Foundations of Science, special issue on "The Impact of Radical Constructivism on Science", edited by A. Riegler, 2001, vol. 6, no.4: 343–360.

Gordon Pask's Conversation Theory: A Domain Independent Constructivist Model of Human Knowing.

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Abstract

Although it is conceded (as argued by many) that distinct knowledge domains do present particular problems of coming to know, in this paper it is argued that it is possible (and useful) to construct a domain independent model of the processes of coming to know, one in which observers share understandings and do so in agreed ways. The model in question is part of the conversation theory (CT) of Gordon Pask. CT, as a theory of theory construction and communication, has particular relevance for foundational issues in science and science education. CT explicitly propounds a "radical constructivist" (RC) epistemology. A brief account is given of the main tenets of RC and CT's place in that tradition and the traditions of cybernetics. The paper presents a brief non-technical account of the main concepts of CT including elaborations by Laurillard and Harri-Augstein and Thomas. As part of CT, Pask also elaborated a methodology - knowledge and task analysis - for analysing the structure of different knowledge domains; this methodology is sketched in outline.

Keywords: Conversation theory, epistemology, learning.

Introduction

In this paper a domain independent model is presented that is designed to help conceptualise and understand what takes place when effective communication occurs, the process of coming to know where one participant in a conversation can be said to understand another participant's "knowledge". First there is a brief consideration of what is "radical constructivism" and what radical constructivists mean by the terms "learning" and “knowledge”. There is then a discussion of learning as a process of cognitive construction, drawing on the seminal ideas of Piaget and their elaborations by Kolb and Rescher. The conversational model of Gordon Pask is then presented. This model places Piagetian constructive processes in an explicitly social context. The model, as in the body of the paper, may be interpreted as a model of learning and teaching in science education. It may also be interpreted as a model of communication amongst scientists, where theories are exchanged and evaluated. Brief presentations are given of variants of the conversational model as developed by Laurillard and Harri-Augstein and Thomas. Finally, a methodology for the construction of models of the structure of knowledge domains is briefly described. That there are distinct domains of knowledge is not put into question (cf. Elam, ed., 1964; Ford and Pugno, eds., 1964; Hirst, 1974; Shapere, 1977; Scott, forthcoming a). However, as noted in the concluding comments, their forms and the distinctions between them are subject to negotiation and agreement within the conversations that constitute a community of observers. The main thesis of the paper, summarised in the concluding comments, is that CT provides an elaborated set of concepts and models that can inform effective “doing” of science and also effective science education.

Radical Constructivism

The concept of “radical constructivism” (RC) has been promulgated particularly by Ernst von Glasersfeld, drawing on Piaget but also, very directly, on the ‘collegiate’ of cybernetic thinkers that formed around Heinz von Foerster in the 1960’s and 1970’s, notably, Heinz von Foerster himself and the biologist, Humberto Maturana. RC is contrasted with the “transmission model”, where ‘knowledge’ is directly taught and where knowledge is conceived as a being a representation of an external objective reality.

“Language frequently creates the illusion that ideas, concepts and even whole chunks of knowledge are transported from a speaker to a listener ... rather each must abstract meanings, concepts and knowledge from his or own experience” (von Glasersfeld, 1991, p. xiv).

Radical constructivists are those who “have taken seriously the revolutionary attitude pioneered by Jean Piaget ...... the concept of knowledge as an *adaptive function* ....that cognitive efforts have the purpose of helping us cope in the world of experience, rather than the traditional goal of furnishing an “objective” representation of a world as it might “exist” apart from us and our experience” (von Glasersfeld, 1991, ibid).

Von Glasersfeld (as my reading of him goes) has little to say about the ideas of Gordon Pask. I think this is an oversight - and a surprising one at that. Pask, by von Foerster’s own account, was an early and central member of the collegiate (von

Foerster, 1993). Pask was a pioneer in modelling cognition as an evolutionary, self-organising process. Pask (1963) is a particularly lucid early essay on these topics. With CT, Pask provides a very comprehensive theoretical framework and (with associates) a wealth of associated empirical studies of learning and teaching. More recent constructivist work on dialogical, conversational aspects of coming to know run the risk of re-inventing or overlooking Pask's work and ideas (see, as examples, Richards, 1991, and Ernest, 1994).

Von Glasersfeld emphasises that observers construct "consensual domains". By what Maturana calls the "structural coupling" of system and environment, the life trajectories of the members of a species create shared ecological niches and consensual domains of interaction and communication, with 'objects', 'events' and classes of them (Maturana and Varela, 1980). There is then the explicit reflexive acknowledgement that RC, as a research programme, is itself a consensual domain, with the aim, as von Foerster (1982) puts it, of "explaining the observer to himself". A secondary aim is to characterise the shared predications that constitute a given consensual domain as a system of beliefs. As an example, the key predication of 'science' is the acceptance of the 'objectivity hypothesis', however it is stated, in realist or constructivist terms, either as "there is a reality independent of the observer" or "let us proceed to construct a consensual domain whose structure and behaviour is deemed to be independent of (i.e., not "structurally coupled" to) the observer." Whatever the a priori predications observers adopt, it becomes critical to recognise that there are such a prioris and that it behoves observers to become reflectively aware of what they are. Pasks's CT comments on all the social and reflective processes that constitute scientists doing science. A Lakatosian "research programme" (Lakatos, 1978) is a Paskian "conversation", a self-reproducing , possibly evolving, conceptual system (see below).

Pask writes as a cybernetician, with an eye on the cybernetic aim of unifying theories and concepts across disciplines. Thus for Pask, anything that can be sensibly said about 'conversation' is part of CT. As a cybernetic theory, CT is *the* theory of conversations. Of course there may be competing hypotheses, but this is to be expected within an evolving research programme. As a unifying theoretical framework, CT adumbrates (Pask's term) the sociolinguistics of conversational interaction, the conversational implicature of Grice, the descriptive pragmatics of communication of Bateson and Watzlawick al and the normative pragmatics of Habermas. Coverage of these topics is beyond the scope of this paper. For more from the perspective of CT see Scott (1987) and Pask (1979).

Careful reading of Maturana, Von Foerster and Pask shows a circularity. The constructivist phenomenal domain of the observer may be taken as a starting point to account for the joint construction of the biological and the cosmological, in general, the scientific domain. In turn, the "scientific" may be taken as a starting point for an account of how observers evolve to become members of a community capable of constructing "consensual domains" (Maturana's term). This circularity is imminent in Spencer Brown's (1969) logic of distinctions. It is indicated globally in Maturana's seminal prose poem "Neurophysiology of Cognition" (Maturana, 1969). There, Maturana suggests that his essay makes sense as a whole by the way the parts hang together. The circularity is quite explicit in Von Foerster's (1974) "Notes pour un Epistemologie des Objets Vivants", where he constructs a circular set of propositions from "Everything that is said is said by an observer" to "The environment contains no information; it is as it is". In similar spirit, CT is explicitly reflexive. It is a theory of theory building that accounts for its own genesis.

What is learning, what is knowledge?

When considering what learning is and how it occurs, it is useful to recall that humans, like all other biological organisms, are dynamical, self-organising systems, surviving - and evolving - in a possibly hostile world. Such systems survive by adapting to their worlds and by actively becoming "informed" of how their worlds work. "Learning", as biological adaptation, happens incidentally in the context of the pursuit of current "need-satisfying" goals. "Learning" as a process of adaptation is going on all the time. One cannot not learn. In humans, learning finds its highest expression. Our "need to learn" is so strong, we experience boredom and actively seek out novel environments.

"Learning", as biological adaptation, tells part of the story. RC emphasises that the "models" an organism constructs as a result of adaptation are tacit. To say they "represent" the environment is a conceptually confused way of talking. Rather, the organism "abstracts" invariants ("objects" and "events") from the consequences of its actions. The organism's "knowing" is a process and its "abstracting" or "coming to know" is a process, one that Pask refers to as a "taciturn" process.

In addition, humans learn intentionally. We consciously set ourselves goals. We deliberately practise habits and skills. We reflect, conceptualise and converse. We share "consensual domains" and come together to learn and to teach. Pask refers to systems that converse together as "language oriented" systems. With Maturana, he argues that "consciousness" is an emergent process that comes of "knowing with another" in consensual domains where "self' and "other" are distinguished and where the experience of being conscious (self-aware) is "knowing with oneself" (for more on this genesis, see Pask, 1981, Maturana, 1989, Scott, 1996, 1999a). In conversation, linguistic exchanges do not "transmit knowledge", rather, they provoke participants into becoming informed of each other's "informings". "Languaging" (Maturana's term) is the "coordination of coordinations of coordinations". Higher level coordinations are "tokens" for lower level coordinations, "objects" and "events", which are themselves "tokens" for the "eigen-behaviours", the invariants or stabilities that arise in sensori-motor activity and "structural coupling" with the environment (see, especially, von Foerster, 1976).

The major aspect of CT that distinguishes it from Maturana's and von Foerster's accounts of cognition and communication is that Pask chooses to distinguish between the "biological" or "bio-mechanical" and the "psychological" or "conceptual". As well as the individuality of biological organisms as self-producing, "autopoietic" (Maturana's term), cybernetic "machines", Pask distinguishes the individuality of conceptual systems, processes of knowing and coming to know, that are coherent, self-producing and, hence "organisationally closed". Pask refers to such systems as psychological (p-) individuals. For Pask, "consciousness" is a property of a p-individual, a system that potentially may "know with itself" that it is a system. It is not a property of a "mechanical individual" (m-individual). The participants in a conversation are p-individuals. The conversation is itself a p-individual. Do note the power of the distinction: m and p-individuals are not necessarily in one to one correspondence. One "m" may house several "p's"; one "p" may be housed by several m's.

When we learn, we are said to acquire "knowledge". In CT, as a radical constructivist theory, "having knowledge" is understood as a process of knowing and coming to know. It is not the "storage" of "representations". However, it is of course still useful to construct external representations of knowledge and to distinguish between different kinds of knowledge.

There are many ways of distinguishing kinds of knowledge. Following Bloom (Bloom, ed., 1956), it is common practice to distinguish between "knowledge", "skills" and "values". Often, different sub-types of "knowledge" are distinguished. For example, Gagné, Briggs and Wager (1992) distinguish motor skills, discriminations, intellectual skills, defined concepts, concrete concepts, cognitive strategies, attitudes, problem solving, verbal information (names or labels, facts, knowledge), rules and higher-order rules. Romiszowski's (1984) classification is even more complex. He distinguishes four main kinds of "knowledge" (facts, procedures, concepts, principles) and four main kinds of "skill" (cognitive, psychomotor, reactive, interactive), with further subdivisions.

In CT, these more elaborate schemes for describing "what is learned" are avoided as introducing unnecessary complication but also because (in the author's view) the distinctions made are not always well-defined or easy to apply. However, CT does make considerable use of one particular distinction, familiar from the time of Aristotle onwards, the distinction between "knowing why" (cognitive, conceptual knowledge) and "knowing how" (procedural, performance knowledge). As discussed further below, "why" knowledge is critically about the coherence (and hence, reproducibility) or otherwise of conceptual systems. “How” knowledge refers to the pragmatic effectiveness or not of applying a particular concept that is part of such a system.

Learning as a process of cognitive construction

Kolb (1984), using ideas from Kurt Lewin and Jean Piaget, provides a simple but useful (and frequently cited) model of the processes involved in constructivist learning (see figure 1).

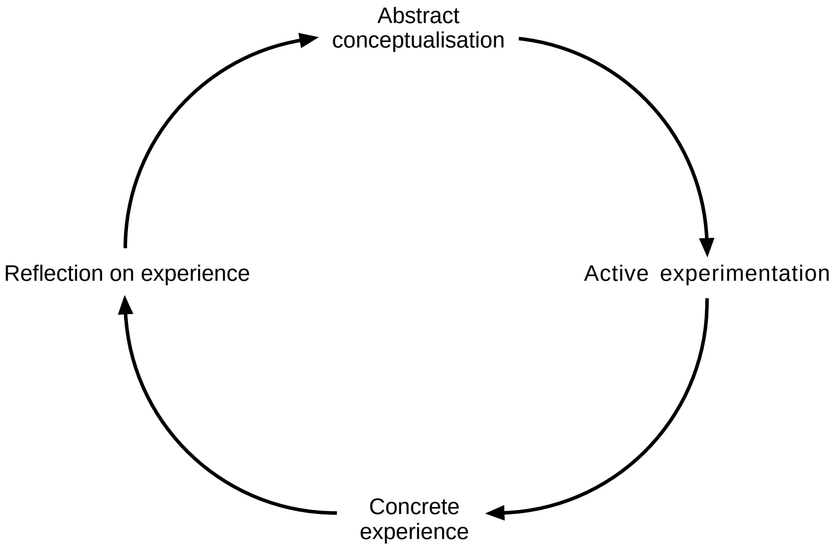

Figure 1 Kolb’s learning cycle

Kolb proposes that learning is a cyclic activity with four stages. These are: *concrete experience* , followed by *reflection* on that experience, followed by *abstract conceptualisation* (the derivation of general rules or theory construction) and, finally, *active experimentation* (the construction of ways of modifying the next occurrence of the experience).

Rescher (1973, 1977), also building on ideas taken from Piaget (see, especially, Piaget, 1972), has constructed a more detailed model than that of Kolb, in which two cycles of activity are distinguished: one corresponding to the acquisition and justification of “why” knowledge, the other corresponding to the acquisition and consolidation of “how” knowledge (see figure 2). Note, the ‘why’, ‘how’ distinction is, profoundly, a psychological one. It does not correspond to the ‘declarative’, ‘procedural’ distinction in artificial intelligence work, which, in any case, is now acknowledged as being invalid (a computer program is a computer program, not a concept or an organisationally closed system of concepts)).

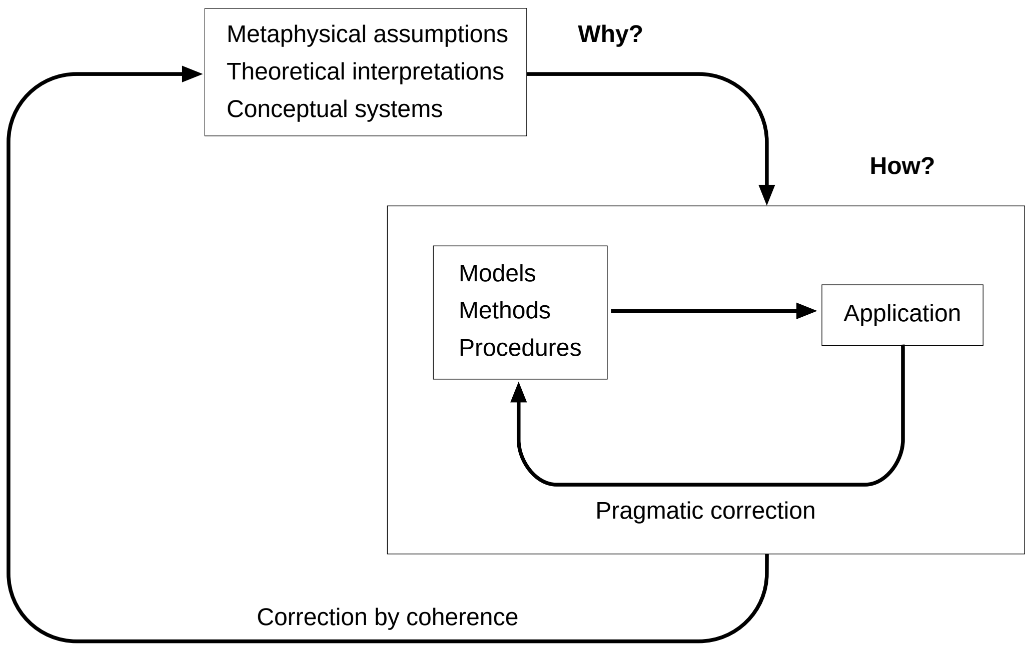

Figure 2 Rescher's two-cycle model

In the "why" cycle, new conceptual knowledge is integrated with existing conceptual knowledge to form a coherent whole, a Paskian p-individual. In the "how" cycle, new "methods" (procedures, operations) are constructed and tried out and are subject to pragmatic correction.

Some reflection will show that this is a far more sophisticated model than that of Kolb, as it not only distinguishes the "conceptual" from the "operational/pragmatic" but also shows their interpenetration: "facts" may always be put into question; some form of constructive or operational/pragmatic "proof" of theories may be asked for (cf. Von Wright, 1971, on "causalists" versus "actionists" in the philosophy of science and Chaitin's, 1999, discussion of the "quasi-empirical" nature of mathematics and meta-mathematics).

In a more extended discussion (Scott, in press a), I summarise Rescher's contribution as follows: "By revealing the process of epistemic validation in science, Rescher has given due acknowledgement to the primacy of affect, praxis. At the same time, he has shown how cognitive methodology may evolve such that a logic and rationale can guide praxis. Although the outcome of praxis is the final arbiter of the effectiveness of those methodologies, the methodologies (cognition, metacognition) are such that they provide not only an apparatus for substantiating theses about the world but also provide an apparatus for their own rational evolution and refinement. The logic of scientific discovery thus pulls itself up by its own bootstraps. There remains a real sense in which logic (cognition) has primacy.

Piaget (1956) captures the complementarity of affect (praxis) and cognition: "Without a mathematical or logical apparatus there is no direct 'reading' of facts, because this apparatus is a prerequisite. Such an apparatus is derived from experience, the abstraction being taken from the action performed upon the object and not from the object itself."

Learning as conversation.

Here we develop a theory of learning that includes the role of the teacher where learner and teacher can be said to be "in conversation" with one another. The model may be interpreted developmentally to inform accounts of the genesis of personhood and the "inner dialogues" that support human learning, as in the classic accounts of Vygotsky (1966), Mead (1934) and Luria (1961). This aspect of the theory is not elaborated upon here (see Scott, forthcoming b). As well as showing a teacher and learner in conversation, the model may also be interpreted as showing two peers in conversation exchanging, justifying and demonstrating theories and their associated models and procedures.

The basic model is shown in figure 3. Pask refers to this model as the "skeleton of a conversation". It shows a "snapshot" view of two participants in conversation about a topic.

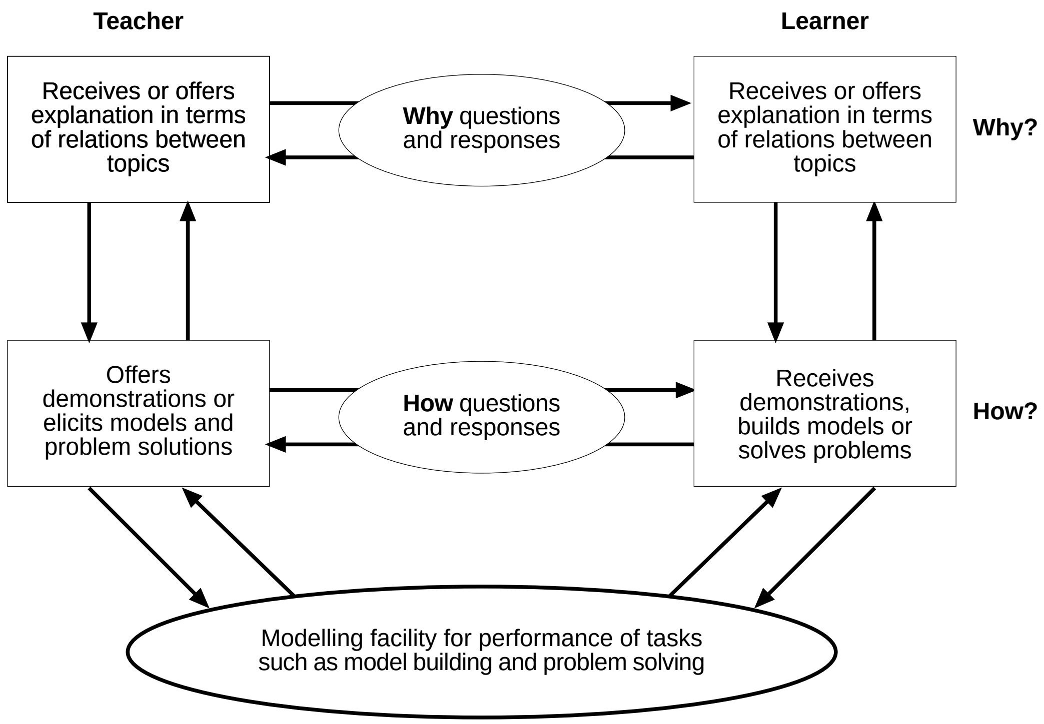

Figure 3 The "skeleton of a conversation" (after Pask).

Notice how it distinguishes verbal, “provocative” interaction (questions and answers) from behavioural interaction via a shared modelling facility or “micro-world”.

The horizontal connections represent the verbal exchanges. Pask argues that all such exchanges have, as a minimum, two logical levels. In the figure these are shown as the two levels: “how” and “why”. As in Rescher’s model, the “how” level is concerned with how to “do” a topic: how to recognise it, construct it, maintain it and so on; the “why” level is concerned with explaining or justifying what a topic means in terms of other topics.

The vertical connections represent causal connections with feedback, an hierarchy of processes that control or produce other processes. At the lowest level in the control hierarchy there is a canonical world, a “universe of discourse” or “modelling facility” where the teacher may instantiate or exemplify the topic by giving non-verbal demonstrations. Typically, such demonstrations are accompanied by verbal commentary about “how” and “why”. In turn the learner may use the modelling facility to solve problems and carry out tasks set. He or she may also provide verbal commentary about “how” and “why”.

Note that the form of what constitutes a canonical “world” for construction and demonstration is itself subject to negotiation and agreement. Here, a brief example will have to suffice.

Consider topics in chemistry. A teacher may:

- model or demonstrate certain processes or events;
- offer explanations of why certain processes take place;
- request that a learner teaches back his or her conceptions of why certain things happen;
- offer verbal accounts of how to bring about certain events;
- ask a learner to provide such an account;
- ask a learner to carry out experiments or other practical procedures pertaining to particular events or processes.

A learner may:

- request explanations of why ;
- request accounts of how;
- request demonstrations;
- offer explanations of why for commentary;
- offer explanations of how for commentary;
- carry out experiments and practical activities.

Pask refers to learning about “why” as comprehension learning and learning about “how” as operation learning. and conceives them both as being complementary aspects of effective learning. These distinctions allow Pask to give a formal definition of what it means to understand a topic. For Pask, understanding a topic means that the learner can “teachback” the topic by providing both non-verbal demonstrations and verbal explanations of “how” and “why”.

Laurillard (1993) provides a useful elaborated account of the exchanges that make up the skeleton of a conversation, interpreted for the kinds of learning conversation that take place in Higher Education. She distinguishes a domain of exchanges of descriptions, conceptions and misconceptions about both “how” and “why” from a general domain of “tasks”. “Tasks” are interpreted liberally as any learning activity the learner is asked to engage in which generates some product or outcome which can then be the subject for further discussion.

In order to round-out our discussion of “learning as conversation”, following Harri-Augstein and Thomas (1991) we will elaborate the Pask model in a different way. Pask notes that conversations may have many levels coordination above a basic “why” level: levels at which conceptual justifications are themselves justified and where there is “commentary about commentary”. Harri-Augstein and Thomas make this notion central in their work on “self-organised learning”, where the emphasis is on helping students “learn -how-to-learn”.

In brief, they propose that a full “learning conversation” has three main components:

- conversation about the how and why of a topic, as in the basic Pask model;
- conversation about the how of learning (for example, discussing study skills and reflecting on experiences as a learner);
- conversation about purposes, the why of learning, where the emphasis is on encouraging personal autonomy and accepting responsibility for one’s own learning.

The model in figure 4 shows the relationships between the components. Laurillard makes many similar points about the importance of these higher levels in the conversations that take place in universities.

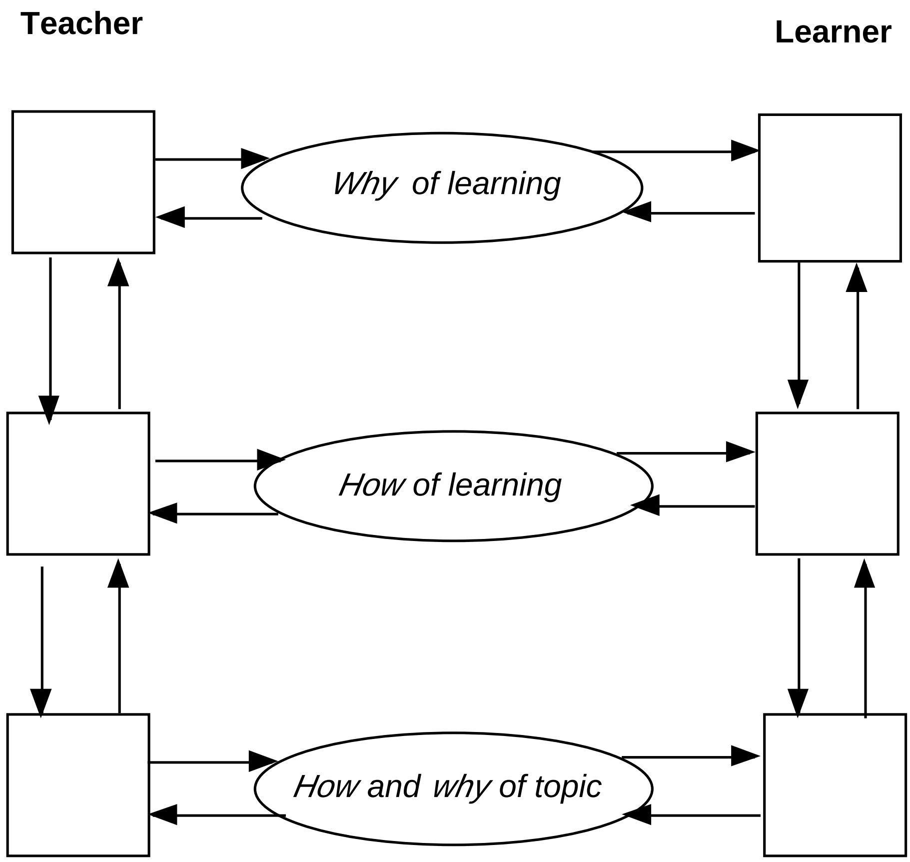

Figure 4. A full "learning conversation" (after Harri-Augstein and Thomas)

Reflexively, the conversation itself may always be the topic of conversation. The processes of process control and production are then heterarchical, with no fixed ordering of levels of control. Biologically, this corresponds to the concept of a self-productive network of processes (an autopoietic m-individual). Such a system is one that can support p-individuation, the evolution, through conversation of stable systems of belief (see also, Scott, 2000 and Scott, in press b).

Modelling the structure of knowledge

Pask and colleagues (Pask, 1975, 1976; Pask, Scott and Kallikourdis, 1973; Pask, Kallikourdis and Scott, 1975) have developed methodologies for constructing models of the structure of bodies of knowledge. The basic idea is that a body of knowledge or subject matter consists of topics related one to another. Two basic forms of relations between topics are distinguished: entailment relations (hierarchical) and relations of analogy (heterarchical). A static representation of such relations is called an entailment structure.

Entailment structures reveal the "why" of knowledge, the conceptual structure of definitions and justifications that relate topics one to another. For a full semantics, the content of topics, their “how”, needs to be specified. This can be done operationally in the form of “task structures”, defined with respect to a canonical modelling facility. In Pask’s phrase, task structures show “what may be done”. They show the “procedural knowledge” or “performance competencies” that someone who understands a particular topic is deemed to have. Task structures may be represented in a variety of ways, for example, as a precedence chart showing order relations between the goals and sub-goals of a task or as a flow chart showing a sequence of operations, tests, branches and iterations.

The basic entailment structure model may be extended and elaborated in a number of ways. Any topic at the lowest level of an hierarchical entailment structure may be analysed further in order to reveal sub-topics (Pask’s term for such an analysis of a topic is “unzipping”). Topics may be explained in terms of each other in different ways. If an entailment structure shows that topic A can be explained in terms of entailed topics B and C, then, in principle, topic B can be explained in terms of topics A and C and topic C can be explained in terms of topics A and B. If these local cycles are added to an entailment structure, the resulting form is what Pask refers to as an “entailment mesh”.

As modelled thus far, the conversational domain, qua entailment mesh, is but a labyrinth of topics, albeit with extensible “edges”. It does not represent the intuitive idea that a body of knowledge is coherent globally, as a totality, a memorable whole. Strawson (1992) expresses the general idea thus: “Let us imagine ... the model of an elaborate network ..... such that the function of ... each concept, could ... be properly understood only by grasping its connections with the others ... there will be no reason to worry if, in the process of tracing connections from one point to another of the network, we find ourselves returning to our starting point .... the general charge of circularity would lose its sting for we might have moved in a wide, revealing, and illuminating circle”.

As an example, within the domain “biology”, in explaining the topic “evolution” one may refer to the topic “cell”; conversely, in explaining the topic “cell”, one may refer to the topic “evolution”. It is only in recent years that mainstream analytic philosophers, like Strawson, have accepted the legitimacy of virtuous (i.e., not vicious) circularities in conceptual systems (for recent formal work on “circularity”, see Barwise and Moss, 1996).

Pask models the global aspect of coherence by imagining that the edges of an entailment mesh extend until they meet. The meeting of opposing edges, top and bottom, left and right results in a closed form, a torus. A conversational domain can also be extended by analogy. However, for analogy relations to be coherent, the bodies of knowledge they are relating together must themselves be coherent (see also Scott, 1999, and Scott, in press b)

Concluding comments

This paper has presented a domain independent radical constructivist model of human learning and outlined an associated methodology for constructing models of knowledge domains. One key concept has been that of the complementarity between two aspects of "knowing": conceptual knowledge and procedural knowledge. A second key concept has been that of "conversation", which explicitly includes the acknowledgement that canons of what is "conceptual coherence" and what are appropriate pragmatic/operational tests of "correctness" of models and methods are themselves subject to negotiation and agreement.

The former key concept (complementary forms of knowing) is explicitly a theory of meaning. It reminds us that, however elegant, persuasive or attractive a theory is, as a conceptual system, as scientists we must always ask what the theory "means" in the "wellfounded" terms of models and procedures that afford prediction and control.

The second key concept (knowing as conversation) adjures us make explicit to ourselves and to one another just what are the founding predications that guide our conduct and praxis as scientists and teachers of science. Here, CT's explicit methodology for modelling the structure of knowledge and the associated formal concept of showing "understanding" by "teachback" can play a key part.

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