Facilitating Authentic Learning in the Virtual Space: An autopoietic view

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Abstract – **In this paper, Maturana and Varela's theories of autopoiesis, cognition and language will be applied to the development of online curricula, with a view to the facilitation of improved problem solving skills for students. In particular the implications of the theory for designing online environments that support self-directed and problem based learning modes will be discussed. It will be argued that autopoietic theory has significant implications for the way in which online curricula are designed and implemented**

I. INTRODUCTION

The use of Internet based technologies for the facilitation of teaching and learning has been growing at a significant rate for the past decade. In particular its adoption for university level teaching has seen a rapid increase in the number of courses delivered either completely over the Internet or through a combination of face-to-face and online modes.

An issue faced by many universities is how to maintain and improve the quality of students' learning experiences whilst at the same time increasing the flexibility through which they can access course content. Most approaches are based on the idea of information transfer, where the student receives the lecturer's meaning through the downloading of content modules, or audio recordings of lectures. This approach attempts to simulate the traditional didactic teaching model where the lecturer, as expert, pours knowledge into the student - an empty vessel waiting to be filled. Unfortunately, this model of teaching and learning has been shown to be inadequate in terms of encouraging the development of generic problem solving and self-directed learning capabilities [1]. Put simply, "...development strategies which do not invite challenge of a person's implicit theories may be seen as comfortable but will not lead to any reappraisal of current theory and practice" [2].

In this paper, Maturana and Varela's [3] autopoietic theory will be discussed in order to explore the process of behavioural change and how this relates to online learning environments. Autopoietic theory, is a biological systems theory developed to provide explanations of the nature and characteristics of living systems. There is not enough room here to describe the theory in any detail and interested readers should refer to some of the following references in order to gain a comprehensive understanding of the concepts within it [4,5]. Suffice to say for the purposes of this paper, that Maturana and Varela's theories encompass cognition, cognitive change and language. Furthermore, they involve considerable discussion of the relationship between the individual and their environment. The processes and rules described within the theory establish a particular epistemology which carries significant implications for the way in which teaching and learning is conceptualised and in particularly the way in which students develop their problem solving abilities.

In the next section I will briefly discuss some of the issues associated with designing online learning environments so as to encourage the development, by the student, of problem solving and self-directed learning skills. This will be followed by a brief overview of autopoietic theory and the epistemological implications of the theory for online learning. Section 4 will draw on existing educational research to suggest a framework for addressing the issues raised in Section 3. Section 5 will discuss what this means in terms of using online technologies, and Section 6 will conclude.

II. APPROACHES TO ONLINE LEARNING

The use of online learning technologies to facilitate more flexible access to educational resources and to provide distance based education has grown considerably over the past 5 years. Like any teaching tools, however, online learning technologies can be misused by teachers [6]. In the same way that some teaching staff simply replace handwritten notes with PowerPoint presentations, reading out the key points of information they seek to convey, the use of online technologies is often limited to the replacement of class notes with web-pages. Mass lecturing via video, or putting lecture notes on the Web. None of these uses has a significant effect on the quality of student learning [7]. These approaches are indicative of transferring, to the online context, more traditional one-way communication approaches to teaching [8]. Consequently, there have been calls for academics to adopt new pedagogical techniques, and other quality assurance processes in their use of the learning technologies [9] in order to more fully realise the potential of the technology in the improvement of student experiences. Part of this process requires that the academics reappraise their prevailing teaching practice, to reflect the new opportunities that the technologies provide.

In approaching this end, what theoretical models are available to us to inform the development of curricula? In the next section, Maturana and Varela's autopoietic theory will be discussed as a basis for examining other approaches to curriculum development for online media. Autopoietic theory is a biological systems theory, which includes descriptions of the cognitive process and the development of language.

III. AUTOPOIESIS & LEARNING

In the context of discussing online learning and the development of curricula appropriate to the medium, the most significant aspect of autopoietic theory relates to the rules and processes which underpin an individual's relationship with their environment.

From an autopoietic perspective, an individual's behaviour is determined by particular states of nervous system activity [3]. The nervous system's activity is defined by what Maturana and Varela have described as operational closure. This presupposes that in all cases nervous system activity results from, and leads to, further nervous system activity in a closed cycle [3]. Operational closure does not mean, however, that the nervous system has a fixed structure, it's structure is plastic, and changes over time. It is this *plasticity* that allows for changes in behaviour and subsequently what we describe as learning [10].

The key educational implication of operational closure is that changes in state of the nervous system are dependent upon the nervous system's internal structure and not external or environmental forces. External or environmental forces may act as triggers for change but it is the nervous system's structure that dictates which forces may be a trigger [10]. Consequently, changes to the structure of an individual's nervous system, and their behaviour, will be unique to that person. The environmental perturbations that act as a change trigger in one person will not necessarily trigger a change in another, or if they do, the change that is triggered may take a different form and/or have different implications for the viability of that person in their environment, given their history.

In terms of the development of online curricula, where a significant component of the student's learning is derived through accessing material over the web, the process of nervous system change described above has significant implications for the way in which online education should be approached. Epistemologically, Maturana and Varela's theory implies that *meaning* is attributed to the online content by the student, rather than the content carrying any meaning to the student, in and of itself.

This implies that the information transfer model of education described above is problematic, as there is effectively no way of knowing what the student will gain from a particular piece of content. The main reason for this is that the meaning the student may ascribe to a particular piece of information is a direct function of their history of experiences up to that point in time. For example, has the student worked in industry or not?; Are they a native to the language that the content is delivered in?; What is their motivation for undertaking the course in the first place – do they seek understanding or simply passing the exam? All these factors and hundreds more directly impact on the way in which the student's educational experience emerges.

The distinction that this point raises is that the content of the online course should not be considered as synonymous with the experience of the student. More accurately, any content provided within the 'learning space' should only be considered as a triggering agent for the student's learning. This is due to the operationally closed and structure-determined nature of the nervous system, as described above. The challenge for educators is to provide appropriate triggering agents, through the combination of online resources, the effective use of chat rooms and bulletin boards, provision of questions and the general structure of the course, such that the student can develop their problem solving skills and learning autonomy.

IV CREATING AN ENVIRONMENT FOR LEARNING

If it is accepted that the use of online learning technologies can only be considered as a triggering agent for the student's experience, the question then turns to how may the educator structure their curricula to create an experiential environment for the student, where appropriate learning triggers can occur.

Perry's [11] model of intellectual development provides some conceptual guidance in regard to this question. Perry studied the intellectual development of college students as they moved through the five years of their degrees, leading him to propose a nine stage model. The model illustrates a general shift, by the students, from what he termed a dualistic view of the world, where students considered problems and issues in terms of true/false, right/wrong outcomes, through to a more contextually relativistic view, where multiple truths are recognized and considered in the development of solutions. Perry concluded that a key factor in the way the students moved through the model was the presentation of unstructured problems where it was not possible to draw a simple right or wrong answer. He posited that presentation of such problems pushed students to consider multiple outcomes and reflect upon their own assumptions about the world. It has been considered desirable for students to develop through to the contextually relative position, as proposed by Perry, for a range of reasons, not the least of which being; "...students failing to reach this [contextual relativistic] level were considered poorly prepared to deal with complex issues in their professional careers. [12].

What triggers are necessary however, to encourage students towards Perry's contextually relative view in the context of using a problem-based or experiential curricula approach? Educational research on the use of these approaches to curriculum design has raised a number of important observations. For example, Loacker and Doherty, [13] in their commentary on curriculum processes (although not specifically in relation to online learning programs) suggest three main phases through which the curriculum may encourage the student towards learning autonomy. The first phase involves encouraging the student to recognise learning as an 'internal' process. This represents a major shift as they, "discover that... learning isn't 'out there' but that it occurs within...", they go on to point out that this shift, "...as a change in perception and abilities is the most difficult hurdle for the beginning learner" [13 p112].

The second shift or phase follows more easily, here the student recognizes, "...that [their] learning is something [they] can carry with [them] from situation to situation, adapting it for use in each new setting." [13 p112].

The third phase of the learning framework Loacker &

Doherty describe builds on the previous two phases, in the sense that it requires self-direction and learning portability as prerequisites. In the third phase, the learner begins to move off-campus and focus on non-academic environments. "Taking [their] abilities into settings that are not designed for [their] learning, [they are] challenged to integrate and use [their] abilities independently and to assume more of the initiative for planning and evaluating [their] development. [They] begin to develop the autonomy and flexibility essential to effective self-directed learning. [13 p115]

As Salner points out "The student must have the opportunity to experience the epistemological dilemmas that characterise each stage [of Perry's model of Intellectual Development] as his or her own personal dilemmas [1 p231]. Consequently the problems faced by the students require an element of authenticity in order to be effective.

This point is consistent with the autopoietic perspective being discussed here, for as Maturana and Varela observe "Learning as a process consists in the transformation through experience of the behaviour of an organism in a manner that is directly or indirectly subservient to the maintenance of its basic circularity." [3 p35], or in other words, people change their behaviour in order to maintain their continuation in a particular context, where it supports their survival.

Underpinning these phases or shifts, many researchers highlight the importance of reflection. Reflection, broadly refers to "...those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations." [14 p11]. The process of reflection is a central tenet of problem-based and experiential learning approaches and fundamental to supporting changes in the problem solving process of students.

Considered from an autopoietic perspective, it is analogous with the ongoing process through which the individual distinguishes themselves and their circumstances in the environment

As part of the structure of the human nervous system, it is possible for humans to generate a domain of self or self-consciousness. For Maturana & Varela, this domain exists through language or a linguistic domain. They describe linguistics as "...an ontogenic communicative behaviour, i.e. a behaviour that arises in an ontogenic structural coupling between two organisms..." [4 p209]. The recurrent interactions that form this history of interactions create what they describe as a consensual domain.

It is within these domains that the individual distinguishes the 'I'. The 'I' is a linguistic distinction within the linguistic domain of the individual and represents a means of differentiating one's self and one's circumstances from all the other distinctions that occur within one's linguistic domain. The linguistic domain of an individual is the domain of all linguistic behaviours and therefore is also in a process of continual change, responding to and affecting the individual's continuous interactions with the environment.

If through the experiences associated with participating in an online course a student reorients the way in which they distinguish the 'I' from the other distinctions in their linguistic domain, there will follow a change in behaviour consistent with the changed process of orientation. The question in terms of the discussions in this paper, however, is how to structure the online curriculum in order to achieve this?

V TRIGGERING LEARNING ONLINE

Educators who are attempting to facilitate the development of generic problem solving and self-directed learning skills through online or distance delivery modes, face the problem that it is practically impossible to determine what will be a learning trigger for each of their students. This is due to the varied histories giving rise to the individual structures of each student and unknowns in relation to the non-online environment in which the student is accessing the material. Consequently, the logistics of spending time with each student to the point where the teacher/lecturer knows the student well enough to have a reasonable chance of structuring an appropriate experience for *them*, is not feasible.

One way to overcome this problem is to turn the process around and encourage the student to find their own learning triggers, or in other words encourage the student to make new meanings out of their experiences, rather than waiting for the teacher to continuously service them with new information. The ultimate goal of experience based learning involves the learner's own appropriation of something that is to them personally significant or meaningful (sometimes spoken of in terms of the learning being 'true to the lived experience of learners'). [15 p227]

The use of complex unstructured problems as the core of the online experience should become the focus here, as within these problems the student is provided with the scope to explore their own assumptions and approaches, not only to the topic area of the course but also their own learning processes. The teacher, through the use of chat facilities and bulletin boards can facilitate class discussion not only of the topic but perhaps more importantly the different approaches that the students are bringing to it.

The key, is in the complexity of the problems raised by the curriculum and the ability of the teacher to utilise the chat and bulletin board facilities to encourage reflection on the learning process. Setting of problems with relatively defined outcomes, will not challenge the student to critique their problem solving process and as such will not affect change in their learning and problem solving behaviours.

These points do not represent a change to the technologies, but rather argue for a change in approach to their use. The potential of online learning technologies to provide improved learning outcomes lies not in the delivery of the information they provide, but through the triggering of student experiences.

VI CONCLUSION

This paper has briefly discussed Maturana and Varela's autopoietic theory in order to raise some of the epistemological issues involved in designing online curricula that encourage the student to develop their problem solving and self-directed learning skills. The key implication of the theory is that the online learning

environment should not be viewed as a mechanism for the distribution of teaching content, but rather a triggering agent for the experiences of the student. As a triggering agent, courses delivered in the online medium need to satisfy three broad characteristics.

The first of these characteristics is that the educational environment, through the structuring or unstructuring of a student's experiences, should provide the student with relatively authentic experiences and form the basis from which they may reflect on their assumptions.

Secondly, the student, through the use of online chat and bulletin board facilities, is encouraged to reflect on their experiences, and their approach to the problems that have been set. This would be analogous to encouraging epistemic cognition [16]. This will begin the process through which they reorient their linguistic domain in relation to the way in which they distinguish their environment – and as a consequence make changes to their behaviour.

Thirdly, the need to maintain autopoiesis and therefore structural coupling with the environment, will in most cases act as a motivating force for the student to reevaluate their assumptions as described in characteristic number 2 above. As such it is the student that controls the change process rather than the educator. The person attempting to assist the student develop their problem solving and learning abilities has only limited control of the environment within which the student has experiences and as the process continues this level of control decreases as the student becomes more epistemically aware and begins to consciously control their interpretation and reinterpretation of their experiences. This situation would be indicated by the student structuring their own experiences in order to perturb their nervous system and further expand their potential range of behaviours.

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