

A Cybernetic Approach to Contextual Teaching and Learning

Philip Baron • University of Johannesburg, South Africa • pbaron/at/uj.ac.za

Sidebar: Educational research concepts in second-order cybernetics

Context: Public universities in South Africa are currently facing the challenge of decolonising knowledge. This change requires a review of curriculums, as well as teaching and learning with the goal of embracing the epistemology of the learners, addressing issues such as social justice and transformation.

Problem: Human communication is subject to several perceptual errors in both listening and seeing, which challenges the success of the communication in the education system. The ability of the teacher and the learners to effectively communicate with one another is a factor for the success of each reaching their goals. The teacher imparts her knowledge in the classroom, but according to von Foerster, “[i]t is the listener, not the speaker, who determines the meaning of an utterance”, for the listener contextualises this information based on her own past lived experience. Thus, the student’s epistemology and her expression of her understanding is integral in the classroom context and should be actively included into the education system.

Method: I present a cybernetic approach to the teacher-learner system, challenging traditional ideas about the role of each actor within the system, with special attention given to Pask’s conversation theory.

Results: Early empirical findings suggest that a conversational contextual approach results in higher student involvement and better memory retention among the learners.

Conversational approaches that are epistemologically inclusive diffuse social problems where the student groups require their individual worldviews to be reflected within the curriculum. This reduces the friction of competing epistemologies within the education system, moving toward a co-created contextually-driven knowledge system.

Implications: Many educators would like deeper engagement from their learners but have not found a way to successfully engage the student group. A cybernetic approach is one method that can be adopted to remedy this. This is particularly useful in contexts where there is cultural diversity and impending social change.

Constructivist content: I address von Glasersfeld’s points on human cognition, linking it to Austin’s speech acts.

Key words: contextual approach, conversation theory, decolonisation of knowledge, education, epistemology, teaching and learning

“Fundamentally, a university is a community holding conversations about knowledge.” (Sir John Daniel 1998: 12)

Introduction

1. Government-funded public universities often account for major student enrolments, particularly in developing countries such as South Africa. In this once-colonial country, public universities still have entrenched colonial legacies. In 2015 there was a mass

mobilisation of students protesting for changes in the way in which education is dealt with. There have been unified calls for what has been termed the decolonisation of knowledge. This is borne out of the largely Eurocentric approach coupled with traditional educational methods within South African universities. There is thus a renewed focus on teaching and learning, and student experiences have become an important aspect when considering tuition, which is in keeping with international trends, as universities move to maximise the student (customer) experience. Governmental education departments have specifically called on educators to address new teaching paradigms. The goal is to enable teaching approaches that empower learners in achieving creativity, problem solving, higher-order thinking skills, reasoning, improved effective communication, interpersonal skills, public speaking, teamwork, and collaboration (Department of Education 2004: 16). These goals are not specific to the South African context, as it is obvious that these skills are favourable to any graduate. However, achieving these goals would require educators to carefully examine their teaching approach. Andre Du Plessis's comments regarding the South African education system are relevant:

“The way teachers have been taught and lectured, the factory bell driven school model and a too fully packed curriculum are some of the forces that prohibit alternative ways of learning. This results in the presentation of science and traditional teacher talk dominating the teaching space, i.e. a transmission model, as well as subscribing to a textbook knowledge teaching approach. The belief is that *‘If I have transmitted it, I have covered it and if I have taught it then my learners have learned what was taught’* which translates into a focus on teaching instead of learning.” (Du Plessis 2015: 4)

2. Du Plessis highlights pertinent oversights in the system, which are also present in other education systems. The first issue is the interpretation of terms. Presenting information is not teaching, and information is not knowledge. These sentiments are not new, for Ernst von Glasersfeld's point was already clear when he stated: “Knowledge is not passively received but actively built up by the cognizing subject” (Glasersfeld 1989: 162). Learning is biological adaptation, which happens incidentally in the context of the pursuit of current “need-satisfying” goals (Scott 2010). Thus, the “information transmitted model” and its associated absolute judgments vested in Shannon theory are problematic, with channel capacity being reliant on human memory capacity (Nizami 2011), as well as cognitive processing factors.

3. New styles of teaching and learning have emerged and teachers have had to become more professional in their approach to teaching, matching their approach to research (Laurillard 2013). The goals of many new teaching approaches are similar to the goals that the interdisciplinary cybernetic approach already provides, yet cybernetic approaches are either unknown or not understood. For example, early cybernetic approaches were the first emerging technology-based learning solutions that had already predicted future trends, such as Pask's (1975a, 1975b, 1976a, 1976b) conversation theory (CT), which has successfully been evolving since the 1970s (see Scott 2001; Harri-Augstein & Thomas 1991; Thomas & Harri-Augstein 2001; Laurillard 1993, 2013).

4. The conversation is the fundamental unit of enquiry for investigating human learning (Pask 1975b). It offers people the means for self-organising their own change (Thomas & Harri-Augstein 2001: 952). CT focusses on the architecture of conversations, the structures

of the interactions, the creation of knowing, and the evolution of perspectives (Pangaro 2001: 802). Pask (1976b), who has made the single largest contribution to this theory, had the aim of exteriorising the mental process of the parties to a conversation, which has specific benefits for the understanding of human learning. CT builds on the topics of memory and understanding and is thus fit for purpose in educational contexts, yet is largely unknown. Within most universities there is no scope for this paradigm in the teaching methods nor in the curriculums on offer, which rather favours a Western linear view (Baron 2014; Scott 2011). In turn, many educators (and students) have not been exposed to a cybernetic epistemology, even with the clear paths defined by earlier cyberneticians.

5. A recent pilot study comparing a traditional teaching method with one that adheres to a cybernetic epistemology (Baron & Baron 2015) provided a quantitative positive result. The results showed that with the introduction of CT, a 46% increase in correct test answers ensued. This result was not surprising. Being a university lecturer, I notice that many adult students have not learned efficient ways of managing their own learning – learning to learn. They have not found efficient methods to understand and verbalise their coursework, remain focussed in class, integrate their understandings of different subjects, conceptualise new theories by integrating them into their already present knowledge store – all features that CT can address.

6. Having incorporated a cybernetic approach into my lecturing style on engineering subjects, I have seen improvements in my pass rates, as well as improved evaluations of my methods from my students (who provide these evaluations *after* completing their modules). The projects and work standard have improved. But, most importantly, the ideas surrounding what it means to be a lecturer and what my role is in the class have changed. This is particularly important in a South African context where there is currently a shift taking place in the universities to decolonise knowledge. Adopting a flexible contextual approach that embraces the students' epistemologies within the classroom is a major requirement in decolonising knowledge, allowing for locally generated (contextually generated) information to be the trajectory of the curriculum. In an attempt to achieve the earlier stated goals in education with the backdrop of decolonising knowledge, I propose a re-examination of the roles of educators and learners within the education system, embracing a contextual approach. Moving from a reliance on hierarchical teacher-learner methods to one that embraces a cybernetic mutual learning approach is challenging. A new way of thinking about teaching and learning is required.

7. The purpose of this article is to provide educators with an awareness of epistemological aspects that are at play in contextual enquiries. CT is provided as a vehicle for embracing a variety of worldviews within a multicultural classroom for the purpose of inclusive teaching, learning, and innovative curriculum design. I have provided six principles of how CT may be incorporated into an education system. A contextual approach to teaching and learning relies on inviting the learners to contribute in an active manner in creating the scope for the learners' own contexts and worldviews. However, in order to work with learner contexts, an enquiry into epistemology and linguistic domains should be attended to, which follows next.

Historical narrations and their linguistic domains

8. There are many classroom teaching approaches available, but they generally all have one fundamental commonality: they require some form of human communication. As human communication is subject to several perceptual errors in both listening and seeing, there are challenges imposed on the success of the communication (Baron & Baron 2015; Glanville 2001, Maturana & Varela 1992). The challenge of accurate human communication gives rise to communication theory, linguistics, and so forth. The ability of the teacher and the students to communicate effectively with one another is a factor in the attempt of each reaching their goals. The teacher imparts her knowledge in the classroom, but as Heinz von Foerster reminds us that meaning is not transmitted in the conversation; rather, meaning is what the listener determines from what she hears (Glasersfeld 2007). Meaning is determined by the listener, as it is the listener who places this message into context in her own neurology based on her past lived experience.¹ For example, a person with no background knowledge in physics would probably not be able to follow the teacher in an advanced physics class. The prior knowledge and past learning experiences that a person has regulate how one interprets and understands new information. The worldview of a person is a factor in how new information is understood by the individual (MacIntyre 1987). The ability to innovate and extrapolate terms originates from the vast works that poets and writers have built up, to a point where it becomes formalised as an accepted societal standard for that society or culture (MacIntyre 1987: 392). Thus, the canonical texts form a foundation and justification system that seems unarguable, unless the arguments are made within the same frame of reference or epistemology. MacIntyre believes that these linguistic domains determine the way we carry out our laws, ethics, rationality, beliefs, and values. Our *weltanschauung* or even our cosmic order, as MacIntyre termed it, is dependent on our linguistic domain.

9. A person's use of language often translates to a different lived experience. For example, a member of the San Bushmen of the Kalahari Desert may share similar existential values regarding birth, death, and illness with a Westerner, however the reasoning and conclusions between these two worldviews might be different and incommensurable. From a biological perspective, Humberto Maturana and Francisco Varela (1992) explain how our experiences are mapped in our neurology, which in turn relates to how our thoughts produce our epistemology. With every person experiencing his/her life differently, there exist multitudes of worldviews.

10. The relationship between names and their evoked meanings are not common to all people. A traveller may use a proper name merely for directional purposes, almost in a way that may seem ignorant to the culture where that name has more substance than merely a label on a map. For example, a few years ago, if a European holidaymaker had to ask for directions to an airport, namely O. R. Tambo, but was not aware of the name change and reads off her outdated map "Jan Smuts Airport", it may evoke certain memories in the

¹ Past lived experience is the collection of past behaviours, memories, and understandings that a person has, including life experiences that assist in how a person interprets her world.

person who has a lived experience of the times of Jan Smuts and racial segregation in South Africa. The tourist may be inadvertently offending the local without having any idea of why this is happening. The *map* is not the territory, as Alfred Korzybski (1933) and later Gregory Bateson remind us. When early Spanish explorers were met by Native American Indians, there were some disputes regarding land ownership. The Spaniards believed in individual property rights, while the Native Americans believed in a common unownable land – as who could own something that was shared? Documents were signed that later were unfortunate for the natives as this new worldview started to take hold of their land (MacIntyre 1987). Thus, the natural course of events in one culture may be immoral or unthinkable to another culture.

11. Following this train of thought within a classroom context, it is an oversight to assume that a group of people sitting in a classroom will all understand the teacher's expressions and integrate this information into their personal worldview. Radical differences in meaning construction are taking place in the classroom irrespective of what the teacher assumes is taking place. This has implications for curriculum design, where educators often assume that students will simply understand the educator's use of language and constructs. Lev Landa (1971) was concerned with the way young people acquire logic and how they manipulate sentences, focussing on grammar and semantic constraints. He pondered the question of whether he was teaching grammar or logic. Landa concluded that he could not teach logic, rather the interpretation of logic, which is imbedded in the universe of grammatical transformations, which are themselves algorithmic.

12. The text and language style used in the textbooks are not excluded from this argument. Students often remember phrases word for word and position these phrases in the correct places in their test answer scripts, yet have no understanding of what these phrases mean, providing what I term "a wall of words." These words only seek to set up a boundary between the students and the very thing they are attempting to master. Pask (1976a: 99) describes this as unsuccessful comprehension, whereby learners are able to describe a topic and even its relations by deriving descriptions. However, upon deeper analysis, when the learner is asked to explain the topic or apply it in another way, she is unable to, as she comprehends the subject only in the sense of making a description. Understanding is different from repetition. Memorising information that has no personal meaning to the student does not serve her (or the educator for that matter). This concept is expanded on in the next sections with the discussion of conversation and meaning generation.

Human communication

13. Conversations provide a context for the human world and become the domain we inhabit, bringing forth our self-consciousness. As Maturana pointed out, our *linguaging* is our manner of existence.² Human linguistic communication has a purpose. John Longshaw Austin stated:

² Unpublished manuscript "Metadesign" <http://www.inteco.cl/articulos/metadesign.htm>

“Once we realize that what we have to study is *not* the sentence but the issuing of an utterance in a speech situation, there can hardly be any longer a possibility of not seeing that stating is performing an act.” (Austin 1962: 138)

14. Speech acts have been addressed by John Searle (1975: 5), whereby he provides five illocutionary points, namely assertive, directive, commissive, expressive, and declarative. For the linguistic communication between people to be effective for any of these five illocutionary points, several factors would need to be addressed: good communication skills such as attentive listening; listening with a clear mind; focussing on the current conversation at hand; and attempting to understand the other with the goal of sharing a mutually co-created world of meaning. An awareness of the other is paramount to achieving these goals. Thus, human communication goals include conveying a message to a designated audience, having this message understood in the way that it was meant, receiving confirmation of this information, and sharing meaning. Von Glasersfeld provides four points of how the listener may determine what meaning to attach to the communication:

- “1. Sounds must be recognized as sound-images of words that evoke associations.
2. These associations are, in fact, re-presentations of elements of past experience.
3. These remembered elements of experience constitute the material for possible meanings of the utterance.
4. Which of these possibilities the listener accepts, depends on the context in the widest sense including the listener’s familiarity with the speaker.” (Glaserfeld 2007: 354)

15. It is thus imperative to acknowledge that a person’s worldview arises out of their past lived experiences and that negating this worldview is also negating a person’s background, which is particularly relevant in the South African context in light of the decolonisation of knowledge. The dominant discourse (usually the teacher’s) should not be the only one on offer. I have addressed this concern in the classroom context by investigating the purpose of one’s position to a topic. For example, after presenting a new topic, I ask the students what this topic means to them. Will they be able to make use of this new information? Can they think of an antithesis to the topic? What can they add to this topic or how can they improve on it by linking it to their daily activities? One result of this approach is that it increases the variety of experience in the class, while also creating an open forum for participation and knowledge production grounded in the here and now.

16. In adopting a cybernetic approach in the classroom, a few cybernetic principles should be known by the educator. This is probably the biggest challenge for the educator as cybernetics is not a model. It is not something that can be learned and then applied (Baron 2014; see also the “Limitations” section at the end of this article). A way of knowing something is different from having knowledge of something. For example, I may have knowledge of the therapeutic counselling process, but that does not make me an effective counsellor. On the topic of counselling, which is deeply reliant on conversation and epistemology, psychologist Carl Rogers wrote several books that describe his humanistic approach. His teachings have been modelled and formulated into something of a “to-do list” for prospective counsellors, yet few can mimic his skill. The problem is that in his most prolific writings, he speaks more about *how* he was present in the here and now, rather than focussing on tricks for listening empathetically. It is the feelings of realness of the here and now and the *spontaneous* relational conversing, including personal meanings, that I believe

he was referring to. One of Rogers's books is actually titled *A Way of Being* (Rogers 1980). Ranulph Glanville (2012: 84) reminds us that cybernetics is something that is lived (in the sense of a verb), not just talked about. This means that the educator needs to change her way of thinking *as well* as her way of being/acting. A theoretical understanding is insufficient. Aristotle spoke of sophia arising from phronesis but also returning to phronesis. The theory of something and its practical example should not be viewed hierarchically, but should rather be viewed as equals, like sophia and phronesis.

I cannot *teach* you

17. In a traditional sense, the teacher “teaches” the students. There is a hierarchy in the system with teacher separate from the students, taking the position of the leader in the class. The teacher may speak individually to the learners, but ultimately the learners are seen as a group by the teacher. The teacher “teaches” and has the main responsibility for what learning should take place. During the lesson, the students may tell their own stories relating to what the teacher has spoken of, following which the teacher moves on with her lesson, usually according to a set lesson plan. If another teacher offered to take the lesson – from the same course file – she would probably offer a similar structure and epistemological stance, including a similar classroom setup.

18. From a cybernetic approach, it is the listener who determines the meaning of an utterance, and the listener's past lived experience is a major contributor to this meaning; thus, the listener's context is also of interest in the lesson and should be incorporated into the learning system. The teacher/presenter/speaker cannot create meaning in another individual; rather, the responsibility of generating meaning is in the hands of the person who hears/sees the message. For example, a teacher may introduce a new topic to a group of students – that of viruses and malware in computers. After the topic is introduced, asking the students what they understand about computer viruses will result in the teacher hearing several different versions of the topic, some with errors. These errors cannot be the sole responsibility of the learners for “misunderstanding” the teacher, as this would ultimately result in students failing the course. It is this introduction of errors that arise in human communication that makes a cybernetic ethic of participation a good fit, for without error there would be no need for cybernetics (Glanville 2012). The teacher – a problematic term itself – is part of the learners' environment and thus has to take some responsibility for her skill in presenting to the students. The teacher, however, is not solely responsible for the learning, as learning is an activity that the student and teacher do within each other's presence, mutually cooperating with each participant in the group but not necessarily under the rules of the teacher. Learning from the lessons of Pask (1975a, 1975b, 1976a, 1976b), the teacher would need to determine if the learners' understandings are within the range of her understanding of each of their understandings.

19. Cybernetics is concerned with circularity and mutual causality. Glanville states:

“The Principle (or Law) of Mutual Reciprocity states that, if through drawing a distinction we are willing to give a certain quality to that we distinguish on one side of the distinction, we must also permit the possibility of the same quality being given to that which we distinguish on the other side of this distinction: If I distinguish myself from you and I consider I am intelligent, I must consider that you (which I distinguish from I) might also be intelligent [...]” (Glanville 2008: 168f)

This principle explains how qualities such as intelligence may be understood to belong to both participants in an interaction, shared, *in the between* (Glanville 2008). In the classroom context, if the actors (teachers) are to think of themselves as having knowledge, so too must they allow the other actors (students) to have the option of having knowledge. There needs to be compliance/cooperation between the relational elements, with neither side thinking they are in control. Is there such a thing as power and control? Does a slave have no power? For example, in Hegel's (1998) *Phenomenology of Spirit*, he shows how the master and the slave are both required for each to individually exist. In the same way the sadist needs a masochist, a parent needs a child, an educator needs a learner. Von Foerster states: "the principle of relativity says that a hypothesis that is true for A and B can only be acceptable if it is also valid for A and B together" (Foerster & Poerksen 2002: 28). The teacher who sees misbehaving or naughty students should also see that this can be mutually reciprocal. What role has the teacher played in this situation where learners are misbehaving or not learning? Is the teacher also misbehaving? What influence has the teacher's own worldview had on the label of misbehaving?

20. For my students to think of me as a good lecturer, I need to co-create a classroom context where their observation of my behaviour gives rise to their experience of me as "good." This in turn means that definitions of behaviour are context specific. I may have one class/student who thinks I am a good lecturer but another who does not. The answer to the question "Am I a good lecturer?" lies in the observing person/group who draws this distinction. Being called a good teacher is an attribute. An attribute is something provided by someone else, as Alan Turing suggested. Turing (1950), in his paper "Computing Machinery and Intelligence", introduced a test based on his question of whether machines can think. This test is set up to determine whether a human can judge if she is interfacing with a human or a machine in a texted conversation. The person who makes this conclusion of intelligent interaction has no knowledge of whether she is interfacing with a human or machine. The beauty of this test is that it moves away from definitions of intelligent behaviour to a determination of whether the tester is engaging in an intelligent conversation based on her experience in the conversation. Turing does not assume intelligence to be the property of the machine; rather, in the way the test is set up, intelligence is attributed to the machine/box/other by the tester. The same applies for teachers. For a teacher to think of herself as a teacher, her students need to attribute this to her by acknowledging that learning is taking place.

21. In CT, Pask is concerned with processes rather than processors. Processors could be seen as the fabric, the physiological or biological stuff of which we are constituted. While the biology is important in knowing how cognition impacts communication, Bateson (1979: 204) reminds us that "[t]houghts can be about pigs or coconuts, but there are no pigs or coconuts in the brain." Louis Kauffman (1987: 56) states that when a distinction is drawn, "A space is severed or taken apart. Form appears in the process, and the form appears to enter into or re-enter the very space that generated it." This highlights the importance of circularity in human communication. Owing to the circularity in the relationship, the notion of unilateral control is rejected. Observers or actors in a conversation are never outside of this system but are part of it, including their own observations and their observations of the other's observations, and so forth. Graham Barnes (2007: 74) says "I don't control you,

though I may think I do or wish I did.” Teachers need to move away from linear thinking – thinking that they are in control of their learners. With the cooperation of the learners in a given context, the teacher may feel that they are “in control”, but this is an illusion. The control is in the between, as Glanville (2008) termed it. This means that there should also be a mind-set change from hierarchy to heterarchy. The role of the teacher could also be seen as a steersman or a variety regulator. According to Pask, “the main point of conversation is the converse of control. It leads to deregulation.”³ New questions arise from this way of thinking and acting: how does the teacher take responsibility in class? How do the learners show their responsibilities? How do you know learning is taking place, and so forth? What is interesting is that many people mistake a “what” for a “how.” To answer a “how” question, it is important to focus on process, who is doing what and what steps were followed.

22. Referring back to Searle’s (1975) illocutionary acts, the teacher may think she is being directive – trying to obtain action from the listener by use of requests or commands – but it is up to the learners to provide their frame of reference to the teacher’s utterance. One of the reasons for conversation is that it generates difference – a forum for clarification, which is close to the nature of learning. Included in the conversation are themes of recognition and respect, with meaning being negotiated within the context of a conversation (Thomas & Harri-Augstein 2001: 952). Although the conversation is between systems that are organisationally closed or autonomous, they are open to information. It is the differences or conflict that arise within conversation that allows the actors to converse, for in the hypothetical scenario of two people with the same knowledge and thought pattern, no basis for communication would be present. Thus, the differences that arise in conversation are in fact the reason for the conversation (Barnes 1993). It is through resolving these conflicts in the classroom that understanding, rather than rote learning, can take place, for learner and teacher are in conversation with each other. Without the conflict, there would not be the opportunity for cooperation, which is one of the behaviours the teacher requires for learning to take place. Notwithstanding that the teacher may also be learning from the information she receives from the students – each perturbing each other in a circular manner.

In practice: A contextual approach to teaching and learning

23. The basis for a contextual approach is embodied in the recent student protests in South Africa with the requirement for social justice, creating scope for the inclusion of the learners’ epistemology into the education system. The reader may be wondering how this may be implemented. I propose six principles as follows:

- a. Create a scope for the learners’ own experiences of their world by inviting each learner to actively participate in knowledge creation.
- b. Adopt a heterarchy over a hierarchy by allowing the learners to become co-creators in the classroom.

³ Pask’s inaugural address “Conversation and support” at the University of Amsterdam, 1987.

- c. Invite the students to discuss their aims, goals, and learning styles.
- d. Set the students' own context and experience of their context as a trajectory for the class's learning outcomes under the co-direction of both teacher and students.
- e. Merge this new information into the curriculum, creating syllabi that are personally relevant to those who attend the class, derived from either implicit or explicit student involvement.
- f. Address the responsibilities that emerge from this communally created knowledge, also measuring its fit for purpose in allowing the students to reach their long-term educational goals in partnership with the needs of industrial partners and other professional organisations/accreditation bodies.

These six principles are exemplified in the following sections starting with Pask and Bernard Scott's teachback method.

Teachback

24. Pask and Scott's (Pask 1970, 1973, 1976a; Scott 2000) teachback is a method in which, after the teacher has presented to the learners the topics of the learning outcomes, the learner is invited to teach back her understanding of this material to the teacher in front of her peers. When the learner teaches back her interpretation of the new concept/s, she is providing a glimpse into her world of understandings, but more importantly, how she arrived at these understandings, including her mental processes. Teachback allows the teacher to assume a neutral position by adopting the role of the student and asking the learner to provide an explanation of her own for the current topic. This also allows for a measurement of the teacher's impact within the system.

Teachback as a content contextualiser and curriculum informer

25. As a person's knowledge is dynamically stored in her head,⁴ using verbal mechanisms to gain entry into this person's knowing allows for a more flexible and rapid enquiry than do written works. The teachback informs the teacher of curriculum changes in a dynamic format. For example, in an electrical engineering class, we were discussing waves and resonance. Having heard previous stories during teachback from students about how they understood magnetism and current in terms of their music system and various disc jockey (DJ) endeavours, I positioned the concept of resonance in terms of subwoofers and how the rearview mirror of a taxi/car on certain notes has excessive vibration that stands out with certain frequencies of the bass rumble. The students had personally experienced this and

⁴ Knowledge and knowing are different. The difference lies in that knowing requires a knower and is tied to context and observation. Thus, there is a dynamic process implied here with the expression of one's knowledge, which could also be described as the re-computation of such knowledge becoming one's way of knowing, as one's own unique neural patterns modulate this knowledge.

thus could make sense of this explanation of resonance. Taking this further, by knowing about popular DJs (matching the students' tastes), I could add the names of different DJs to the explanation and discuss (and play) parts of songs and their bass lines. Discussions of the audio amplification ensued, including how the amplifier works harder (higher power consumption and heat dissipation) for hard house music (higher beats per minute) than for deep house (lower beats per minute), which then introduces the topic of power supplies and so forth. Thus, the teacher hears contextual information that the learners provide, which the teacher can then use in future explanations, allowing for this information to be framed in a manner that has personal connections to these learners. The classical example in engineering textbooks on the topic of resonance is that of soldiers marching over a bridge. This example is important, but no student in my 12 years of teaching has ever seen soldiers walking over a bridge, and thus it is an abstract example. For the learners to have a sense of immediacy and personal associations to the topic, I use the information from their teachback to personalise the topics (implicit approach).

26. The teachback allows the teacher an opportunity to enter the students' contexts. For example, in my protection engineering class, while we were discussing lightning protection and earthing, a student asked if tyres placed on the roof of a shed reduce the incidence of lightning strikes. I have not seen literature on this issue and common sense suggest there is no logical basis for putting tyres on the roof of a shed for lightning protection. However, I was intrigued by just how this student arrived at this question and thus invited him to tell more about the context. He described shacks – and not sheds – in an informal settlement and how he had been told that rubber tyres on the tin roofs reduce the incidence of lightning. This contextual information opened the door to an important discussion. It adjusted the entire trajectory of the topic, as many students started asking questions linked to this “daily life” challenge. Questions such as, “Would bathing in a steel bucket also be dangerous even though the bucket is not touching any other steel?”, “If I am touching the metal side of the shack when I am sleeping, would I get a shock?”, and “How can one construct a shack to take into account lightning?” Would these students have asked these questions if I had simply answered the student's original question with a “No, tyres do not stop lightning strikes on a shed”, stripping the class of the openness to introduce contextual information into the topic? Through invitation, communal discussions allow for contextual experiential information to enter the classroom.

Teachback as a form of social learning

27. Albert Bandura (1973, 1977) and his work on social learning theory (SLT), including vicarious learning, has led researchers to find that peers are an important aspect in the learning system. Students are interested in hearing what their peers think. One aspect of SLT is identification. When the viewer/listener can identify with the speaker (during the teachback), the influence of the speaker is thought to be stronger, and thus peers may also act as teachers. The teacher can also use this aspect to her advantage by thinking in terms of Ross Ashby's (1956) law of requisite variety. What this means is that if the teacher is able to create a context whereby the students (or most of them) can identify with her, she has a better chance of influencing their learning. This links to von Glasersfeld's (2007) earlier point regarding how learners attach meanings in communication when there is familiarity

with the speaker. To achieve this, the teacher would need the variety in her knowledge base. For example, having knowledge of topics that interest students does help. I have found music, technology, sports, and politics to be popular.

Teachback as a form of error exploration

28. During teachback, the learners will also tell stories that show a misunderstanding of concepts. It is important for the actors to see how others created their interpretations. Merely correcting the student robs the whole system of exploring the learning process. Von Glasersfeld (1992) claimed that people need to be allowed to make sense of their experiences for themselves, which the teacher needs to allow before attempting to modify or correct. This allows the teacher entry into the learner's world to see how the learner is interpreting the teacher's information. If the teacher corrects the learner immediately without exploring how the learner came to make the mistake, how will the teacher know that a lasting correction has taken place? Thus, by exploring the grounds for the error, the teacher may also determine the gaps in her teaching, determining common areas of misconception. This also forms a type of measurement for the teacher.

Teachback as a form of language practice

29. Many students experience barriers both in their verbal and written forms of communication. Teachback may also be used as a language tool and public speaking forum whereby the students may practise grammar, syntax, and public speaking in the presence of their teacher. This links to the earlier stated challenge that Landa (1971) encountered. I thus invite the learners to make use of conversational learning as a language tool. In Milton Erickson's (Haley & Erickson 1973) progressive therapeutic solutions, he took the approach of "prescribing the symptoms." Erikson would prescribe the very thing the client was battling with. If a person was experiencing insomnia, for example, Erikson would prescribe a night of staying awake at all costs. The results were surprising, as once the client had a different focus, one of trying to stay awake instead of sleeping, they became relaxed and fell asleep! In the classroom, students may be shy or fearful of making errors, especially in front of their peers. By prescribing the symptoms early in the semester, I have created the scope for the learners to use a conversational approach in the classroom, thus creating a grammar practising ground.

Curriculum design as an ongoing conversation

"It's not what you look at that matters, it's what you see." – Henry David Thoreau (2006: 102)

30. I have noticed that many educators confuse the terms *syllabus* and *curriculum*. This may be due to the many definitions for the term *curriculum*. My understanding of curriculum rests on Robert Ulich's definition:

"A curriculum, or a program of studies, represents an attempt on the part of educational institutions to provide a learning person with a coherent sequence of impressions, exercises and cognitive subjects by virtue of which he can participate consciously, conscientiously, and productively in the cultural development of the nation and of mankind as a whole." (Ulich 1967: 12)

31. While the scope of Ulich's definition is wide, it reflects the important cultural aspects that underlie education as mirrored in Lev Vygotsky's (1978) social, cultural, and historical aspects of learning. Educators frequently fall into the trap of designing curriculums as a form of control over the learning process (Lewis & Pask 1972: 7). Too often educators create curriculums based on "what was done before", adhering to some body of knowledge or layout that has become dominant at their university (Lewis & Pask 1972: 7). Design of a curriculum should be a conversation (Dubberly & Pangaro 2015: 74). When I became aware that the design of a curriculum is a form of communication with the learner, a shift in my thinking and acting took place. I became aware that I was entering a conversation with the learner and that my design set out a restricted conversation. The students were not reflected within *their* curriculum. I was thus creating curriculums in a vacuum in a sort of behaviourist approach, making assumptions about what the learners' goals might be. It was like I was taking the role of a biologist who is conducting an experiment on animals in a laboratory, viewing my objects of observation as external and independent from me. B. F. Skinner's (1968) radical behaviourism is still a major influence in the education system – for good reason, as behaviour-shaping methods are of great use to many learners both young and old. In the case of remedial education, behaviourism is highly beneficial in rectifying specific learning deficiencies (Meyer, Moore & Viljoen 2008). However, in terms of higher education, with the goals of innovation, creativity, problem solving, and independent thinking, a behaviourist approach may be restrictive. I am aware that this is a harsh view and that there are much newer behaviourist approaches, but if the receivers of the curriculum are not reflected in the curriculum, it probably also means that the syllabus is impersonal and epistemologically polarised. The educator is communicating both explicit and implicit, or tacit, aspects in the curriculum and portraying her own worldview in her design. I do not wish to have conversations that are restrictive and exclusive. Paul Pangaro sums it up with his critique of "personal computers", which is fitting:

"If I were sitting in front of you now in a human-to-human conversation and responding to your question, should I give you the same answer I would give anyone else? Should I give you the same answer no matter what the previous question was? Shall I just ignore what I have observed in our previous conversations about what is an effective conversation with you?" (Pangaro 2001: 793)

32. There is a feature missing in the design of curriculums, to which Pangaro alludes. The missing feature is personalisation. If educators expect their learners to move through the system like cattle, how can they also expect these same learners to reach the goals of higher-order thinking, self-reflection, innovation, problem solving, and creativity? I have shifted my focus to curriculums that are designed to encourage problem solving and participation, whereby the learner may take responsibility for her own learning, all while I acknowledge that there are differences between my goals and the learners' goals. I challenge the students to answer questions such as:

- If you had *any* three wishes, what would you change about this module?
- If you were given the opportunity to present this module, how would you do it differently? Why?
- In this class, what have you liked and disliked so far?

Designed for openness: Universe of interpretations

33. Thinking of how to personalise modules need not be challenging. Invite the learners to participate in the curriculum design by opening up the conversation during the design phase, or let the design be an ongoing, dynamic feature. In the same manner that knowing is a dynamic recomputation of knowledge, so too may the curriculum reflect ways of knowing. Allow the students to take part in relevant staff meetings regarding curriculums. The curriculum can also be seen as a teaching strategy, as Pask (1976a) noted. One goal of CT is varying the method used in navigating the course content, as the individual cognitive styles of the learners are not uniform, thus students should be given the scope to learn with their own style (Pangaro 2001). For instance, in my computer networks class I have opened up several aspects of the curriculum to the learners, including the assessment methods and dates, parts of the content, and duration of each class. Through classroom conversations the students have provided learning outcomes and overarching goals they would like to achieve in their module. For instance, they selected an assignment as one assessment method. The topics of the assignment directly address the learners' interests. I would not have thought of including topics such as wearables (smart watches, activity trackers, etc.), networking in online gaming, and the dark web into the syllabus. These ideas came from the students, who when given the opportunity provided good topics. With a bit of steering these topics could easily be part of a computer networking curriculum and thus were fit for purpose. The students all passed these assignments on their first attempt as they were personally interested in undertaking the research. Students moderated and corrected their peers, as they had become "specialists" in these topics, including providing a high level of attention during their peers' presentations. The topics were personally relevant, but most of all there was a shift in ownership and the associated responsibilities. The reader may be wondering if the students genuinely opted to present their work in front of their peers. This was my steering. I asked the students how they will get jobs without formal interviews, how they will make presentations in their working lives. I frame the presentation as a training ground, challenging the students to allow me to act as a coach for presentation skills. They agree, and this becomes part of their assessment. Convincing the students to present in front of their peers may seem easier said than done; however, if I genuinely care about the learners achieving their goals (for example, being employed after graduation), they in turn cooperate and provide a high level of commitment.

34. During teachback the teacher hears the learner's ideas about the concepts and what meaning she has attributed to the content. Thus, the teacher becomes what I term a "creative contextualiser": a person who finds interesting techniques for placing the important curriculum knowledge areas in the territory of the learner's backgrounds so she may integrate this new content and understand it in a personal way (implicit student involvement). The reverse is also applicable whereby as a group we introduce the learners' context or challenges into the course content, creating new locally generated knowledge (explicit student involvement). The learners who are now co-creators in the class have a sense of responsibility and immediacy as it is their content, too. The teacher needs to adapt

to the idea of individual learning differences. This introduces the next topic on learning strategies and attention.⁵

Learning strategies, attention, doubt, and innovation

35. Each student has her own unique learning style and learning strategy. Learning style refers to the differences learners demonstrate in their willingness to adopt a learning strategy and how efficient they are in executing this strategy. The outcome of mismatching a teaching strategy (imposed on the learner) and a learning strategy (adopted by the learner) results in “high magnitude impairment” (Pask 1976a: 121). Too often, students’ learning strategy is based on the teaching style of the instructor. The teacher in her manner of teaching is not only conveying information, she is also conveying a learning style owing to the nature of how the syllabus is laid out and presented. For example, I have found many students battle with mathematics. Upon further investigation I observed that many teachers ask the students to do the most difficult sums for homework. Most students were unable to perform these sums, spending hours on only a handful and still not getting a good result. The students have assumed that their learning style should match the teacher’s teaching style. The students in this case had not learned to learn and develop their own style, taking responsibility for their own learning. Diana Laurillard (2013: 12) notes that there are no professional training requirements for university academics in terms of their teaching competence, and there is still little research on tertiary student learning styles. By allowing for student involvement in staff meetings, where student representatives have a voice regarding the teaching strategies, these issues were uncovered.

36. Pask (1976a) noted that the goals of the learner are paramount in the learning process; hence, the teacher needs to work with the learner’s goals. Sadly, little effort is put into the manner in which university students handle the goals of a learning situation (Laurillard 2013: 58). Howard Gardner states:

“It is our claim that the capacity of individuals to acquire and advance knowledge in a cultural domain and apply it in some purposeful fashion toward a goal has equally to do with the competencies inside a person’s head and with the values and opportunities afforded by society to engage these competencies.” (Gardner 2006: 198)

37. Aims are what are linked to goals as the milestones that the learner incorporates in attempting to reach her goals. In this sense, *goal* is defined as the end destination, while *aim* is the determined path. The aim(s) stand in as a proxy for the learner’s attentional focus. The type of attention a person incorporates as part of her classroom involvement is of interest to me, as selective attention and division of attention impact the ability of the learner to acquire and process the information in class. Students may sit in class offering pseudo-listening (a type of non-listening that consists of appearing to be listening), or what Edward Hallowell and John Ratey (2011) term *pseudo attention deficit disorder*. This challenges the learning system, as without attentional focus the role players will not achieve their goals. There is

⁵ Attention is defined in the way that George Kelly (1955) or Frederic Bartlett (1932) used the term, referring to a locus of awareness.

thus a lack of authenticity in this system. I may perturb the group by asking if they are okay with skipping today's class and wasting this amount of (their parent's/sponsor's) money, which may also be part of the students' goals of pleasing their parents. This is not only applicable to students though. A teacher too may be preoccupied and behave in a type of pseudo presence in class.

38. There are instances when students are not up for class. I have found these classes can be used as reflection times. Glanville (personal communication 2014) noted how people forget to reflect on their achievements or projects both during and after completion, suggesting equal amounts of time for both working and reflecting. Laurillard (2013: 58) believes that traditional assessments provide mostly unreflective feedback. Incorporating reflection times during class has resulted in students displaying critical thinking. By introducing doubt into the system, reflection may be sparked. A group of students had a submission date for their case study presentations. Instead of keeping to the scheduled plan, I initiated a general conversation about each of their topics on their submission day. I started by introducing doubt into the conversation by asking the learners to tell me if they thought they had solved the problem they were working on. After hearing their answers, I asked for their doubts about their own work. Students are often afraid to openly verbalise their doubts, however, with the whole lesson spent on this topic, critical reflection started to take place and obviously the teacher, who should be a specialist on the topics of the assignment, too perturbs the now knowledgeable students on their topics. With the introduction of doubt, antitheses arose, and what was most interesting was the challenges that the learners proposed to their peers while also acknowledging similar concerns in their own work. I asked the students if they would like more time to revisit their work. The success I believe is shown when the majority take this opportunity and opt for a revision time, with new submissions now showing a critical view of their work.

Listen and learn: Moving from hierarchy to heterarchy

39. For connectedness in conversation to take place, there needs to be a listener who wants to learn about the observations of another person. Glanville (2001) recommends keeping an open mind. How does one do this? I have attempted to address Glanville's request by taking a position where I see the other person as the expert. If I am attempting to achieve a contextual enquiry, then the speaker is the expert in her own life as she has lived it. I do not have the answers and thus need to get answers from the other, taking a *not knowing stance* (see Anderson & Goolishian 1992). Glanville's next items are willingness and tolerance, generosity and trust, followed by enjoying difference and supporting variety. Without a personal interest in the conversation and the views of the other, no new creative understandings can emerge. I, the teacher, am genuinely interested in finding out about the views of the students in my class; however, tolerance in conversations can be challenging.

40. I have become aware that every person has his/her own epistemology. James Griffith, and Melissa Griffith (1992) challenged mainstream psycho-therapy in how therapists could take responsibility and own their own epistemology. Hearing the beliefs of other people may challenge one's own beliefs. The classroom too can be a challenging arena. After years of teaching, I actually want to be challenged, as it makes the class more interesting and fun. I

do not want my own ideas and meanings to be the only ones on offer. Tolerance is needed to allow conflicting views to be present while being merged in my own epistemology. A great side effect of listening is finding out new ways of knowing. There are two items here, not just finding new information but also finding new thoughts in the lead up to how people form their understandings (their mental processes). Speaking does not mean joining the conversation. Listening forms the link for joining, as one can transmit information, but without a receiver, the transmitter is irrelevant. Cooperation does not mean the students doing what the teacher wants, rather the students taking part in the class and being *part of* rather than *receivers of*. Listening is a choice. Thus, a requirement in this approach is authenticity in focus. I ask myself these questions:

- Am I genuinely interested in the learners who are sitting in the classroom?
- Do I care if the learners do not achieve their goals for my modules?
- Am I prepared to challenge my own worldview and be open to other narratives and be open to learning?
- Am I prepared to match the variety that the students bring into the conversational spaces? (Am I prepared to do additional research into topics that are of interest to the student?)
- Am I expecting the students to pay attention, yet I am not?
- Am I creating a predictable context where the students can trust me?

If my answer is “no” to any one of these questions, it is time for me to take a break or change profession. These six reflection points, together with the students’ feedback, provide a measure of my own epistemologically sensitive approach to teaching and learning.

Limitations

41. There are challenges in modelling teaching approaches. People gravitate to modularising new information – looking for good examples – and then attempting to follow it in a duplicate manner. This may be acceptable for the introductory stages of learning; however, as in the counselling example given earlier, one cannot just learn stuff, regurgitate it, and expect one’s audience to be impressed. This person would surely not have sufficient variety in her options of behaviours. In learning cybernetics, one needs to move away from a model to a way of thinking and being (Glanville 2014; Baron 2014). One needs to step inside this paradigm and become part of this information process, changing one’s mind-set from information processing to meaning generating.

42. Conversational learning may be challenging when there are large groups of students and/or classroom layouts that are not conducive to conversation. Pask (1976b: 24) found 90 minutes to be the maximum teachback time. For university students who have many classes during the day, I have found 45 minutes to be appropriate.

43. Awareness of hearing disabilities is important for the inclusion of all learners in the system.

Conclusion

44. Vygotsky's (1978) central focus on learning was social, cultural, and historical, which forms a complex system of which one is a part. For Vygotsky, to understand learning, one must also look to the social processes from which a person's thinking is derived, while acknowledging the cognitive growth as a *collaborative* process since we learn through social interactions. This means that our investigations, including our studies on education, teaching, and learning, must include all the observers within the system and their socially embedded context.

45. CT has already added much to the field of education; however, it is still relatively unknown in the South African context. CT and tools such as teachback are major contributions of cybernetics. This links Aristotle's ideas about knowledge, merging the "knowing why" (theory/conceptual ideas) with the "knowing how" (practice or performance), and obtaining verification of this knowledge by allowing the students to participate in the here and now – as Rogers found most valuable. A contextual approach to teaching and learning implies an allowance for the students' own context to become a trajectory for the class's learning outcomes, making space for their own experiences of their world; merging this into the curriculum to allow for modules that are relevant to those who attend the class by creating a conversational scope for students' own examples; and allowance for a shared forum of discussion. In terms of decolonising knowledge, adhering to the approach presented in this article allows for the diffusion of social tension as the students' voices are not only heard, they are acted upon.

46. Learning begins with each student's aims or outcomes (Pask 1975b: 45). For the teacher to reap the fruits of *new* approaches in education, changes in the ideas surrounding responsibilities in the classroom are required. Von Foerster (1984: 61) says "If you desire to see, learn how to act." Viktor Frankl's book *Man's Search for Meaning* (Frankl 1985) teaches humanity that when meaning and purpose are tied to a situation, great things can be achieved. Find the student's reason for being in the class and work with it. The road becomes less rocky.

References

- Anderson H. & Goolishian H. (1992) The client is the expert: A not-knowing approach to therapy. In: McName S. & Gergen K. J. (eds.) *Therapy as social construction*. Sage, London: 25–39.
- Ashby W. R. (1956) *An introduction to cybernetics*. Chapman & Hall, London.
- Austin J. L. (1962) *How to do things with words*. Oxford University Press, Oxford.
- Bandura A. (1973) *Aggression: A social learning analysis*. Prentice-Hall, Englewood Cliffs NJ.
- Bandura A. (1977) *Social learning theory*. Prentice-Hall, Englewood Cliffs NJ.
- Barnes G. (1993) Future of psychotherapy today. *Psychiatria Danubina* 5: 5-26.
- Barnes G. (2007) Education in mind: Mind in education. In: Glanville R. & Müller K. H. (eds.) *Gordon Pask, philosopher mechanic: An introduction*. Edition Echoraum, Vienna: 65-96.

- Baron P. (2014) Overcoming obstacles in learning cybernetic psychology. *Kybernetes* 43 (9/10): 1301–1309.
- Baron P. & Baron A. C. (2015) A quantitative examination of two different teaching paradigms in a Germiston based pre-school. *Kybernetes* 44(8/9): 1207–1218.
- Bartlett, F. C. (1933). Remembering: A study in experimental and social psychology. *British Journal of Educational Psychology* 3(2): 187-192.
- Bateson G. (1979) *Mind and nature: A necessary unity*. Fontana, London.
- Daniel J. (1998) V. C.'s view. *Sesame. The Open University's Newsletter* April/May: 12.
- Department of Education (2004) White paper on e-education transforming learning and teaching through information and communication technologies (ICTs). *Government Gazette* No 26734. South Africa.
- Du Plessis A. (2015) Rethinking traditional science teaching through infusing ict learning embedded by a “learning-as-design” approach. *Journal of Baltic Science Education* 14(1): 4–6.
- Dubberly H. & Pangaro P. (2015) Cybernetics and design: Conversations for action. *Cybernetics & Human Knowing* 22(2–3): 73–82. <http://cepa.info/3529>
- Foerster H. von (1984) On constructing a reality. In: Watzlawick P. (ed.) *The invented reality*: 41-62.
- Foerster H. von & Poerksen B. (2002) *Understanding systems: Conversations on epistemology and ethics*. Carl-Auer, Heidelberg.
- Frankl V. E. (1985) *Man's search for meaning*. Simon and Schuster, New York.
- Gardner H. E. (2006) *Multiple intelligences: New horizons in theory and practice*. Basic Books, New York.
- Glanville R. (2001) An observing science. *Foundations of Science* 6(1): 45–75. <http://cepa.info/3636>
- Glanville R. (2008) A (cybernetic) musing: Five friends. *Cybernetics and Human Knowing* 15(3–4): 163–172.
- Glanville R. (2012) *The black boox. Volume 1: Cybernetic cycles*. Echoraum. Vienna.
- Glanville R. (2014) Acting to understand and understanding to act. *Kybernetes* 43(9/10): 1293–1300.
- Glaserfeld E. von (1989) Constructivism in education. In: Husen T. & Postlethwaite T. N. (eds.) *International encyclopedia of education. Supplement Volume 1*. Pergamon Press, Oxford: 162–163. <http://cepa.info/1404>
- Glaserfeld E. von (1992) Guest editorial. *Educational Studies in Mathematics* 23(5): 443–444. <http://cepa.info/1435>
- Glaserfeld E. von (2007) The constructivist view of communication. In: Müller A. & Müller K. H. (eds.) *An unfinished revolution. Edition Echoraum, Vienna*: 351–360. <http://cepa.info/1559>
- Griffith J. L. & Griffith M. E. (1992) Owing one's epistemological stance in therapy. *Dulwich Centre Newsletter* 1: 5–11.
- Haley J. & Erickson M. H. (1973) *Uncommon therapy*. Norton, New York: 122–127.
- Hallowell E. M. M. & Ratey J. J. (2011) *Driven to distraction: Recognizing and coping with attention deficit disorder from childhood through adulthood*. Anchor, New York.
- Harri-Augstein S. & Thomas L. F. (1991) *Learning conversations*. Routledge, London.

- Hegel G. W. F. (1998) *Phenomenology of spirit*. In: McNeill W. & Feldman K. S. (eds.) *Continental philosophy: An Anthology*. Blackwell, Oxford.
- Kauffman L. H. (1987) Self-reference and recursive forms. *Journal of Social and Biological Structures* 10: 53–72. <http://cepa.info/1816>
- Kelly G. A. (1955) *The psychology of personal constructs*. Volumes 1 and 2. Norton, New York.
- Korzybski A. (1933) A non-Aristotelian system and its necessity for rigour in mathematics and physics. In: Korzybski A., *Science and sanity: An introduction to non-Aristotelian systems and general semantics*. International Non-Aristotelian Library: Lakeville CT: 747–761.
- Landa L. N. (1971) *Algorithmization in learning and instruction*. Translated by V. Bennet and edited by F. Kopstein. Educational Technology Publishers, Englewood Cliffs NJ.
- Laurillard D. (1993) *Rethinking higher education*. Routledge, London.
- Laurillard D. (2013) *Rethinking university teaching: A conversational framework for the effective use of learning technologies*. Routledge, London.
- Lewis B. & Pask G. (1972) *Open university. Curriculum context, design and development course team, teaching strategies – a systems approach*. Open University Press, London.
- MacIntyre A. (1987) Relativism, power, and philosophy. In: Baynes K., Bohnman J. & McCarthy T. (eds.) *After philosophy: End or transformation*. MIT Press, Cambridge MA: 385–409.
- Maturana H. R. & Varela F. R. (1992) *The tree of knowledge: The biological roots of human understanding*. Revised Edition. Shambhala, Boston MA.
- Meyer W. F., Moore C. & Viljoen H. G. (2008) *Personology: From individual to ecosystem*. Fourth edition. Heinemann, Sandown.
- Nizami L. (2011) Memory model of information transmitted in absolute judgment. *Kybernetes* 40(1–2): 80–109.
- Pangaro P. (2001) THOUGHTSTICKER 1986: A personal history of conversation theory in software, and its progenitor, Gordon Pask. *Kybernetes* 30(5/6): 790–807.
- Pask G. (1975a) *Conversation, cognition and learning*. Elsevier, Amsterdam.
- Pask G. (1975b) *The cybernetics of human learning and performance: A guide to theory and research*. Hutchinson Educational, London.
- Pask G. (1976a) Conversational techniques in the study and practice of education. *British Journal of Educational Psychology* 46(1): 12–25.
- Pask G. (1976b) Styles and strategies of learning. *British Journal of Educational Psychology* 46(2): 128–148.
- Pask G. & Scott B. C. E. (1973) CASTE: A system for exhibiting learning strategies and regulating uncertainties. *International Journal of Man-Machine Studies* 5(1): 17–52. <http://cepa.info/1892>
- Rogers C. (1980) *A way of being*. Houghton Mifflin Company, New York.
- Scott B. (2000) CASTE revisited: Principles of course design in a hypertext environment. *Information Services & Use* 20(2/3) 117.
- Scott B. (2001) *Conversation theory: A constructivist, dialogical approach to educational technology*. *Cybernetics & Human Knowing* 8(4): 25–46. <http://cepa.info/1803>

- Scott B. (2010) The role of higher education in understanding and achieving sustainable development: Lessons from sociocybernetics. *Journal of Sociocybernetics* 7: 1: 9–16. <http://cepa.info/1793>
- Scott B. (2011) *Explorations in second order cybernetics*. Edition Echoraum, Vienna
- Searle J. R. (1975) A taxonomy of illocutionary acts. In: Gunderson K. (ed.) *Language, mind and knowledge*. University of Minnesota Press, Minneapolis.
- Skinner B. F. (1968) *The technology of teaching*. New York: Appleton-Century-Crofts.
- Thomas L. F. & Harri-Augstein S. (2001) Conversational science and advanced learning technologies (ALT) Tools for conversational pedagogy. *Kybernetes*, 30(7/8): 921–954.
- Thoreau H. D. (2006) *Walden*. Yale University Press, New Haven CT.
- Turing A. (1950) Computing machinery and intelligence. *Mind* 49: 433-460.
- Ulich R. (1967) Social and individual aspects of the curriculum. In: Burnham B. (ed.) *New designs for learning*. University of Toronto Press, Toronto: 12–17.
- Vygotsky L. S. (1978) *Mind in society. The development of higher psychological processes*. Harvard University Press, Cambridge MA.

Received: 6 April 2016

Accepted: 8 September 2016