

Complexity thinking in ALL practice

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Complexity Theory is a movement that has its beginnings in the physical sciences and mathematics. However, the understandings of this movement have led to recent developments in theories of learning and cognition. Learning is no longer seen as an act of capturing information or a process of meaning construction; learning is understood as a process of adaptation and evolution that emerges through the learner's interactions with a dynamic and responsive environment (Davis, Sumara, & Luce-Kapler, 2000; Doll, 1993). It is important to assert here that this theory is not one that lends itself to prescriptive practices, but what it offers is insights into the nature of learning, and as such guides preparation in facilitating learning (Davis & Sumara, 2005). This paper will explore complexity theory and how it can be used to inform ALL practice.

Key words: complexity theory, learning as adaptation and evolution.

1. Introduction

Students who are referred to learning centres often arrive feeling like failures. They frequently speak of being 'underprepared' for the study of their choice. It is also not surprising to note that these students are often labelled as being 'disadvantaged' by their cultural and linguistic backgrounds. They are usually conditioned to perceive their 'lack' as their inability 'to get it' and perhaps this perception arises from the way learning and knowledge have been presented to them all of their lives.

Knowledge is often understood as a body of information and skills that must be captured and learning tends to be seen as an act of capturing. Ideas of 'capture' in relation to learning and knowledge seem to be ingrained in mainstream education psychology. How do these ideas play out in the area of Academic Language and Learning (ALL)? This paper is an attempt to seek alternative understandings of the experience of learning and making knowledge, and what this experience means to academic language and learning practice. It seeks to (re)vision our practice as academic language and learning educators by exploring learning and knowledge making through the lens of complexity theory.

2. Notions of knowledge and learning

Ellsworth (2005, p. 16) speaks of "a particular kind of knowledge – a knowledge already gotten by someone else, knowledge which is considered legitimate, a physical entity that can be caught, measured and transmitted in ritualistic ways". This idea of knowledge as object permeates much of what we understand of learning. The objectification of knowledge leads to dualistic thinking about knowledge, legitimising knowledge that needs to be captured, and spurning knowledge that is intrinsic to the knower (Davis, Sumara, & Luce-Kapler, 2000). The assumption here is that knowledge is a pre-existing entity, a 'thing' and learning is a process of acquiring and internalising the 'thing'. Ellsworth (2005) proposes that knowledge viewed in this manner is dead.

Ideas of knowledge as ‘object’, dead knowledge, underlie most of the 20th Century learning theories. These theories share a common underlying assumption that an external body of knowledge exists and that this knowledge needs to be internalised. Behaviourism views the learning process as change in behaviour that is brought on by some form of stimulus that is present in the external environment (Bigge & Shermis, 1999). Therefore, behaviourists believe that it is possible to predict and control behaviour, and that knowledge is the association between the stimulus and the change in behaviour. However, it is only possible to apply this theory to processes that result in visible behaviours. It does not account for phenomena such as language learning or problem solving.

Cognitivism, on the other hand, views the learner as an information processor and understands learning as taking place in the brain. Knowledge is understood as schema or mental representations that change through the learner’s experiences (Bigge & Shermis, 1999). These theories view the mind as a kind of computer where information that is received is processed to create a particular outcome. Therefore, learning is understood as a mental occurrence where an external reality is captured and internalised. Davis, Sumara, and Luce-Kapler (2000, p. 57) propose that both of these learning theories “share a fairly mechanistic, cause-and-effect world view...[that] rely on a series of interrelated and commonsense, but problematic dichotomies – including mind/body, internal/external...” They interpret these learning theories as a form of reduction – the act of breaking down learning to its most basic constituents. Davis et al. (2000) use the term “complicated” to refer to these theories and suggest that these theories assume a mechanical view of learning by reducing it to a linear process that can be broken down into discrete parts. Whilst these notions of learning have proved useful in some situations, they fail to account for learning that happens without formal instruction.

Perhaps at this point it is necessary to take a step back and think about these learning theories and learning at university. Behaviourism and early cognitivism offer limited explanations about learning (Davis et al., 2000; Klein, 2006). University curricula today are mostly based on constructivist approaches (Lo, 2010). Constructivism views learning as a process of co-constructing knowledge. It is based on a belief that knowledge cannot be transmitted by the teacher to the learner. Learning can only take place when the learner is engaging in an active process of building and creating knowledge through participation and interaction. Therefore, the teacher is not the disseminator of knowledge but, in fact, the creator of environments in which learners can construct their own understandings.

Barr and Tagg’s (1995) seminal paper on constructive approaches in higher education highlights the struggle university teachers had at that time in conceiving how constructivist approaches translate into the classroom. They point out that whilst teachers understood the need for such approaches, they were unable to apply these approaches to their teaching. Barr and Tagg (1995) believe that “the reason is that they have been applied within the structures of a dominant paradigm that rejects or distorts them” (p. 14). This struggle is still evident today as university teachers grapple with constructivist approaches while trying to mediate the tension of securing the ‘content’ of a particular discipline and imparting the key skills/competencies that learners require to communicate that content to members of their community. ‘Content’ and ‘skills’ in this sense are often associated with specific pre-defined objectives. These pre-defined objectives are normally ascertained through abstracting the complex knowledge of a discipline to its fundamental parts. In this way, teachers are programmed to centre their ‘instruction’ around predictability, patterning, control, linear-thinking and universality; ways of thinking that view the world as an ordered mechanism. The reality is that the world is in many cases far from being an ordered mechanism, and it is against this backdrop that complexity thinking or Complexity Theory (CT) emerges. CT, which has its origins in chemistry, physics, information science, cybernetics, and systems theory has brought a range of disparate ideas together and challenges the orthodoxy that exists in a broad range of disciplines from language acquisition to physics (Davis & Sumara, 2006).

3. Complexity Theory

What is Complexity Theory (CT)? CT escapes a definition. It is frequently referred to as “a theory of change, evolution and adaptation, often in the interest of survival, and often through a combination of cooperation and competition” (Stewart, 1991; Battram, 1999; Morrison, 2002 as cited in Morrison, 2006, p. 1). CT at its most fundamental is a theory of change. It is not a cohesive theory but appears to be a collection of ideas about the dynamics of change in a system.

Davis and Sumara (2006) prefer to discuss CT as “complexity thinking” and understand it as “a way of thinking and acting” (p. 18). They emphasise that it is futile to attempt to define CT and suggest that CT “is positioned somewhere between a belief in a fixed and fully knowable universe and a fear that meaning and reality are so dynamic that attempts to explicate are little more than self-delusions” (p. 4). The desire to know is very human; however, reductionist perspectives have sought to break things down to their fundamental parts, to compartmentalise and establish hierarchies where none exist. These perspectives often seek to isolate and disconnect from the surroundings, failing to realise that all that exists, exists in relationship to everything else. Doll (2008, p. 192) proposes that this way of thinking is an “ideology” where an obsession with “order” and “routine method” which seek to predict and control, permeates the business of teaching and learning. CT challenges this ideology as it sees the whole as greater than the sum of its parts.

3.1. Unveiling complexity

To understand complexity, it is helpful to examine Prigogine and Stengers’ (1985, as cited in Morrison, 2008) example of slime-mould that demonstrates a fundamental principle of complexity.

If the environment of the slime-mould becomes depleted in the essential nutrients needed to sustain life, the amoebas discover this through chemical sensors and cease to reproduce. They collect together and form a ‘foot’ containing about a third of the aggregated cells and spores. These migrate in search of a new environment that is suitable to sustain life, forming a new colony of amoebas. (p. 20)

Prigogine and Stengers’ example clearly demonstrates how an organism responds to change in order to survive. This process of ‘self-organisation’ is necessary for the mould to adapt to its changing surroundings.

Self-organisation is a fundamental aspect of a complex system. Unicellular organisms like the slime-mould, crab grass, ant hills, brains, the Internet, communities, schools and classrooms are all complex, adaptive systems. Davis and Sumara (2006, p. 5) list the following behaviours or traits as essential for an entity to be considered as complex: “self-organized, bottom-up emergent, having short-range relationships, nested structure, being ambiguously bounded, organizationally closed, structure determined and far from equilibrium” (Table 1).

As Davis and Sumara (2006) point out, these explanations are limited as they do not account for all possible cases of complexity. However, these features enable us to appreciate why CT is employable in understanding educational and institutional change as these enterprises are constituted by human beings who are by nature unpredictable.

Kuhn (2008, p. 182) acknowledges the possibilities offered by CT in understanding the dynamics of human endeavour and suggests that complexity and education may be brought together because the business of education is “multi-dimensional, non-linear, interconnected, far from equilibrium and unpredictable”. Educational systems and institutions are multi- (students, teachers and administrators) with several facets. While these roles might be constructed hierarchically, systems may be non-linear as the actions that arise from the interactions of these individuals are not always connected in a sequential manner; the system can make sudden jumps in state or possess sensitivity to initial conditions, there is a possibility of chaos or output which may not be the sum of all inputs. These human beings come together in several associations and endeavours because they are interconnected and almost always in a state of

flux. They are far from equilibrium and unpredictable. Thus, educational institutions and their practices are complex systems as they are made of human beings whom themselves are complex entities.

Table 1. Glossary of terms and examples.

Term	Meaning/Explanation	Example
self-organisation/emergence	This is the ability of individual members of a system to interact with each other and transform themselves through collective action that is not centrally controlled. This change is also not initiated by a leader or an external party. The collective activity arises from interactions of each individual of the system as the individuals respond to their nearest neighbours.	A group of students understanding a concept through interaction and knowledge sharing, as opposed to receiving direct instruction from a teacher.
bottom-up emergent	Qualities or capacities that arise from the synergy of individuals in a system that is more than the sum of their parts. These qualities and capacities do not depend on a governing top-down structure.	Change in a school is sometimes brought about by the actions of teachers or students at ground level and not directed by the principal or institutional directives.
short-range relationships	Information exchange happens among neighbouring individuals and is not dependent on a hierarchical relationship.	Collegial exchange amongst teachers.
nested structure	The individuals that make-up a complex system are complex themselves. Therefore, the interactions of these individuals result in new patterns of behaviour.	The different strengths of individuals in a team can create a team characteristic that reflects a new strength.
ambiguously bounded	Complex entities do not have strict boundaries as they are constantly in a state of flux with their surroundings.	A teacher in a school might not only be acting in the role of a teacher – she might also identify herself as a parent or a friend.
organisationally closed	Although the entities of a complex system are constantly interacting with their neighbours, they are constant as they are able to retain their identity.	Whilst a teacher might play several roles (friend, mentor, or parent), she is still first and foremost a teacher.
structure determined	Complex systems have the ability to change their structure in order to ensure their survival.	Departments within schools are often re-structured to maintain economic feasibility.
far from equilibrium	Complex systems are not stable.	Contexts are always changing.

Davis and Sumara (2006) draw on Warren Weaver, the physicist and information scientist, to explicate the notion of a complex system; they point out that complex systems exceed their components. The human body is a complex system as it is made up of a number of parts that come together to function in a particular fashion. Would the human body still function in the same predictable way if it was dismantled and reassembled? In contrast, human creations such as the clock are mechanical systems that can be dismantled and expected to function in a predictable manner when reassembled. In fact, anything that is man-made and much of the technology that we take for granted are mechanical inventions. Davis and Sumara refer to such systems as “complicated”. Much of what we take for granted as understandings of learning, knowledge and educational research have been fashioned on reductionist views of the universe as clockwork mechanisms. In other words, learning is often seen as ‘complicated’ when it is, in fact, a complex endeavour (Davis et al., 2000).

One feature of complex systems that is central to the discussion in this paper is ‘self-organisation’ or ‘emergence’. Davis and Simmt (2003, p. 41) explain emergence: “[F]or reasons that are not fully understood, under certain circumstances agents can cohere in functional collectives – that is, they come into unities that have integrities and potentialities that are not represented by the individual agents”. Doll (1989, p. 67) explains emergence as “spontaneous occurrence” and refers to his classroom observations when he co-taught a sixth grade mathematics class. While Doll and his colleague worked hard to design a problem-solving environment for their students, he found it surprising when students suddenly understood something that they had had difficulty with before. As a teacher, he found it challenging to pinpoint when and how such learning occurs and could only make sense of the teaching task as a “tricky one of combining flexible time with directed time in the right proportion”. Thus, emergence is not predictable, nor is it linear. Instead, emergence is a creative process that comes about as a response to change.

4. Problematising Academic Language and Learning Practice

To understand how CT can be applied to Academic Language and Learning (ALL) practice, it is necessary for us to trouble ALL practice. This is because a ‘practice’ only comes about through systematic constructions of how things should be enacted, and more often than not, the constructors are entities that remain invisible. It is in this way that cultures come to be codified – ways of ‘being’ that come to be understood and enacted (Usher, 1996). These constructions are not natural or neutral. Therefore, an interrogation of these constructions/discourses is necessary to pave possibilities to look beyond the taken for granted in order to create space for new understandings.

What is ALL practice and how is it perceived by its significant others? ALL “advisers... identify and address the changing needs of tertiary students in respect of their academic skills and learning” and the role of the ALL advisor “is to assist students in understanding expectations, processes and product” (Bartlett & Chanock 2003, p. 3). This understanding of ALL practice exceeds the idea of language-in-use or meaning making. It evokes the idea that ALL is not generic, and that it occurs in certain ways, according to shared assumptions and rules that constitute a discipline.

However, ALL practice was not always seen in this light. It, in fact, started in the 1980s as what Stevenson and Kokkinn (2007, p. A46) describe as “a spill over of counselling practice”. The assumption then was that counsellors from student services staff could assume responsibilities for teaching study skills (Roe, 1982, as cited in Stevenson & Kokkinn, 2007). As pointed out by Stevenson and Kokkinn (2007), the early model for ALL practice was very much a deficit model. It was seen as an intervention that was necessary to bridge what academic staff at universities considered a ‘lack’ which was attributed to the inadequacies inherent in the ‘failing student’ and compounded in later years by the inclusion of the ‘non-traditional’ student.

This discourse, the deployment of the ALL practitioner as the ‘fixer’ of academic literacy and knowledge inadequacies is still evident. While this expectation is not acknowledged as such, the ALL practitioner is held responsible for bridging the skill deficit that the non-traditional student

presents with, and is also held responsible for playing the role of an “agent of change” to “transform” learners as scripted by control strategies, to conform to current ideas of governmentality (Percy, 2011, p. A136). The assumption, then, is that the ALL practitioner is able to provide solutions to a problem that is not really a concern of mainstream teaching at higher education. This is a top-down imposition. As such, the perception of significant others within the discourse of higher education is that the practice of the ALL advisor is to ease the difficulties of various stakeholders in higher education. Learners, on the other hand, are seen as imperfect, as being in “need” and/or as having ‘problems’. This view sees learning as an individual enterprise that can be predicted and controlled.

5. Complexity theory and ALL practice

In what ways can CT inform ALL practice? CT is not a theory that seeks to prescribe; at the most fundamental level, CT is a means for us to re-vision our practice. At this point, ALL practitioners are seen as a separate entity from mainstream teaching; their duties are to fix learning problems and ‘problem learners’. Learning problems and ‘problem learners’ are seen as the locus of ALL practice. This perception, coupled with the hierarchical system of learning that more often than not relies on the transfer and transmission of knowledge, seems to be a stumbling block in re-visioning our practices. These reasons have led to a deficit model of ALL practice.

However, it is vital to remember that, as members of institutionalised learning, we are complex systems. We not only have the tacit ability of self-organisation and self-maintenance, we also have the ability to adapt to changing environments. We are considered to be “learning systems” (Davis & Sumara, 2006, p. 92). To learn, systems must exhibit three conditions that Davis and Sumara (2006) refer to as “specialization, trans-level learning, and enabling constraints” (p. 136). These conditions do not occur singularly in a consecutive fashion. Instead, these conditions are interdependent and occur simultaneously. They “are not easily pried apart” (Davis & Sumara, 2006, p. 136).

Specialisation is the need for both diversity and redundancy within a system. In a collective such as the ALL classroom, redundancy is the common ground of members. It is where members have similar attributes, skills, understandings, responsibilities or language. Davis and Sumara (2006) suggest that redundancy is necessary for a complex system to maintain coherence and adapt to stress as it facilitates interaction among members of a complex system. Diversity, on the other hand, creates opportunities for new understandings and possibilities. Diversity and redundancy “must co-exist in productive tensions” in order for new knowledge to be produced (Davis & Sumara, 2008, p. 40).

Trans-level learning refers to the dynamics of the collective learning system; members of a learning system must interact with each other. Davis and Sumara (2006) propose that to enable such interactions “one must relinquish any desire to control...control in a knowledge-producing collective must be understood as decentralized, arising in local activities” (p. 144). This does not mean that teacher-directed activities are to be precluded, but rather that the decentralized structure is valuable as it allows for the possibility of emergence (Newell, 2008).

Enabling constraints are structural conditions that balance a need for a common identity or purpose, and sources of randomness that require the learning system to adapt (Davis & Sumara, 2006). This means that while the idea is not to control, boundaries must be in place to position members of the collective. In this way, there is “sufficient coherence” to “allow for the emergence of unanticipated possibilities” (Davis & Sumara, 2006, p. 149).

Davis and Sumara’s (2006) explanation of the conditions for emergence: specialisation, trans-level learning and enabling constraints are organised around dyads. Their purpose in employing pairs to explain conditions necessary for adaptive systems to learn is “to foreground that complex emergence happens far-from-equilibrium” (p. 136). They see emergence as a balancing of opposites and not as dualities. These three terms (specialisation, trans-level learning, and enabling constraints) will be explored and discussed in the following section.

5.1. Emergence in the ALL classrooms

How would we create emergence in the ALL classroom? Perhaps the most important thing to hold in mind is the idea that emergence is a bottom-up phenomenon. It is not achieved by prescribing. On the other hand, this does not mean that one resorts to *laissez-faire* teaching. Davis and Sumara (2006, p. 152) suggest that although “complexity cannot be managed or scripted...it can sometimes be occasioned”. The focus then is to facilitate spaces in which individuals within the collective can come together and interact to create emergent understandings.

It was by accident that I came to understand such a space when I was asked to teach an ALL class for mature-aged students who were returning to study. The program of study designed for this class included time management, reflective thinking, analysing assignments, and academic writing. There was a manual with accompanying Powerpoints that was meant to be used to teach the class. The eight students who made up the class came from different disciplines – Health Sciences, Engineering, Humanities, and Business – and had signed on for the program through the online registering facility. They were also varied in age and gender. The only common link that these students seemed to share was the fact that they were feeling anxious and uncertain about their ability to cope with the demands of academic writing and full-time study. I discovered this in my first session with them.

While I had a prescribed teaching and learning program, I had concerns about how a ‘one size fits all’ approach would work in a classroom of diverse learners. With this in mind, I decided to allow students to have a say about the content that we would cover in the program of study and the manner in which we would cover the content. In the first lesson of the program, I introduced the concept of reflective thinking and students reflected on their learning experiences thus far. Through this activity, we were able to identify several hurdles, which were referred to as “road blocks”. The “road blocks” that the students identified were issues such as time management, problems with writing, especially paraphrasing, and difficulties with referencing. It is not surprising that these issues were topics of study outlined in the teaching manual that I was given. I then invited students to decide the order in which these issues will be addressed in class and suggested that it would be more relevant for them to learn these elements in the light of their own writing.

Students then agreed on a weekly schedule of topics. They also decided that the best way was to workshop their writing. One common complaint that they voiced was the lack of feedback on their writing from their content tutors. So, the feedback that the students obtained by bringing their writing to class was desirable. Workshop activities included deconstructing and discussing texts written by their colleagues. There was excellent attendance at these sessions and lively discussions. In fact, the group that was made up of dissimilar individuals came together as one. They learnt from each other and helped one another to overcome “roadblocks” with minimal interference on my part. A bonus was that all of the students except for one, who dropped out because of financial difficulties, scored distinctions not only for the writing assessment but also the content unit.

On reflection, I wish to make sense of the above teaching and learning experience with regard to CT. As a group, the students had elements of specialisation. Whilst they were all from diverse disciplines, they shared a common problem which was their fear of not being able to cope with the demands of academic discourse. This could be understood as common ground. On the other hand, their diverse disciplinary backgrounds served as a platform for new understandings and possibilities. One example of this was when the Engineering student helped the Health Science students understand the importance of clearly outlining information in the Methods section of a report. The Engineering student demonstrated how the section should be written in order to establish the idea of credibility. He reinforced this by explaining that enough information should be provided to replicate the work. The Health Science students who initially thought that the Methods section was merely a summary of their experiment had to re-think their understanding of it. They had to adapt the information shared with them by the Engineering student, resulting in new insights for them about writing the “Methods Section” in their own discipline, Health Sciences. In this way, although there was specialisation (the diverse disciplines of students), the

interaction of different knowledge among the students resulted in emergent understandings that went beyond the knowledge base of individuals within the class.

There were also elements of trans-level learning going on in the classroom. Although I had set the stage through a teacher-directed enterprise (the reflective thinking lesson), the focus of most lessons was brainstorming and small group problem-solving. As we workshopped their writing, I stepped back to allow students to discover discourse patterns, and the idea of voice and audience before bringing these elements of academic writing together for them. Thus, by giving up the desire to transmit learning outcomes to the students through top-down teaching methods, I was able to fashion opportunities for emergent behaviour to take place. This allowed students openings to discuss their interpretations of the writing task, and provide appropriate feedback to their classmates. Therefore, the learning that was going on was formed mainly through peer interaction and feedback. This form of shared or decentralised control resulted in collective knowing.

The fact that the students came from diverse disciplines was an enabling constraint. Although their different ways of thinking challenged interaction and exchange of ideas, it offered students a point of comparison, thus allowing them to strengthen understandings of their own disciplinary writing conventions. Students guided each other to make sense of their shared understandings within the confines of their disciplines. There were many questions from the students. However, I found that there was no need for me to answer all the questions. The students often helped each other realise the specifics of disciplinary discourse and in this way reinforced their own understanding of the rules of their own discipline. The result of this exercise was that there was collective realisation of the 'rules' that marked academic and discipline discourse and the need for critical engagement with the writing task.

This experience has prompted me to think that perhaps what we need to do in the ALL classroom is to occasion and facilitate spaces that will allow emergence. Whilst there is need for direction from the teacher, it is important to engage with the prior knowledge that students bring to the learning experience. We need to invite students to share their understandings and experience of writing, and structure these experiences to form a resource that the students can draw from continually. Students should also be encouraged to pay attention to each other's ideas. The ALL practitioner's role then would be to bring these ideas together, to merge and blend these sometimes disparate, sometimes common understandings that have emerged bottom-up and to guide students to uncover disciplinary conventions.

CT encourages us to view teaching as dynamic and contextual; it allows us to uncover structural conditions that constitute the 'teachable moment' and to increase the frequency of these moments. These ways of teaching and learning are perhaps unfamiliar; they may bring periods of ambiguity and uncertainty. However, they do offer possibilities for us to move forward as ALL specialists. CT does not offer answers. It does not provide us with a 'handbook'; it is not a grand narrative. Nevertheless, it does give us space to think differently about what we do as teachers. It enables us to shift from "discourses of control towards frames that foreground context, connection and contingency" (Davis & Sumara, 2010, p. 856). Thus, instead of being considered remedial teachers of 'problematic' students, we have the possibility of re-inventing ourselves as 'connectors' or 'bridges'. In this case, the ALL specialist is the bridge that serves as the connector between the learning of the content classroom and the language and learning in-use, by constructing teaching spaces that allow the occasioning of emergence.

6. Connecting thoughts

CT has been likened to "new wine in old bottles" (Morrison, 2006, p. 6). In fact, Morrison questions whether the elements in CT are the same elements raised in constructivist educational theories. Also, he notes the descriptive nature of CT theory and observes that the language used in elucidating CT is often not intelligible.

I understand my attempts at articulating CT in the light of ALL practices as the work done in "challenging disciplinary boundaries and interrupting disciplinary procedures...that has to be both within and against disciplinary standards of discourse" (Elam, 1994, as cited in Lather,

1996, p. 526). Lather's (1996) purpose in making this statement was to respond to calls for intelligible and "accessible language" in reporting academic work. Lather troubles this call for "plain speaking" (Lather, 1996, p. 525). She quotes Walter Benjamin's words, "[N]othing more subtle than the advice to be clear in order at least to appear true". Clarity often comes with reduction, a simplification of the complexities that are inherent within any natural system.

I believe it is necessary for us to think of CT as a framework that allows for a "s-s-s-stuttering" practice (Deleuze & Guattari, 1987), a practice that situates itself within, and in conflict with, traditional practices. This is because all knowledges are at best partial and multiple, always in interplay, always in flux and never definitive.

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