others, the importance of clarity in expression and compassion in judgement.

All of these qualities are not, however, developed in a context of the almost exclusive imposition and adoption of authoritative ideas and works but in the context of the development of oneself and more importantly the subject that lives only in the minds of people who care.

Can any of this be assessed? The above discussion intentionally focused on learning and not on education. The limitations the educational process may put on the natural learning process is considered later.

In respect of educational courses, in research, it is important that even the established subject framework is questioned, accepting the fact that a significant (but not exhaustive) knowledge of that existing framework is first required. The 'subject framework' is from the above discussions defined as accepted inter-relationships between subject information, which is a product of a way of looking at the world. The definition of 'possibilities within this framework' and the formation of new relationships between established 'facts' and in some situations even the facts themselves, will therefore have to be evaluated by the academic, this puts the academic very much at the centre of the course. The ability for academics to make such judgements is of course justified by their established expertise in the field but the fallibility of the judgement of creativity and ideas is born out by the numerous stories of designers and authors having ideas rejected which are later shown to be worthy. The validity of assessing such work lies in subject experts' ability to see the limitations of a personal perspective and the possibilities in others.

SECTION B: Education

1. Overview

Although related, there is no reason to assume that education and learning are the same. Although learning will inevitably provide the foundation for any educational process, the characteristics of education are determined by many other factors. In order to determine the differences between 'natural' learning and education, it would be pertinent to identify the inherent characteristics which educational institutions must display, at least in the relatively short term.

Learning is said to take place

'in the mind as we react with our environment and use our powers of reason, imagination and memory.' (Williams 1977)

However, education is said to be

'purposeful learning in which interaction between individuals and their environments are mediated through specialised institutions whose role is to stimulate learning activities and shape their form and content.' (Williams 1977)

As far as any conclusions concerning positive educational trends are concerned, the institution will inevitably introduce an inertia and the changes will have a chaotic (that is, non-deterministic) nature, however careful the design. Fortunately, it is this very chaotic nature which allows the creativity on which any institution relies, particularly in a constantly changing social and commercial context.

The most obvious question concerning the issue of the difference between 'natural' learning and education is: 'If learning occurs 'naturally' then what is the attraction of Higher Education courses? Over and above providing the form and content of learning activities, the most apparent attraction for students is to be guided, informed and 'sparked' by subject experts and facilities in a 'mediated environment'. In a broader context, students are given the opportunity actively to meet others with differing and similar views and experiences and who are similarly engaged in academic or artistic activities. Further, the students are attracted by (or at least accept by contract) the opportunity to be assessed by those academics who represent this 'gateway' to subject expertise or professional development. In return, the academics are charged with the responsibility of facilitating the development, assessing and rewarding certain learning characteristics of the students. The selection of these characteristics or hopefully qualities puts an implied importance on those related directly to the pursuit one of many lifestyles and/or professional positions.

The institution itself importantly provides a context that partly determines the educational culture. The social and academic culture that the student perceives or experiences will to a degree promote certain decisions, reactions and behaviours. Although the students frequently have some preconceptions of university life, the departments will nevertheless provide an important cultural centre or focus in terms of the students' idea of academia.

With the recent increase in student numbers and general changes in working practice, the feeling of 'belonging' to a department can be threatened. Although an intangible quality, this can determine the academic relationship between the students and the department as a whole. As a result this will affect the relationship between the student and their course, the students with the academics and the students with their peers. As the trends that affect this relationship are unlikely

to reverse, such effects may be worthy of consideration as it represents the academic focus for students' studies and the support that this offers.

A consideration of the departmental student study facilities and environments will be a contributing factor in the success of many educational changes designed to enhance quality. This therefore affects the overall provision of 'cost effective' educational support for attending students in terms of their idea of 'scholarship'. The students' personal idea of scholarship which is reflected in their motivation and working practice, is affected by the support offered, the dissemination of good practice, educational technology access, academic support/guidance, peer support, administrative provision and assessment processes.

Although it is inherited to a large degree, the working environment and facilities available also has a significant affect on staff working practice. In particular, this can determine the academics culture in relation to the implementation or continued development of courses and the dissemination of practice (not just information). The cost-effectiveness of departmental centres is difficult to determine. Still, statements such as 'this department used to be a leader in the field of the use of educational technology, but he left' indicates the possible temporary nature of any educational developments if the practice remains individually driven and not inherently disseminated within the department. The cost of this is possibly easier to envisage.

2. Educational Quality

If the quality of education is to be enhanced it is necessary to identify the purpose of education. This observation is purely based on the definition of quality as 'fitness for purpose'. Without a defined course purpose there is no framework within which to identify quality improvements.

In order to address this and other issues of quality, a survey of previous studies into educational effectiveness has been carried out which has revealed several relevant conclusions. In many cases the original authors' remarks will provide a clearer insight into their perspective and conclusions.

It is apparent that the learning process is frequently not open to objective judgement or quantification. Although the need for some measure of educational effectiveness is apparent, the following quote does make an important point in respect of the value of such measures.

'No evaluation study can examine all the nuances of worth, but a study that ignores them to concentrate on objective measures of achievement is potentially irresponsible. Qualitative and quantitative measures must both be used but predominantly qualitative.' [pending]

3. Assessment and benchmarking

'Research, so far, has identified several key influences on the quality of learning – the nature of the teaching, the learning activities provided, and above all the assessment procedures adopted. Assessment procedures which students believe to demand mainly the provision of correct factual answers…have been shown to encourage surface approaches to studying. The extent to which assessment dominates student thinking in a class, affects how strategic those students will be.'[Entwistle 1997]

The overriding importance of the nature of the course assessment on the student approach to studying is well documented. This brings us to the link between teaching and the quality of learning, the way teaching and assessment influence students' approaches to studying also affects

the quality of their learning outcomes. In order to define quality in teaching we need to know what influences the students' approaches to studying.

A possible way forward is to try and make the assessment criteria explicit. It is argued that such explicitness will give the student an insight into the course expectations. This assumes, of course, that they appreciate the depth of meaning of the words used in the context of the subject.

'Interviews with students who had just taken their final examinations showed the students had all tried to understand their notes during revision, but the type of understanding they were aiming for, and achieved, was markedly different. Students had differed in the breadth of understanding they had sought (how much material they had studied), in the depth of their understanding (how much effort they had put into making connections), and in the structure they had used to organise it. [Entwistle, 1995; Entwistle & Entwistle, 1996].'

As discussed earlier, the limitation of explicit assessment criteria is that the concepts are in many cases ineffable and an appreciation of the terms used is required if the meaning of them is to be conveyed. It can be argued that it is this very appreciation which in part the course is designed to instil.

Different subjects tend to adopt different pedagogies. The use of short answer questions is common is sciences but rarely used in humanities subjects. Similarly, long essays are rarely used in sciences. This may be because it has been established that these methods are tailored to the subject discipline. It may also be true that good teaching ideas can work across disciplines, particularly an understanding of the full learning process.

'There was a definite tendency for subject specific "graduateness" and sceptical about cross subject agreement. Even with cross subject competencies, it was felt that different subjects would place different emphasis and therefore put different levels as acceptable. [Also] a lack of common use of definitions caused problems. [There was a] focus on outputs as opposed to process.' [HEQC 1998]

This raises the problem not only of a lack of common definitions but also of defining the 'acceptable level'. Again it is possible that this 'level' is linked to the course and the students' idea of scholarship. The last statement refers to this by emphasising the importance of the quality of the learning process as opposed to the learning output. This viewpoint is not taken because of the secondary importance of learning output but because of the impossibility of conveying the contextual meaning of the terms to students at the start of the course. The emphasis should be placed on 'this is the learning process of an academic' as opposed to 'this is the academic output that is expected of students'. The learning practices and state of mind of an academic leads to an appreciation of these 'explicit' terms, but these terms do not inherently lead to the learning practices and state of mind of an academic.

A contrasting view is reflected by quotes from a discussion paper on educational quality [UDACE 1992]

'At present degree is described in terms of process i.e. three years full time study rather than achievement. As a result notions of quality are based on the process rather than its outcome. Due to mass expansion this is hard to sustain. A quality system based on outcomes is more rigorous and transparent.'

Similarly:
'The principal benefit in an outcome led approach lies, therefore, in providing a focus for staff, students and employers to examine more clearly what they are seeking to achieve.'

It is not argued that this would not be a useful state of affairs, it is however argued that it is not achievable purely with outcome definitions. The claim would not apply to promoting quality in art for the same reasons.

'[Outcome definitions were] not generally understood by students and had to be clarified by conversation, i.e. the descriptions were not clear due to terminology.'[ ]

Direct access to (experience of) the previous learning outcomes of the course, as opposed to definitions of, may significantly assist the students in achieving those ends particularly if they are given guidance in what learning practices will achieve them. The library is full of generic high quality learning outcomes but what **is** the academic process produces a high quality book in a certain subject area?

'It is necessary to develop processes within each institution to link outcome definitions with quality assurance.' [UDACE 1992]

Although the value (or lack of value) of definitions has been discussed, it is proposed that this link between process, outcomes and quality, which has been discussed in relation to institutions, is precisely what the students themselves would benefit from appreciating, understanding and practising.

Hence, the underlying approach to quality is that the great academic works are an inspiration to staff and students alike, the differences is that the staff have experienced the learning process which produces them, the students have not. This focus on the development of the learning processes of students as opposed to purely the output of great academics not only gives a generic course purpose for quality developments but also provides a skill which is transferable to future learning situations. This is particularly true of the development of strategy design and the generation of ideas.

It is claimed that learning the true assessment criteria of a course by gaining access to previous course work will lead to standardisation of students work. This is a worthy claim and is not taken lightly. It is interesting however that it is felt that the students will identify a common 'standardised' content or 'formula' for a high grade. This suggests that there is one. It would be interesting to see how the publishing of highly graded work from open (and possibly closed) questions, for course student access would affect the academics assessment criteria, particularly if all work started to arrive deserving a first class grade even in the absence of plagiarism.

The direct involvement of students in the design of the assessment process is fraught with difficulties, particularly when the academic 'knows' the content and the process that the student is still learning. Negotiation under these circumstances seems to be a meaningless term but direct access to many examples of high quality course work would give a greater insight than any definition. The emphasis of the assessment would be likely to change but maybe to an open one which rewards the complete learning process.

"..students can play a particularly valuable role in the development of approaches to assessment, and this dialogue can itself help to increase their motivation and advisement. … Current assessment practice tends to neglect these questions of validity in favour of reliability, and many academic staff lack experience of appropriate approaches to assessment." [UDACE 1992]

The problem of deconstructing the learning process and defining it in terms of its components demonstrates the same failing as the deconstruction of any holistic system (or concept). It is the meaning of and the relationship between the components which fails to be conveyed.

Again, this is recognised by practising academics:

'It is difficult to assess any single outcome in isolation, many are implicitly assessed.'

'It was apparent that implicit in the 'knowledge based outcomes' were a variety of cognitive skills.'

That it is a holistic state of mind and approach to the subject which is truly required of the students is documented by many subject experts. The definition and value associated with these terms are determined by the academic and can only be undertaken by the academic. Their decisions are based upon past experience and expertise developed by being in the (or a similar culture) for extended periods. Furthermore, the distribution of these terms will loose their specific meaning if transferred outside the culture.

This causes problems with course quality evaluation and explicitness. The very terms that are used to define the learning outcomes and assessment activities and criteria are those terms which the student learns the meaning of during the degree program. It is not a solution to reduce these terms into simpler activities for lower level learners because they will not appreciate or understand the meaning of these lower level terms. For example 'analyse' has a specific cultural meaning, which the student may not appreciate. Early on in the course, the assessment term might be 'identify relevant details'. The word 'relevant' is a value judgement which the student will learn whilst existing within the culture but cannot guess the meaning on entering the course. They cannot therefore use the term as a guide to the course profile.

The effect of the academic culture of 'scholarship' predominates. It is a holistic experience. The students accept this culture and learn to adapt to succeed. The culture of research and inquiry is central to the culture or practice of researching academics. Evaluating the quality of the scholastic culture and 'improving' its quality needs to be undertaken carefully. It is not possible to break it down to see of all the components are there. This is analogous to the evaluation of a piece of art or music. Even the terms derived from a deconstruction are value laden. What does 'evaluate' mean, and how does the student know when they have 'evaluated' enough in sufficient 'depth'.

'Knowledge was not just a 'body of irrevocable truths (Schwab 1962) 'the concept of structures of a discipline' [educational record volume 43] but was concerned with patterns of procedures, methods of enquiry and ways of distinguishing relevant and irrelevant information. It was the definition and clarification of those causing the difficulty at anything other than a superficial nature especially to those outside the specialist area.'[UDACE 1992]

Although it is accepted that quality by definitions of outcomes is a worthy aim, it has been argued that the meaning of definitions of academic outcome require an academic perspective. Furthermore, not only are fundamental learning processes omitted, but that the present methods are not responsible for these aims being achieved. It is suggested that this approach makes the same assumptions about how people learn as do the transmission methods for concept development.

As with the transmission method of teaching, the argument is one of emphasis and the need for an understanding of what methods result in what learning. The danger of the use of inappropriate methods or an unintentional emphasis, is that it may be detrimental to the very motivation for learning.

'Some respondents feared that the process of subject benchmarking might stifle creativity and diversity by constraining UK higher education to a conventional and outdated approach.[QAA 1998]

Clearly, it is not just institutional diversity and creativity that may be restricted, it is student diversity and creativity.

After a concerted effort by a particular department in an American University (supported by management) the following general conclusions were made.

'Increasingly, however, it is being recognised that it is not sufficient to look at teaching or assessment in isolation. Rather, high quality learning can be guaranteed only by providing a whole learning environment that supports deep approaches. The result was a whole series of changes [and] also a clear recognition that the effectiveness of those changes depended on their combined effect as an interacting system' [Eizenberg, 1986, 1988].

Tables 1-5 in appendix A give information which reflect these changes in approach. As opposed to the implied change from surface to deep learning methods, the model in figure 2. shows these to be components of the same learning cycle. This learning cycle is holistically represented in research activities. It is proposed that it is necessary to develop processes within each institution to link outcome quality with process quality and that this is directly related to developing the same link in the learning of students. This approach provides a foundation for course purpose and course design.

4. Course Purpose.

Whatever the defined purpose of a course, its realisation may be restricted by practical factors such as the ability to manage the course, the possibility of assessing certain outcomes, the provision of facilities and soon. Many authors have argued that the students' expectations should be of significant importance when designing a course. Beaty has suggested that in relation to conceptions of learning and the reasons for taking a course.- students develop what she calls an individual study contract. Interviews with students show marked differences in the reasons why students are taking a particular course and what they want to get from it.

The term 'contract' describes those reasons in terms of both a general learning orientation and specific goals which a student has at that time (Beaty et al., in press). Students differ in the extent to which they have vocational, academic, personal, or social reasons for taking a course. However, perhaps the most marked influence on the way they subsequently study is whether their interest in the course is in the content of the course itself (intrinsic interest) or in the other benefits the course might bring (extrinsic).

Whilst the students experience and perspective is important, it is the very raising of awareness of what it is to be an academic which is at least in part the purpose of the course. This appears to be somewhat against the 'market/customer' approach to education.

'Ideas of academic standards, pursuit of excellence and scholarship are not among the constructs which students evaluate the process of higher education.'[Percy 1976]

Students and employers may for pragmatic reasons consider that higher education should be primarily a process of professional development. This may well be an effective basis for the purpose of higher education but surely it is a central purpose of higher education to question and challenge established ideas. The educational process implied in the employers approach may appear to actually assist in the professional development of student although commercial organisations have to be similarly aware of what qualities it truly requires of people now and will require of people in the future in a constantly changing social context.

Designing courses to deliver information in a structured way at an appropriate pace with supportive explanations do not necessarily promote the required learning processes. It is possible that the ability to handle unstructured information at a varying pace with little supportive explanation is a more realistic description of commercial working life and that fond assumptions to the contrary could be misconceived. Consequently, it may be more useful to guide the students in how to respond to such a situation.

A famous study was carried out where an actor who knew nothing about the relevant subject gave a lecture with almost no content. Regardless of this, the lecture was highly praised by the students. Maybe there is something in this and it warrants further investigation in terms of the over-riding importance of motivation and aspiration, but the overriding responsibility lies with the academics to investigate effective learning support practices.

Unfortunately, at present it appears that such developments do not appear to be occurring to any discernible degree.

'[There has been] 50 years of research studies looking for improvement of grades by serving student preferences, with no positive conclusive results.'[L.B. Krause]

'…Higher education teaching lags behind other professions. Scientists, engineers, accountants, lawyers, linguists, doctors and other professionals have a rich history of past practice which they can call on. They have researched to find out what works and what does not and then they have used this knowledge in new situations. By testing to see whether new discoveries work and by reflecting on the outcomes, true professionals are able to carry their chosen fields forward. However, for some unexplained reason, academics are reticent about looking at what has been discovered about learning and teaching and using these results in the profession of teaching in higher education."[UCoSDA 1998]

Many professions do, however, have a clear fitness for purpose that is easier to define. For academics, a sense of direction and therefore the motivation to investigate and implement any course quality improvements is not clear. Maybe the learning process itself will provide this direction and purpose. It is again highlighted that this situation is not dissimilar to the students' predicament and indeed any learning situation.

As far as the purpose of the course is concerned, accepting the personal differences of students' purpose, it is that which has been gained from the course after leaving the institution that prevents the course assessment from being totally academically focused or an arbitrary hurdle. These qualities will always be demonstrated in and by the subject studied but must nevertheless have a broader social significance or application.

5. Transferable Skills

There has been an increasing emphasis on what have been referred to as competencies.

'Recently, these traditional academic skills have come to be seen as insufficient, at least from the point of view of employers. As part of the Enterprise in Higher Education Initiative in Britain (see, for example, Elton, 1994), much more emphasis has been put on skills which employers believe to be important in helping graduates be more effective when they enter employment.'[ ]

It has been clear that achievement in formal education contexts also depends on effort and the general level of student motivation. Other influences (over which the course has influence) are

identified as individual learner characteristics, style and reason for course, course experience and assessment procedures.

The approach of transferable skills is that they are a common motivation for students to learn or at least a common reason. The discussion as to whether skills are transferable is continuing. This is related to the contextual nature of both skills and meaning. Contextually a 'skill' is not an isolated quality and it is the ability to bring the appropriate skills together for the situation that determines success. This reflects two aspects of learning, firstly the danger of deconstructing learning down into components (or skills) and secondly the overriding importance of the ability to form contextual strategies (apply the appropriate skills to a situation). The importance of the contextual and holistic nature of skills application has been documented.

'Traditional workshops on study skills have, in fact, been found to be largely ineffective for two reasons. First, the workshops often stress separate skills, like taking notes or writing essays, in a manner suggesting that these are 'mechanical' skills with little thought required. Then, even where more effective workshops are provided, they have little effect on everyday studying unless teaching staff reinforce the ideas put forward and stress the importance of spending time in developing these skills. Research on student learning stresses the importance of helping students to develop an awareness of their own study strategies, by consciously monitoring their own ways of studying and the extent to which they are effective (e.g. TLTP, PASS CRLI, 1995)' [Entwistle 1997]

Whilst awareness of the effective study strategies is advocated above, the overriding importance of appropriate strategies and the 'ability to bring it all together' to form a complete and effective experience is emphasised. The inability to do this (which also applies to information) results in surface learning. The purpose of the course should therefore address this issue by always providing activities which allow the learning components to be brought together whilst still being able to discern the process improvements which can be made.

6. General breakdown of surface and deep learning in education

Surface Approach

- Concentrating only on assessment requirements.
- Intention simply to memorising and reproduce parts of the content.
- Accepting ideas, information and structure passively.
- Not reflecting on purpose or strategies in learning.
- Associated with anxiety and fear of failure.

Deep Approaches

- Intention to understand material for oneself.
- Interacting vigorously and critically on content.
- Relating ideas to previous knowledge/experience.
- Using organising principles to integrate ideas.
- Relating evidence to conclusions.
- Examining the logic of the argument.

Once the production process of a piece of assessed work has been mastered or the process is unclear then the reasons for adopting a surface approach is clear. Even a strategic approach will in some cases lead to the adoption of surface learning if this is how high grades are easily achieved.

The surface approach of concentrating only on assessment requirements cannot therefore be seriously criticised if it is successful. Extensive studies have shown that it is successful and indeed studies have advocated that all students would do better to adopt approaches which emphasis a strategic approach. If the codified purpose of the course is to, either intentionally or otherwise, test for memory and recall, then the student will be successful. Indeed undertaking other forms of learning which were more conducive to research was shown to be detrimental. This is discussed below.

The adoption of deep approaches, if not explicitly assessed, are (initially) more for personal satisfaction than academic success. It has been suggested that, in the long term surface learning can cause a cumulative problem, the students however cannot be expected to know this. Being made aware of this at the start of the course and being encouraged (forced) to adopt learning strategies which are beneficial in the long term is surely integral to the education process.

It is proposed that the development of, knowledge, concepts, creativity, strategy, techniques and expression are the scholarly abilities that to explicit high quality education and students. The purpose of the course is therefore to develop scholarship by providing assignments which require the identifiable application of these abilities in a holistic and integrated manner. This is in itself an authentic transferable skill.

7. Traditional Course Design

The most difficult question to address is how can education help individuals develop the scholastic learning process.

Within the education system, learning occurs 'by interacting with and transforming received knowledge so as to own it and make it personally meaningful. Students do this by actively constructing or reconstructing information – i.e. modifying, revising, transforming, connecting, extending, or relating it to what they already know – in an effort to make sense of it.' (Nicol, 1997)

The approach to education advocated puts a greater emphasis on active material engagement than the material delivery and adoption emphasis of traditional education. It will be apparent to academics that in practice neither approach, active or transmission, is exclusive and that the difference is one of emphasis.

The underlying problem of an emphasis on the transmission mode of education is summarised in the following conclusion.

'Students get so bogged down in details that they fail to recognise underlying concepts. Neither do they possess the theoretical knowledge or the ability to function at the cognitive level required to recognise existing patterns and structures.' [Woolnough and Allsop 1985]

It may be a more positive approach to assume that students *do* have the 'ability to function at the cognitive level required' and that the problem lay in the educational approach which is based on assumptions which are not true.

The previous section on learning suggests that the above and similar conclusions are representative of a problem with the approach and not an inherent problem with students. For instance:
'Learners do not know what they should be looking out for and cannot apply what they have learnt.' [Marton & Saljo, 1996]

That is, the students are reacting to a situation. It is possible, indeed it is argued, probable, that this is a strategic response to an educational method, which unwittingly encourages it. It is reasonable to assume that as education differs from natural learning in its emphasis on assessment, then students (as with most people) will determine which behaviour or response is expected in order to succeed, and adopt strategies which achieve that end. If putting an emphasis on memorising information and adopting set (albeit superficial) styles of essay writing and correct responses to standard questions results in high or high enough grades then surely this is a sensible approach.

Many studies have been carried out into the learning styles adopted by students. One study of over two thousand students focused on the four learning styles defined by Jungian personality types as described in the section on learning.

- Sensory Feeler
- Sensory Thinker
- Intuitive Feeler
- Intuitive Thinker

The study concentrates on making the students aware of their learning styles and modifying them for better grades. As shown earlier, it would seem that these learning styles are actually a different emphasis on different stages in the learning 'cycle' and indeed reflect the differing qualities of different students. The conclusions below may be considered somewhat worrying, particularly considering that this was an extensive nature of the study. They show that certain qualities can be easily assessed and therefore are, whilst other important but difficult to assess qualities are simply ignored. Although it is suspected that the following supportive evidence was not intended as such, this conclusion is reflected by the following summarising quote.

'Students who are most likely to succeed (sensory thinkers) have learned to trust memorisation and recall. Students who learn conceptually (intuitive thinkers) are not performing at their best and can improve significantly when taught appropriate study technique.… The intuitive thinker is perhaps ideally suited for a career in research sciences, but often does not find academic success early due to natural dislike of repetition and memorisation.' [L.B. Krause 1999]

Although these conclusions are of value, it is advocating that if students adopt a sensory thinker approach, i.e. memory and recall, then they will improve their grades with the traditional assessment process. Implied in this is that the qualities associated with the other forms of, or approaches to learning are not being recognised or rewarded by present assessment methods, in spite of the fact that they will be 'suited for a career in research sciences'. Whether this tendency is reflected in other subjects has not been recorded. From the students' perspective, the comment that the students would benefit by adopting the study approach of sensory thinkers is a pragmatic suggestion but there is no acknowledgement that the education system should be concerned and therefore considering ways to address this problem.

The effectiveness of this emphasis on transmission followed by recall, either intended or otherwise, has been questioned but a lack of underlying reasons has meant that studies have been very tentative about any direct criticism.

'..contemporary research on learning seriously questions the usefulness of the 'transmission concept….'.

'….[This] should not be interpreted to suggest that a 'transmission role' is wrong. Far from it. The intention has been to emphasise that if students are only fed information by their lecturers and the only expectation is that they remember and recall this information for exams, then their educational experience has been very poor.'[Nicol 1997]

In respect of the emphasis on the transmission mode of education TLTP material has been adopted quite extensively by some subjects (such as Law), but has not proved successful in other subjects. The core nature of the law syllabus and material does promote such central resourcing but the response in other subjects s more indicative of the personal interpretation of the course by the lecturer. Interestingly, the lecturers who developed the material were very pleased with the material produced and felt that it gave them a good resource. This is possibly the sort of activity the students should become engaged in.

Academics are also aware that designing and assessing appropriate questions that engage the students is the most difficult task. Ironically, once this is completed, all that is required is the answer. Of course, an astute questioning strategy is the mark of a good academic and requires the activation and judgement of their knowledge together with an underlying strategy and purpose.

'The final feature is that effective learning is encouraged by prompt feedback. Every higher education teacher is aware of the demands of marking student work. However, often the effort in marking is for administrative purposes rather than to encourage and guide learning. Sadly students realise this.' [Jackson 1997]

In terms of the course syllabus and content:-

'There is ample research evidence that departments demanding unrealistically heavy workloads encourage surface learning from their students – the exact opposite to what these departments claim to seek.'[Jackson 1997]

Naturally, this depends on what is meant by 'unrealistic' and 'heavy workload'. If this heavy workload refers to high student work output then this maybe a view on how hard should a student be expected to work. However, if it is referring to an expectation to absorb and accurately recall large amounts of information then this is contradictory to the reflection process that many courses claim to advocate. The transmission and testing for accurate recall and superficial re-structuring of information is a situation which lecturers and students are forced into three ways. Firstly, it is their only educational (as distinct from learning) experience, and secondly, it is how they achieved their high grades, and finally if they believe that the 'concept is in the information'.

This belief causes a cumulative problem. As workers in the field produce more and more works, the amount of information that students are expected to absorb increases. Presumably, in a thousand years time whole libraries of diverse and incrementally structured theories will have to be read and recalled and degrees will be very long.

The appropriate structuring of material is seen as one way to convey the course information more effectively. This does provide good notes and readily comprehensible information. But is the course purpose to purely convey the course information? Whilst badly or unstructured information is difficult to retain and requires reorganising, it is not the lecturers' structure which the course is intended to convey.

'Some students had relied heavily on their lecture notes, which not only limited the breadth of their understanding, but also meant that they simply accepted the structure offered by the lecturer. They did not seek their own way of making sense of the material.'[Marton & Saljo 1996]

Alternatively, the emphasis will change to the process of effective learning itself which the experts underwent in order to solve the problems addressed or create the theories or literary works. The argument that 'we are not all geniuses' and that most people just have to remember the work of others, assumes that the learning process for students is essentially different, as opposed to just

less advanced. It will hardly ever be the case that remembering the work of geniuses will be of over-riding help in future tasks (outside of exams) and indeed, if carried out excessively, is not a boring and demotivating process.

Alternatively, it is not the production of a piece of academic work itself that is important to future academics but the mental process of its conception and production.

The decision to re-evaluate a course will be partially determined by an identification or re-evaluation of the purpose of the course and partially by a belief that there are better ways to learn. Indeed that many people are not learning this way already but not being assessed in a way which identifies this. People are rarely aware of the personal learning process in which they engaged.

The meaning or an appreciation of the significance of information is limited in depth by the personal understanding of the student. It follows that 'I understand' usually implies 'I think I understand enough for my purposes' or indeed, more an expression of confidence. It is only when ones own expression of understanding is challenged that the proposed development of understanding is externally validated. In such cases, for example during dialogue in seminars, the academics contribution is in direct response to the learners' expression of their personal understanding. This can provide explicit and new links between previously known information, previously known understandings or modify old assumed relationships. The strategic cognition and targeted modifications of understanding show the importance of feedback over passive forms of interacting with information which can occur such as with reading, lecturers or notably television.

All of the above information still of course leads to the same issue that every academic faces, that is, it is the motivation to apply the information that is important.

8. Research Based Courses

Despite all of the above, lecturers cannot be expected to account for all the complexities of learning and education. However, it is possible that ways of promoting such development in students maybe found. No one method of instruction will work best for all students but the research emphasis is designed to accommodate a broad range of learning styles but to put each in perspective of the complete learning process.

Disciplines have their own pedagogies involving distinctive ways of knowing and forms of discourse, each with their own values and goals. They also have their own characteristic patterns of teaching methods and associated learning activities and assessment methods. Despite inherent subject differences, questions are raised about the extent to which the pedagogies associated with disciplines are an inevitable consequence of inherent characteristics of the discipline. So can effective pedagogies be applied across disciplines?

Any lecturer who has developed a course will know how much this helps in understanding the subject. They will also appreciate that astute questions are at the centre of an academics' abilities. With present assessment methods, creativity as the ability to 'see possibilities within a framework' is in many cases not explicitly rewarded by the educational system. It may be possible (in fact in any other situation it would be argued, likely) that, outside if research, successful students and therefore academics display memory/recall skills, that is breadth of understanding, over and above any other. Can this ever produce a creative learning environment? The fact that active researchers appreciate or at least experience the entire creative learning cycle does strongly imply that they are in a position to judge (with care) the creative output of others. Indeed this is the basis

for the, not infallible, peer review process of research papers, over and above the recognition of subject boundary advances.

The above situation provides a justified foundation for the claims that the research activities of staff are directly related to course quality. It does however seem that at present, this situation is significantly under exploited by research led institutions.

The overall objective or a research based course is to encourage the students to develop the ability to reassess the relationship between the information which has been presented by the lecturer and consequently formulate their own understanding of the subject material. This is rarely achieved with closed questions which have one correct answer, or even with open style questions where the 'appropriate' style and content can be predetermined by the student. The predominant forms of understanding in students seem to be influenced by the format of the examination and the types of question anticipated.

When such questions are used the students are known to resort to convergent thinking and surface learning. In spite of the fact that the lecturer may present such questions in an attempt to develop the students' understanding of the subject, this does not occur.

"In tests of convergent thinking there is almost one conclusion or answer that is regarded as unique and thinking can be channelled and controlled in the direction of that answer. In divergent thinking on the other hand, there is much searching about or going off in different directions. This is most obviously seen when there are no unique conclusions. Divergent thinking [is characterised] by being less goal bound. There is freedom to go off in different directions, rejecting the old solution and striking out in some direction is necessary, and the resourceful will more probably succeed."[Guilford 1959]

Open or research type questions will inevitably result in a more subjective or negotiable assessment but by this very negotiation with the student, this problem can become part of the learning process. The development of a research proposals and activities is probably as familiar to academics as the transmission method. This is particularly true in research based institutions. The pattern of research development does not really need much description but some points are listed.

- Research starts with an informed and personally interesting proposal.
- It is personal and judgement at this stage is restricted to the justification of the purpose and the proposed means and methods of achieving the objectives.
- Research is frequently dealing with unknowns (to the researcher).
- It is not as 'safe' as learning the set works of other 'researchers' (although this is a component) and assessment should reflect this uncertainty.
- Although the content maybe contentious, the process and the form of presentation of the work is established.
- Once the problem has been defined, development of many skills may be required and this should be reflected in the "achievability" of the proposal.
- The proposal will have to be deconstructed down into smaller identifiable tasks with identifiable although not necessarily definable outcomes.
- Access to the research of other academics and students is useful guidance, challenging and reassuring.
- A developing resource is valuable.
- Support is required during this process as the patterns and structure of research are frequently not apparent to students and they often find difficulty in the deconstruction of complex problems down into simpler and familiar areas.

As with all forms of learning, the publishing of students' work related to open questions (named or anonymous) would be of great value to both the researcher and other students.

An outline of the relationship between learning outcome categories and assignment scope is given in Appendix B.

The implementation of research based courses will probably be of greater value than any preconceptions as to their effect. In the final analysis, the main motivation to change teaching methods is when the true nature of student learning with different educational methods is apparent and appreciated by the academics.

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Appendix A

Breakdown of educational modifications implemented by Eizenberg.

Table 1: Lecturers' descriptions of the aims of higher education:

The graduate should be capable of
- • adopting a distinctive way of thinking about concepts, evidence, and theories
- • taking a distanced, critical stance towards subject matter, assumptions and explanations
- • tackling issues systematically, logically, and effectively
- • examining the adequacy of evidence and checking alternative interpretations of it
- • demonstrating a thorough understanding of complex, abstract concepts within the discipline
- • writing clearly and cogently, following appropriate academic styles and conventions
- • setting and solving problems by applying concepts and techniques appropriately

Table 2: Personal transferable skills

Problem-solving skills
- • applying concepts and principles to the analysis of problems
- • producing original or imaginative products or ideas
- • using numerical or statistical analysis to solve problems

Initiative and efficiency
- • using initiative, and carrying out one's own ideas
- • achieving results within realistic constraints of time, money, etc.
- • showing greater self-confidence
- • taking responsibility for one's own development

Interactional skills
- • working co-operatively with others in a group or team
- • interpreting and understanding people's feelings and behaviour
- • leading and organising group activity

Communication skills
- • making effective oral presentations in formal situations
- • producing effective written presentations, considering design and layout
- • demonstrating computer literacy
- • making oneself understood in a foreign language

Table 3: Approaches to studying

Deep Approach **Transforming**

- Intention – to understand ideas for yourself by
- Relating ideas to previous knowledge and experience
- Looking for patterns and underlying principles
- Checking evidence and relating it to conclusions
- Examining logic and argument cautiously and critically
- Becoming actively interested in the course content

Surface Approach **Reproducing**

- Intention – to cope with course requirements by
- Studying without reflecting on either purpose or strategy
- Treating the course as unrelated bits of knowledge
- Memorising facts and procedures routinely
- Finding difficulty in making sense of new ideas presented
- Feeling undue pressure and worry about work

Strategic Approach **Organising**

- Intention – to achieve the highest possible grades by
- Putting consistent effort into studying
- Finding the right conditions and materials for studying
- Managing time and effort effectively
- Being alert to assessment requirements and criteria
- Gearing work to the perceived preferences of lecturers

Table 4: Individual Forms of Understanding

- Breadth of understanding
- Depth or level of understanding
- Structure used to organise the material being learned
  a. little or no structure being imposed on the facts learned
  b. relying exclusively on the lecturer's structures
  c. producing prepared answers to previous years' questions
  d. adapting own understanding to expected question types
  e. relying on an individual conception of the topic

Table 5: A learning environment designed to support a deep approach

Action taken

Curriculum

- linking curriculum to faculty goals
- matching curriculum, teaching and assessment
- incorporating professional applications
- defining 'essential' information
- selecting appropriate textbooks

Rationale from research findings

- openness to students
- clarifying goals and standards
- increasing vocational relevance
- which encourage personal understanding

Teaching

- analysing the derivation of new terms
- emphasising principles and concepts
- creating opportunities for 'good' teaching

- actively engaging students
- rather than encouraging memorisation
- rather than accumulation of details
- rather than 'covering the syllabus'
- by learning from problem solving

Appendix B

Identifying open and closed assignments as a basis for assessment criteria

Specific Method	Specific Case
Specific Method	Specific Implied Case
Specific Method	General Case
Specific Method	Open Case
Specific Reasoning (Theory)	Specific Case
Specific Reasoning (Theory)	Specific Implied Case
Specific Reasoning (Theory)	General Case
Specific Reasoning (Theory)	Open Case
General (Subject) Reasoning	Specific Case
General (Subject) Reasoning	Specific Implied Case
General (Subject) Reasoning	General Case
General (Subject) Reasoning	Open Case
Open (Novel) Reasoning	Specific Case
Open (Novel) Reasoning	Specific Implied Case
Open (Novel) Reasoning	General Case
Open (Novel) Reasoning	Open Case

	Case			
	Taught	**Implied Bounded**	**General**	**Open**
Given Method	K	K/U	U	U
Given Theory	K/U	U	U/A	U/A
General Reasoning	U	U/A	A	U/A
Open Reasoning	A/C	A/C	A/C	C

Specific Case - Given Taught	- K -	Can You Remember How to Apply to set case
Specific Implied- Given Implied Bounded	- U -	Can you make and Apply connection and 'see' the relationship
General Case	- A-	Can you Generate reasoning for context Over view perspective
Open Case	- C -	Can you Extend subject reasoning (novel) Extend boundaries

K Know-How
U Surface (Breadth of Understanding
A Appreciation/Deep Understanding
C Creativity

The progression from top left (K) to bottom right (C) is related directly to the expected qualities of a student for different degree grades 3rd - 2:2 - 2:1 - 1st.

Figure 1:

The Learning System: A Pedagogic Model

- Information, method, cognition = components of the learning system
- Memorising, practice, reflection = learning processes
- Knowledge, skill, concept = learning outcomes
- Arrows and description (e.g. exemplify, analyse, design) represents possible learning/assessment tasks for the inter-related components.

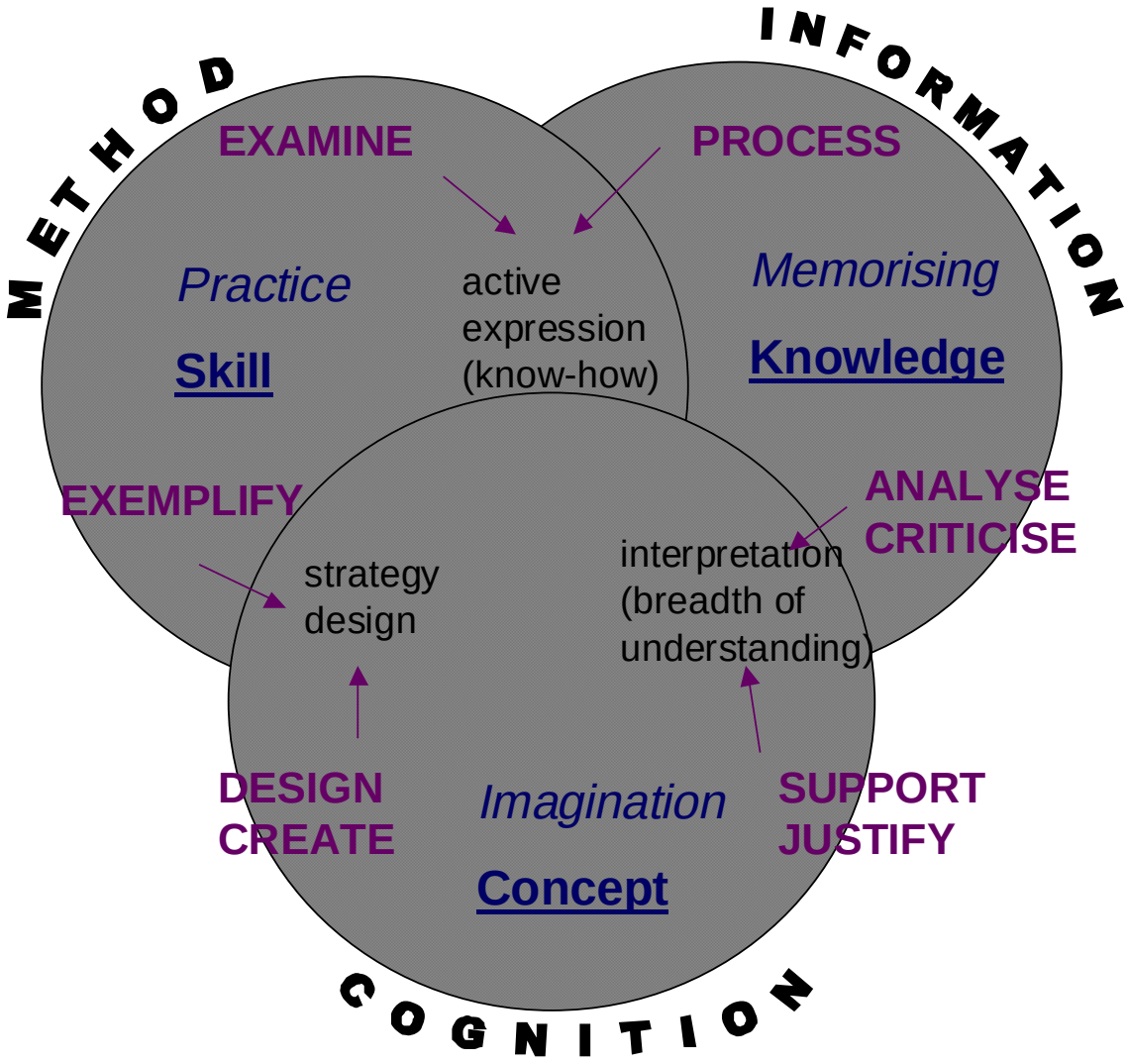

Figure 2:

TELRI Pedagogic Model: The learning cycle mapped onto learning processes

TELRI approach is trying to limit the "short-cut" that students often take from surface learning to strategy design for learning and promote course designs that draw more heavily on the cognitive and reflective component and so enhance deeper learning of a research-orientated nature.

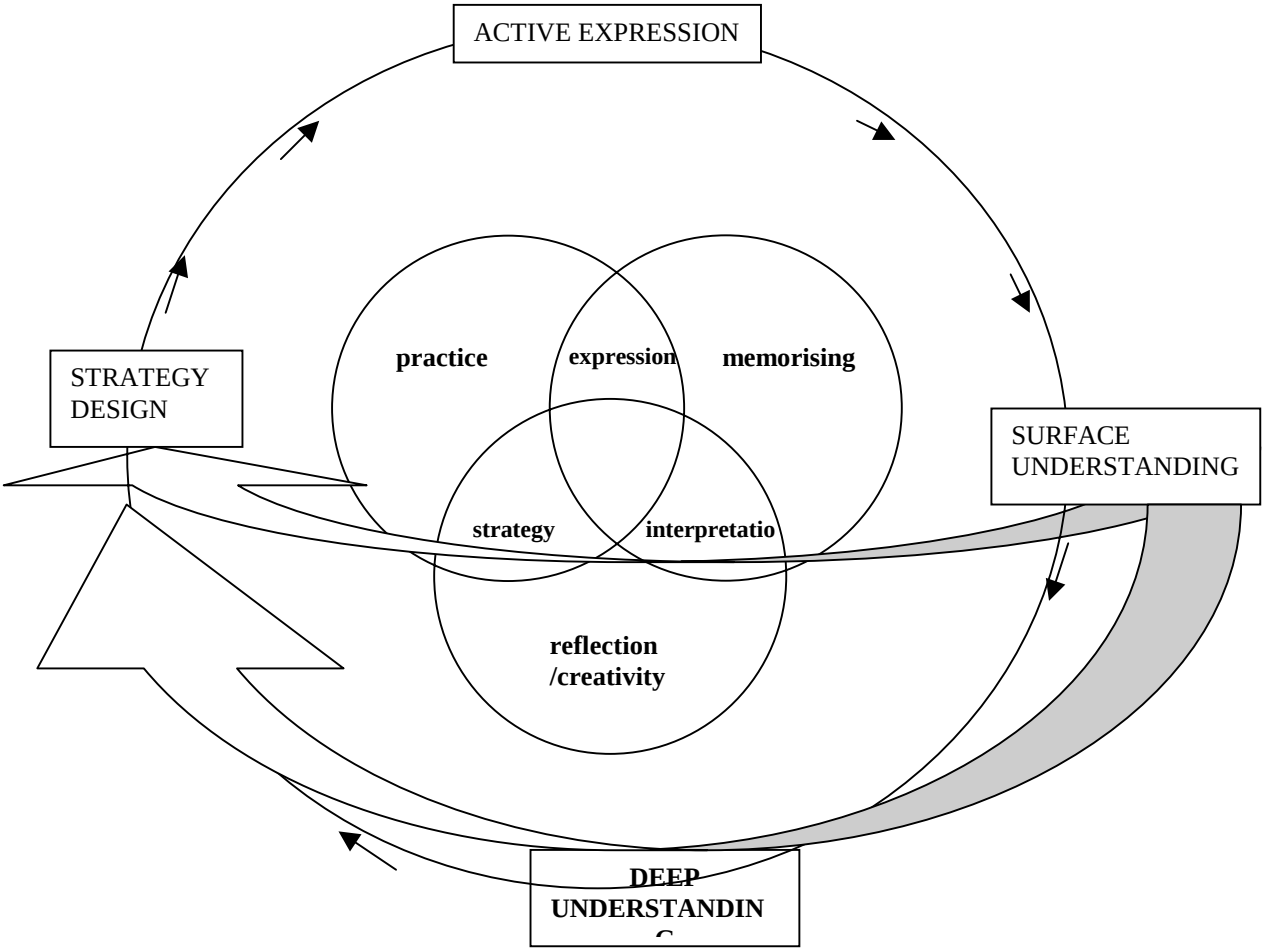

Figure 3:

Learning style (after Kolb & Myers-Briggs) mapped onto the learning cycle.

This model might inform how difference subjects emphasise different areas.