

Cybernetic Circularity in Teaching and Learning

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This article presents an investigation into the meaning of 'learning'. It uses cybernetics as a framework to look at the fundamental questions of: What is learning and why do people learn? Why do they learn this (and not something else)? How does learning happen? The article first describes the origin of cybernetics and its central tenets of circularity, feedback and communication, which suggest that learning is fundamentally about living. The living system learns as it fits with the environment in an integrated brain/body/environment learning system. This leads to a discussion of teaching and learning as building relationships with self and others in communication, with self and others, with or without the intention of changing and being changed in the encounter. Teacher and learner inevitably change (learn) as they interact whatever the context. The article suggests that what is happening in the encounter between teacher and learner, that which we call 'learning', happens to each of us in the same way all of the time. Learning is change; change learning. 'Teacher' and 'Learner' change (learn) together in a constant feedback network of communication.

We all have a particular way of looking at the world. Sometimes it is examined and consciously adopted, often not. Sometimes we endeavour to be consistent, sometimes we happily hold various conflicting beliefs. Often our belief systems are made up of fragments gleaned over a lifetime and held together with the glue of our heritage.

Cybernetics is one such way of looking at the world. When I accidentally happened on cybernetics I found it sat well with my hitherto tacit beliefs about how the world works. As I discovered the language, theories, philosophy and personalities of cybernetics I was compelled in the name of consistency to examine its implications for living. In addition, because I'm a teacher, I examined its implications for teaching and learning to see what difference it made. I applied a cybernetic lens to familiar questions like: What is learning and why do people learn?; Why do they learn this and not something else?; and How does learning happen? I found cybernetics made quite a difference to the answers that previously I would have offered as my 'common sense' view. And although cybernetics did not change my idea of what constituted *good teaching* it did give me a new set of explanations for why this might be *good teaching*.

So What is Cybernetics?

Cybernetics is a term coined by the mathematician, Norbert Wiener, in 1947, from the Greek *kubernetes* meaning helmsman or cox, which is also where we get the word *governor*, which in turn has connotations of controller or regulator (Glanville, 2005). The choice of cybernetics to name this new field of study indicates something to do with steering (helmsman) and control (governor), both of which rely on communication to do a good job. In fact, cybernetics originally centred around control and communication in people and machines (Wiener, 1948) where communication was unambiguous, and

transmitting a message was an 'engineering problem' (Shannon, 1949). The 'controller' was there to ensure that information was conveyed as accurately as possible. If there were discrepancies the behaviour of the controlled system was changed according to the wishes of the 'controller' (Glanville, 1995). Ultimately, feedback governed the changes in communication, which changed behaviour, which changed the communication and so on in a circular feedback loop that enabled a system to maintain a desired state.

Thus, cybernetics not only had something to do with control, communication and feedback but also was underpinned by the central notion of circularity (von Foerster, 1992). However not everyone interested in this new field of study felt that communication was that straight forward (or circular). When this notion of circular feedback and communication was applied to other areas of life, things became complicated. Messages were not unambiguous, meanings were constantly being negotiated and no-one could be the controller sitting outside the system knowing exactly what the message was supposed to be. As von Foerster (1992, p. 10) stated, they came to realize that they too were "included in a larger circularity, maybe within the circularity of their family, or that of their society and culture, or being included in the circularity of even cosmic proportions." How could the observer be outside looking in when there was always another system, engulfing the observed system and the observer? The observer was always part of a system that was observed by another and so on. As part of the system, the observer always, by being in the system rather than outside of it, made a difference to the system and the system inevitably made a difference to the would-be observer. This was cybernetics of cybernetics, a cybernetic study of cybernetics itself, second order cybernetics.

The Far-Reaching Implications of Second Order Cybernetics

If we can no longer be on the outside looking in, then there is no one outside the system able to explain discrepancies in the transmitted and the received messages – no communication can be controlled by an outside controller. We have no way of knowing if information is conveyed accurately. Information itself becomes a slippery concept; whose version of information are we talking about? Both listener and speaker recognize that, as Maturana (1988, p. 27) points out, “everything said is said by an observer,” which means that nothing can be said as an unambiguous statement of fact, everything said is colored by somebody’s history (see also Maturana, 1987). Nothing is said as an absolute truth “but as an *invitation to orient* in a particular manner - and no more” and those habits of orienting “depend upon (inter-) personal history (based of course, on our initial biological structure) - and no more” (Donaldson, 1992, p. 6, emphasis in the original). In the same way we could say ‘everything heard is heard by an observer’ because everything heard is heard through the filter of a life. As Brier says, “communication of information” has given way to “jointly actualized meaning” (1992, p. 3) where we “give meanings to the utterances we perceive others to have made” (Glanville, 1995, p. 48). Information, in this view of the world, does not enter us, it is constituted by us.

In recognizing that by communicating with others in a system we negotiate and constitute meaning, and that by being *of* the system we change and are changed *by* it, we are inevitably led towards the idea that there is no pre-existing reality, but that we create this world of ours by living in it. The world is not being revealed through our enquiry but constituted by us, through the particular questions we ask and those we don’t ask, as we change and are changed in constant feedback/communication with the environment, each other and ourselves. As I describe, through my life history, what I observe, my observations become my construction of reality (Glanville, 2001). This realization is one of the major implications of a cybernetic view of the world. We are observers and as observers we describe *one* domain of reality while being aware that there are many domains of reality. In this paradigm there is no one ‘right’ view of the world, no possibility of objective commentary on a fixed reality. Likewise there is no one system but as many systems as there are people doing the observing (see Dell, 1985; Efran & Lukens, 1985; Efran, Lukens, & Lukens, 1990; Maturana & Varela, 1992). Thus circularity, feedback and communication, which are central to cybernetics of cybernetics, (which has now once more become known simply as *cybernetics*) lead inevitably to a reality that we construct in constant feedback and communication with and in an environment.

System and Environment

At this point I need to introduce two common terms that are used in a specialized way – system and environment. *Systems* can be non-living like a bicycle or a house; living like a single cell, or a person or frog made up of many cells; or social systems like a club or an organization. The literature discusses two major ways of conceptualizing such systems. The first conceptualization considers a system in terms of a whole and its parts; the second conceptualization considers a system in its environment. A parts/whole perspective implies hierarchy, that is, parts within a whole, and parts can be wholes that have parts, within an ever-receding system. Or as Glanville (2001, p. 14) says, “a part is a whole in a role.” A parts/whole perspective can be useful for examining non-living systems, however, it can be difficult to examine living systems in this way because they may no longer be living if taken apart for examination. The biologist Bertalanffy (1968) suggests that systems can also be viewed as networks of relationships in an environment. He says that parts of a system should be understood in the context of the whole. In this view of systems properties of the whole “arise from the interactions and relationships between the parts” (Capra, 1995, p. 15). These interactions and relationships occur within the whole. They constitute the whole as that particular whole. Such a system, far from being understood if taken apart, would cease to exist if taken apart. In this interdependent world the notion of a linear hierarchy disappears in favor of the circularity of an interacting whole. With the notion of circularity it is easy to see why cybernetics sits more comfortably with a system environment way of carving up the world than with the hierarchical system of parts and wholes.

Significance of a System and Environment View of the World

If I create the world by living in it and I see the world in terms of system and environment, I must also create the system and environment. Again, the implications are far reaching. I can draw boundaries for systems and environments wherever I like. I may see myself as a system in the environment of my family or my work or my local ecosystem. Another member of my family, my work or my ecosystem will not be able to make the same distinctions as I do, the distinction that separates my system from its environment. They will make their own distinction and will *be* in a different environment, if only because theirs will include me. I may also, of course, distinguish my family as a system in the environment of my community, or my ecosystem in the environment of the country’s ecology. The universe is an environment out of which I can carve many systems. A system jumps out from the background environment when I notice it as a coherence against

the background noise. It may be, for example, that I notice that car drivers are becoming more aggressive, this is a difference in the normal pattern of events, it jumps out from the background of car driving. I give it a label, *road rage*, identify conditions in which I think it occurs and talk about it. *Road rage* becomes a phenomenon, soon it is seen, speculated on and written about around the world. The distinction I made (road rage/other driving) arose from my own “interests and values, personal history, emotions and *cognitive capacity*” (Parra and Yano, 2002, p. 80, italics in the original). Having made this distinction the system I have identified becomes information to me. The information did not belong to me independent of the phenomenon, I had to notice something, a difference, for there to be any information to know. Nor did it belong to the phenomenon, which did not ‘exist’ until I distinguished it from the background environment. The information, and associated learning, arose in interaction/communication between living system (in this case me) and environment, it belongs to us both, created somewhere in the space between us, an idea that I shall come back to later (Glanville, 1999).

Through a cybernetic lens a particular system and a particular environment do not have an existence as system and environment until I, the observer, distinguish them from background noise and define them as system and environment. This idea of noticing a difference is, like circularity, central to cybernetics. Once we distinguish something from the background as different it becomes information to us, or what Bateson (1972, p. 381) calls “a difference which makes a difference.” We learn something new, and in the learning we change the phenomenon as we bring it into focus, provide it with attributes and communicate our observations to others, and we are changed by it, as it becomes part of our lives.

Change as Learning

This brings us to one of the major implications of cybernetics for learning. Circularity, feedback and communication - with all of its negotiations and hit-and-miss potential - imply change. They take place over time in a constantly changing environment. We change the environment by being part of it and are changed by the environment through feedback and communication with it. In a cybernetic view of the world, we living systems do not adapt to the environment as in the classical system-environment model (Krohn, Koppers & Novotny, 1990), but through our history of interactions over time both system and environment change as we find ways to ‘fit’ together. Maturana and Varela (1992) argue that evolution and adaptation, which they say are the terms used by an observer to describe our history of finding ways to fit together, our co-history of change, happen to individuals nanosecond by nanosecond over lifetimes and generations. This means that in the

process of living we change, and our whole mind/body is changed by the people, environments and ideas with which we come into contact. According to Maturana and Varela (1992) this change is learning. Even if the change is infinitesimal, it becomes part of who we are and, in turn, who we are affords changes in our environment. Thus, everything we do and say contributes, however minutely, to the making of the future of our universe.

However, each living system is structurally different; therefore, each living system will find significance in, and be changed by, different triggers in the environment. Brier (1999) says that for something to be seen as information it has to be relevant to our survival. He also points out that for it to be relevant to survival, in biological, social and/or cultural terms, it must in some way be anticipated by our mind/body otherwise we would not ‘know’ it was relevant. In other words, learning is fundamentally about survival, about living; we can only recognise in the environment and take from the environment as information, something that we, in some way, already anticipate through our whole mind/body structure. We can’t notice a difference unless in some way we are already prepared to notice it.

We anticipate out of what our bodies already know and our anticipations allow us to ‘fit’ or ‘not fit’ with the environment. This view of learning as the recognition of something, information, in the environment that is anticipated and relevant to survival, has consequences for the traditional view of what constitutes learning and how learning takes place. Maturana and Varela (1992) argue that learning takes place not by taking in information from the environment but by going on living in the environment, mutually adapting and changing. They propose that this is what we call learning and provide a definition of knowing as effective behaviour in a context. They suggest that as long as we are learning we are also living. We either live/learn together or we part company or we die. Knowledge is neither out there, to be ingested, nor totally inside us. Freeman and Núñez (1999, p. xiv) say that the “mind is not restricted to the brain or body but extends out into the world” and “the mind is a seamless fabric of inner and outer experience.” In this way, they argue, learners incorporate the world into their being through experience. Learning is constructed in communication – in the relationships we build and the connections we make – with our environment, which includes other living systems. In this view, knowledge is not formed by the senses taking information in, but as a whole body changing in dynamic reciprocal interaction in an environment. In fact, learning may be more accurately described as engendering knowing rather than some kind of static, stored knowledge. In this cybernetic view of the world it appears that learning happens to us as we communicate in an environment. It enables us to go on living.

To Summarize

Above I have identified what I see as the fundamental principles of cybernetics. These principles can be summarized as follows.

- We are all observers.
- As observers we are always embedded in a system and cannot claim an outside view.
- We observe through the lens of a life history and our observations cannot be other-wise because we only have this one mind/body and this one life history out of which to observe.
- As observers we notice differences, make system/environment distinctions; different observers make different distinctions, notice different differences, carve out different worlds from the background 'noise' that becomes *information* to us.
- Information does not reside in the observer, system or environment, but arises in the process of living *between* the observer and the system/environment.
- In constant, communication and feedback we change our carved out world and are changed by it, with or without the intention of changing and being changed.
- This change is called *learning*.
- Learning arises from the need for survival – in social, economic, cultural or physical terms – and enables us to go on living.
- Learning is triggered by the environment, fits within our life history, will be anticipated, and will be different for everyone.
- We are all observers observing in a system.

The above summary provides what to me are some interesting answers to the questions with which I began: What is learning and why do people learn?; Why do they learn this and not something else?; How does learning happen?

Implications for Teaching

Although this model suggests that learning is triggered by the environment, happens to us continuously, and is not necessarily what anyone sets out to teach, formal teaching in educational settings is nonetheless an integral part of our way of life. As part of the environment of living systems, teacher and teaching become part of who we are.

The above answers to my questions about learning suggest particular ways of understanding teacher and teaching that may be useful in constructing effective learning environments. For example, if learning is change and change is the continuum of living, then teaching, within the particular environment in which it is embedded, is

about fostering changes that will take students along a particular life trajectory. If people learn/change through a need to survive then teaching has to satisfy the survival needs of many individual students. If learners learn this and not that because they take from the environment whatever fits with a life history, and can be anticipated in some way, then teaching is about constructing diverse environments so that many learners can find ways to fit. And if learning happens in communication with an environment that includes self, artefacts and other living systems then teaching is about providing many and varied ways for communication to occur.

Teaching as Fostering Change

Teaching, viewed through a cybernetic lens, is about fostering changes that will move students' lives along a trajectory that connects with the society in which it is embedded. Whatever we do, our students and our selves will change in the encounter. However, we cannot directly *cause* change or 'input' our knowledge into students. The only thing that we can do to foster change is create environments in which the changes we wish to occur have a chance of occurring; environments in which students find ways to fit. Since we are part of the learning environment we are confronted with the prospect that whatever we contribute may become part of the being of others. Therefore the multi-media text that is teacher (Murray, 1999) is a powerful part of student learning. A teacher who sees the world through a cybernetic lens will be aware that we teach who we are, and students learn the implicit messages of our being and acting in the classroom just as we learn theirs. To invite relationships that connect learners to the learning environment and immerse them in a particular world will require all of the teacher's enthusiasm, knowledge, curiosity and energy. Such learning environments will provide a range of options for explaining concepts, demonstrating, modeling and relating to students, any one or combination of which may trigger learning.

Teaching as Contributing to Survival

Teaching, through a cybernetic lens, must communicate something relevant to survival in the student's particular social, cultural, technological, economic and political environment. Students' survival needs will be many and varied. Some, for example, will be related to their place in the social system, some to their families and some to their place in the wider world and their hopes for the future. Their survival needs will grow out of their past histories. Thus teaching and teacher have to assist students to make links with their own histories and enable them to anticipate the learning through connections with past experiences.

Survival, however, will also be operating at a more intimate level in the classroom. In our teacher/student interactions all involved will be 'reading' the situation, striving to maintain 'a stable state' through minute-by-minute decisions. Student survival at any minute may or may not be linked to whatever the teacher is teaching. If the classroom milieu is an unknown, students may not be able to find ways from their past histories to 'fit'. In this case they may 'depart' for another environment. This could be by creating change in the environment, making some part of the environment familiar, withdrawing into thoughts, or physically relocating. Just what it is that threatens the student's survival may depend on where in Maslow's hierarchy of need that student is operating. For some it could be the daily struggle to find the basic necessities, for others it could be building esteem of self and others. Whatever the actions they cannot be otherwise at that moment in time, and are, from the point of view of the mind/body living system, entirely logical.

This view of how the world works provides teachers with different options for dealing with what they might see as inappropriate responses (or behavior). Rather than actions that may increase a student's need to 'depart' the environment, because in some way it threatens their survival, teacher actions can be directed towards understanding student responses. In a 'cybernetic classroom' the teacher, rather than paying attention to controlling a student's response – something that would appear from the above discussion to be impossible – instead pays attention to understanding the history out of which this logical response arose.

Of course, the teacher too is a living system and part of the classroom milieu, making minute-by-minute survival decisions. Those decisions, made within the context of feedback and communication in the classroom environment, will depend on the teacher's life history. Reading the classroom world is important to survival in it for teachers as well as students (Murray, 1999).

Teaching as the Construction of Environments

If there are no direct inputs of information through the senses for storage in the brain and we cannot directly cause learning then construction of a learning environment is all that we, as teachers, can control. The learning environment includes teacher, artifacts, texts and all communication. Thus teacher preparation, including reflection on past experiences, rehearsal, and thought given to teacher/student communication scenarios are important ingredients of successful learning environments. They will extend the repertoire of what Schön (1979, 1983) refers to as *reflections-in-action* which he says, are the tacit theories that guide the moves of practicing professionals in second-by-second decision making.

If learning is triggered by the environment and we connect with the environment in idiosyncratic ways, then it is essential to provide as wide a range of potential 'triggers' as possible and many ways of connecting with the learning environment. A wide range of artifacts and texts may be necessary as well as ways to connect with them including discussion, hands-on experiences, reading and reflection, providing many ways into the world in which the teacher hopes to engage students.

There will, however, always be numerous other ways in which students can connect with the stream of living/communicating afforded by the total environment, only one small part of which can ever be consciously set up by the teacher for *teaching* a particular idea or skill. What stands out from the background noise for one student may be different for another. Hence students may or may not learn from the environment what it is that others wish them to learn.

Teaching as the Creation of Opportunities to Communicate

In constructing learning environments that include multiple ways of engaging with the materials, teacher and other students, teachers facilitate learning through communication, through the relationships built, with self, others and artifacts. Building and maintaining relationships that allow people to communicate freely is therefore an essential part of the teacher's role. An awareness of cybernetics will heighten awareness of the communication options afforded by the environment and sensitivity to the ways in which communication, as part of the environment, supports learning.

The integral nature of learning and communication indicates that one of the ways to increase the likelihood of learning is to maximize opportunities for communication with self in reflection and others in discussion. Just as the teacher may benefit from reflection and rehearsal so too may students. Because different parts of the learning program will resonate with different students in different ways some will need time to reflect on and rehearse ideas while others will need time to reflect on and practice know how. Time for both kinds of rehearsal and reflection therefore would seem to be important. If communication is a whole body endeavor, multiple ways of relating to the environment through a variety of activities would also seem to play a part.

Concluding Remarks

A cybernetic view of the world suggests that the only environments that exist at any moment are the inside mind/body learning environment of the living system, which has been shaped by the living system's

history of interactions, and the immediate outside environment with all that it affords. The only possible learning that can occur is learning contingent on these two environments as the living system fits with the outside milieu and through communication with artifacts, self and others reorganizes its internal 'gnolocopoeia' (Murray, 2002) until we are once again comfortable with our world. Knowing something about cybernetics may not change your view of what constitutes good teaching but it may provide a different and interesting explanation for why a particular approach seems to 'work' while another does not.

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