HAY 02494

Beyond the letter; or the structure and strangeness of creativity in schools

HAYNES Felicity Ann (Dr)

Graduate School of Education, The University of Western Australia

35 Stirling Highway, Crawley, Nedlands W.A. 6009

43 Robinson Street, Nedlands W.A. 6009

Phone/FAX 618 9386 7730

fhaynes@ecel.uwa.edu.au

Abstract: This is the first of a pair of papers investigating the complexity of creativity in the classroom. Art teachers know that the act of trying to capture or measure creativity in the classroom can have the effect of completely destroying it. Rhetorically, it is recognised as having value in generic outcomes but it is often eliminated from practice in teacher education programmes or maps of curriculum outcomes at the classroom level, because it is seen as intuitive, irrational and beyond any systemic evaluation. By grounding creativity in the process of making purposive connections between logical systems and holistic perceptions, by defining it as purposive reassembling of parts into new wholes, I demonstrate that creativity cannot be programmed, or controlled but nevertheless, it depends enough upon sufficient "reasonable and purposive" structuring to make it amenable to guidance and evaluation in the classroom. I use examples from Hofstadter's futile attempt to formulate and programme the rules of original alphabet fonts because part of his ambition to do so rests on his desire to train students in creativity in a step-by-step programming sequence. I show that Hofstadter contradicts himself by denying the autonomy of the creative artist and how creativity, even collaborative creativity, can be systematically evaluated without destruction of spontaneity or the deliberate expression of personal meaning.

This paper concludes that creativity must accommodate reasonableness rather than the logic of a closed system. Part two will show the "reasonableness" of the creative relationship between our intellectual constructions and the constraints of the physical world. Both parts of this paper require educators to shift from an atomistic or hierarchical rational structuring which seeks certainty and control to an open systems process of bricolage or heuristic understanding.

************************************************

Critical and creative thinking in the curriculum

You've dropped a coin between some cushions in an old chair. When you gingerly try to reach between the cushions to grab the coin, the very act of sticking your finger in there widens the crevice and the coin slips further in. You see that any more of this reaching, and your coin will be lost forever in the depths of the chair. Striving for something can have the effect of reducing that thing's availability. The theme of this year's conference presumes that
educators want or need certainty and control. I want to show how creativity will continue to elude educational evaluation if educators try too hard to capture it in a closed system of measurement but that it is open and accessible to contextual and reasonable evaluation.

In 1997, Bruce Haynes and I accepted a contract from the Education Department of Western Australia to undertake a task which we thought was impossible - to monitor development in critical and creative thinking skills across the eight learning areas and through the eight developmental levels. However, expressing our concerns about the impossibility of the project, we, in collaboration with educators and teachers, constructed a tentative complex map of thinking skills which presumed that judgement of their worth was context-dependent, that is, it presumed intentionality and relevance to purpose in the student. We noted that such skills did not seem to progress along the linear developmental trajectory proposed in the learning areas mapping project by the Education Department of W.A., but were indications of a much more complex and holistic iterative reflective process in which generic thinking and learning skills such as those listed by Ennis, and Splitter and Sharp were continually and appropriately being invoked to support each other. Our definition of thinking proceeded from the assumption that binaries such as Arts/science, reason/imagination, critical/creative thinking, calculative thinking/poetic thinking (Bonnett, 1994, Splitter and Sharp, 1995) are useful in providing temporary signposts through the curriculum but of limited use because they bracket out potentially creative synergies where the tension between both sides of the binary is exploited to produce new syntheses.

We (Haynes and Haynes, 2000, 2001. see Appendix A). provided a three-level matrix of many thinking skills organised along a critical thinking column, a making of meaning column and, to emphasise the social nature of reasoning and creativity, a third, the community of inquiry. These three aspects were to be evaluated in a complex mapping exercise involving standardised critical thinking tests and teacher’s evaluation of student outcome statements, teachers’ logs of critical events, and self reporting from the students. What was original about our scheme was the open reflective process encouraged within a developing community of inquiry in the classroom and the encouragement of individual students themselves to reflect on their own progress through diaries and conversations with others.

Inclusion of collaborative creativity in the generic outcomes

Our report was seen by many to be impossibly complex. Over thirty generic reasoning skills were listed, including a developmental model of a sense of humour, and it was acknowledged that these thirty were not exhaustive. It was simply too detailed to be used as a checklist by a teacher in a hurry and it required a fairly radical revision of the evaluation methods generally used by the Department. However the report did have some impact on the Western Australian Curriculum Framework, with many outcome statements being rephrased to reflect a more open attitude to generic outcomes across all curriculum areas. For example, these (Curriculum Council, 1998, pp.20-25) show that creative and independent thinking is valued in the curriculum

1. Students use language to understand, develop and communicate ideas and information and interact with others

2. Students select, integrate and apply numerical and spatial concepts and techniques

6. Students visualise consequences, think laterally, recognise opportunity and potential and are prepared to test options
10. Students participate in creative activity of their own and understand and engage with the artistic, cultural and intellectual work of others

11. Students value and implement practices that promote personal growth and well-being

12. Students are self-motivated and confident in their approach to learning and are able to work individually and collaboratively.

However, five years later, the Western Australian Curriculum Council is commencing a mapping exercise to check the usefulness of student outcome statements for teachers trying to place students at particular levels. But creative and critical thinking do not appear in any of the mapping exercises, and the progress made for critical and creative thinking seems once again to have reached a halt, Syllabuses and curriculum focus more on outcomes and scores on normed test results these days than on creative fun and the student's remarkable capacity to make meaning in context. It seems to be contradictory to organise creativity, and very difficult to help teachers or students become creative, so creativity, in disappearing from the curriculum, disappears from the classroom.

This paper investigates one of the paradoxes of control and openness in creativity in the classroom and demonstrates to what extent it depends on rational structures while at the same time moving beyond them. It suggests that an apparent reluctance to include them in a mapping exercise may arise from misconceptions of creativity as simply intuitive or "authentic", the binary opposite of logical. The view of creativity as expressing the intuitive essence of the child owes much to Victor Lowenfeld (1947) who persuaded many art teachers that any interference from the teacher or attempt to control the child may thwart the natural flow of creativity from the child. I will argue in this paper that creativity comes from fruitful interaction between teacher and students or between students and students, or between artists, students and teachers, and that it is best facilitated by using tension between schemata or rational structures constructively. Pragmatic constraints on what a student can do creatively will be discussed in part two.

Douglas Hofstadter (1985) raises the question of the architecture or structure of creativity first in his book *Godel, Escher and Bach*, and then more explicitly in his reflections on his own column in *Scientific American*, *Metamagical Themas: Questing for the Essence of Mind and Pattern*. Hofstadter has been largely ignored by educators, or dismissed for his perversity, perhaps because he acknowledges that he is searching for an impossibility—the essence of creativity, the rules that would explain how the human mind, possibly uniquely, can create works of art. Hofstadter is continually pushing the boundaries, seeking to find explanations for the inexplicable, while at the same time always maintaining that the whole which pulls things together in a new way will resist laws of explanation as much as the coin eludes the reaching fingers.

He (Hofstadter 1985.p.210) praises architect William Huff for trying to instil in his students the mental architecture that underlies the skill to create beauty, a structuralist position reminiscent of Bruner. Hofstadter quotes another architect Louis Kahn: "What Huff teaches is not merely what he has learned from someone else, but what is drawn from his natural gifts and belief in their truth and value. In my belief what he teaches is the introduction to discipline underlying shapes and rhythms, which touches the arts of sight, the arts of sound, and the arts of structure. It teaches students of drawing to search for the abstract and not the representational. This is so good as a reminder of order for the instructors/architectural sketchers (like me), and so good especially for the student sketchers without background. It is the introduction to exactitudes of the kind that instill the religion of the ordered path"
Believing in this "architecture" of creativity, "the religion of the ordered path" will take Hofstadter too far towards a platonic faith in the primacy of abstraction to be able to account for creative practical genius but it is a start in reminding us, as Bruner did, that creativity favours the well-prepared mind, that creativity does require structuring, and that the created product has to be deemed of value by someone, even if it is only the creator, so cannot not merely be idiosyncratic intuitional, or personal whim.

Hofstadter (1979) has Crab sing the following song:

A turner of phrases quite pleasing

Had a penchant for trick'ry and teasing.

In his songs the last line

Might seem sans design;

What I mean is without why or wherefore.

Achilles, like a good teacher, leaps in to suggest that the last line is - not only "sans design" - but "without rhyme or reason". Is there any teacher who wishes to defend Crab's creative instinct against that of the wiser Achilles? Crab may well have reasons for His last line, but they are not as convincing as Achille's suggestion.

Creativity cannot be simply perverse or idiosyncratic, breaking the rules for the sake of breaking the rules. Originality, while it might be necessary, is not a sufficient condition for creativity. Breaking the rules must have some value, value perceived by others to be creative. To say that it is not enough to breaking the rules to make a creative product might allay some of the fears of educators in allowing it within the classroom. If rules are broken in a creative act, then others are kept and the broken rule maintains its tension in relation to the other rules that are being adhered to. It seems more a matter of stretching rules than breaking them, or breaking one rule while keeping others. Hofstadter says that creativity consists of knobtwiddlings - parameter-based changes. He (1985 p.195) gives these examples from the repertoire of standard deformation devices in mathematics:

lengthening or shortening a line

rotating a line

introducing a "hinge" somewhere inside a line segment so that it can "flex"

introducing a bump or pimple or tooth (a small intrusion of extrusion having a simple shape) in the middle of a line or vertex;

Shifting, rotating, expanding or contracting a group of lines that form a natural subunit.

Hofstadter discussed many geometric forms of these parquet deformations in chapter 10 of Metamagical Themas. An simple example of knobtwiddling or regrouping is Fylfot
Flipflop Fig 10-1. executed in 1963 by Fred Watts at Carnegie-Mellon (Hofstadter 1985, p.124.)

Of this Hofstadter (1985, 1951-6) says:

If you simply let your eye skim across the topmost line, you will get the distinct impression of scanning a tiny mountain range. At either edge you begin with a perfectly flat plain and then you move into gently rolling hills, which become taller and steeper, eventually turning into jagged peaks, then past the centrepoint these start to soften into lower foothills, which gradually tail off into the plain again. Subtler to see is the line just below, whose zigzagging is 180° out of line with the top line. Thus notice at the very centre the line is completely at rest; a perfectly horizontal stretch flanked on either side by increasingly toothy regions. Below it there are seven more horizontal lines. Thus if one completely filtered out the vertical lines, one would see nine horizontal lines stacked above one another, the odd-numbered ones jagged in the center, the even ones smooth in the center.

Now, what about the vertical lines? Both the left hand and righthand borderlines are perfectly straight vertical lines. However their immediate neighbours are as jagged as possible, consisting of repeated 90 degree bends, back and forth. Then the next vertical line nearer the center is practically straight up and down. Then there is a wavy one again, and so on. As you move across the picture you see that the jagged ones gradually get less jagged and the straight ones get increasingly jagged so that in the middle the roles are completely reversed. Then the process continues, so that by the time you’ve reached the other side, the lines are back to normal again. If you could filter out the horizontal lines, you would see a simple pattern of quite jaggy lines alternating with less jaggy lines.

When these two extremely simple independent patterns - the horizontal and the vertical - are superimposed, what emerges is an extremely rich perceptual feast, At the far left and right, the eye picks out fylfots - that is, swastikas - of either handedness contained inside perfect squares. In the center, the eye immediately sees that the central fylfots are all gone replaced by perfect crosses inside pinwheels.

And then a queer perceptual reversal takes place. If you just shift your focus of attention diagonally by half a pinwheel, you will notice that there is a fylfot right there before your eyes! In fact suddenly they appear all over pinwheels! And conversely, of course, now when you look at either end, you'll see pinwheels everywhere, Now when you look at either end, you'll see pinwheels everywhere with crosses.
This ubiquitous visual phenomenon is called regrouping in which the boundary line of the unit cell shifts so that structures jump out at the eye that before were completely submerged and invisible - while conversely, of course structures that a moment ago were totally obvious have now become invisible, having been split into separate conceptual pieces by the act of regrouping or shift of perceptual boundaries.

Why does Hofstadter examine these mechanical abstractions in this extraordinary detail? I feel the same impatience that Polanyi did when he said you don't need to know the rules of physics to ride a bicycle. You learn it by getting on the bike and adjusting your balance. More of that praxis in the following article. The benefit of Hofstadter making the rules of these line drawings explicit is that in principle a computer could be programmed to do this sort of patterned knobtwiddling, and Hofstadter is searching for the logical patterns that underpin our neuroprogramming.

Remember that he has worked closely with Daniel Dennett and Dennett (1997) wants to deny the existence of a purposeful intentional self. So this minutiae of rule-following reflects a cognitive psychologist's dream of being able to explain and predict creative behaviour, to break things down to their smallest possible components or rules and then allow them to be reconstructed step by step. By extension, if Hofstadter can show that a computer can be programmed to make the regrouping that reverses a fylfot, then children too can be hardwired, trained to do creative regroupings by similar knob-twiddlings. Hofstadter was then optimistic that a computer could be programmed to provide this parquet deformations. Indeed technology since then has allowed us to construct fractal patterns and morph, say from person to leopard in ways almost as complex as an Escher transformation by feeding in mathematical transformations: Beginning from complex woodblocks like Escher's Liberation (in Hofstadter (1979 p.57), computer imitations of Escher can now be found at and indeed form part of an interdisciplinary creative exercise in mathematics and art. But which do we feel is more creative - these formulaic creations or the elaborations of artists build on Escher's work deliberately, to a different purpose, such as Nokadet's Springtime (2001) which plays humorous games with parts and wholes rather than merely distorting patterns.

**Creativity is not atomistic knobtwiddling**

The way people make variations in visual art is quite different from the way the computer makes mathematical transformations of Escher or Mondrian paintings. They are trying to make something for a purpose, usually to make meaning. When they look at some creation by an artist (or computer) they abstract from it some quality that they observe in the creation itself, not in the algorithm behind it. They look for the “intention” of the artist, even when deconstructionists insist that there is nothing beyond the text itself. There is an assumption that Nokadet had some good reason to make colour a part of his tessellations and to soften the geometry of Escher. When we are asked what this picture means, we do look at its referents, but it is immaterial whether the picture represents the spirit of a Japanese Easter bunny family or an ingenious patterning of composite bunnies. For us to make meaning we have to pull together the component parts into a new whole which looks at relationships between the colours, the lines, the patterns and the whole. This newly abstracted quality is there for the seeing by an acute observer and there are better and worse ways of looking at it. The person who does not see the big bunnies has missed the point. This making of meaning is a trial and error process in which we make hypotheses and try for the best fit. In understanding the relationships between the big bunny and its components we can begin to understand the intention of the artist better.
Exercises in creatively making connections

You might say that I am talking about critical analysis in my making of meaning, and not about the creation of it. Yet I don’t think analysis and creative imagination are as far apart as empiricists have made them. Creativity is the ability to make connections between different systems of thinking, a way of putting things together to make sense. Hofstadter in an article “On the Seeming Paradox of Mechanizing Creativity” says “I see creativity and insight, for machines no less than for people, as intimately bound up with intelligence, so that I cannot imagine a noncreative yet intelligent machine... To me, "noncreative intelligence" is a flat-out contradiction in terms.” (Hofstadter, 1986 p.527).

I invite you now to join me in an intelligent and creative exercise, to make sense of the following illustration:

What were the rules you followed to make that into two words? If I provide a context from the real world and suggest that the image might appear on a small box on a post near a gate, or by a road, is it easier to see the words "mail box"? The rules by which the “meanings” click into place are not computer-like algorithms, nor are they irrational. They are intuitively perceived patterns only in the sense that they more or less fit templates of previously experienced shapes. There is a correct answer here. The mind makes holistic connections where algorithmic rules cannot. It pulls parts together in a different way to make sense of them. There is an “aha!” of recognition.

A similar rule-governed process will take place if I ask you to do a more creative exercise - to see things other than they are. Look around the area in which you are now and find the shapes of each letter of the alphabet in the lines of everyday objects around you. I don’t mean in the title of a book or sign - I mean the angle of tree branches, or the corners of furniture or patterns in the carpet. In this case there are multiply different correct answers, especially because there are many possible variations of letter shapes. But the answers have to be reasonable, especially if I make the exercise one of sharing your discovery of latent letters with someone else. Part two of this exercise might involve your ‘finding” a three
or four letter word in the natural environment, giving a clue to the word to a partner and then pointing roughly to the location in which the letters appear, and having them see the same letters you do to guess the word. If this exercise is futile, it may be because your own creative exercise is too irrational, and idiosyncratic. Creativity, especially of an art work, must be accessible to an audience and that will require rules, even if they are heuristic and open rather than algorithmic and predictable.

**Relevance and context:**

The rules might consist of little more than exercising critical judgement in order to make connections, to make parts relevant to a context. If I ask you see patterns, I am assuming that relevant connections are there to be made. Why is relevance so important? Because relevance, as Trudy Govier (1985, 1997) argues, is directly related to rational structures and making connections together. The rationality of relevance includes shared agreement and adaptability, both open concepts often made social by linguistic abstractions. If I ask you to see how these three shapes relate to each other, you will assume there IS some connection and you will have to describe the connection in a language to test your perception of connections with mine.

Each is a string of symbols familiar to all English-literate people. What is it about being able to name the three shapes as the letter A, or the three "pictures" as an alphabet that helps us to recognise the pattern? We can make sense of the creative A’s when they are placed in a context for which we know the rules.

Of these fonts, Hofstadter (1985,p243) says "To native readers of the Latin alphabet, it is an almost immediate visual experience to recognise how any one of them is an "A." No conscious processing is required. ... Note that no single feature, such as having a pointed
top or a horizontal crossbar is reliable. Even being open at the bottom is unreliable. What is going on here?" It is of course pattern recognition, and we can recognise the pattern without necessary and sufficient criteria for the letter A because we have associated it many times in different handwriting and fonts already. We have a broad repertoire of possible variations. We have abstracted the spirit of A from many different forms of it. On the next page, he provides 23 variations of the Chinese character "hêi" meaning "black" and invites the reader to consider how the various features of the canonical or "Platonic" character "are implanted in these mortal incarnations". The rationalist dream of reflecting fleshless concepts in their physical conceptions! But it is more than a dream, Hofstadter believes that the rules for constructing variations on the letter A are programmable, that the complexity of computers enables us to approach the vision of a unification of all typefaces. The underpinning assumptions (Hofstadter, 1985, p.261) are that

(1) Underneath all 'A's there is just one grand ultimate abstraction that can be captured in a finitely parametrizable, computational structure - a "software" machine with a finite number of "tunable knobs" (we could say degrees of freedom" or parameters", if we wished to be more dignified):

(2) That every particular 'A" is just a product of this machine with its knobs set at specific values"

Meanwhile back in the classroom, James, aged ten, constructs this fox out of autumn leaves.

Osborne and Brady (2000, p.3) trying to explain this act of creativity also see creativity arising from a recognition of the abstract in the particular:

In what ways are leaves like foxes? How is a "whole" composed of parts? In creating his fox James engages such questions. The leaves, as James handles and examines them, assert their own qualities. This can happen because they possess both generalizable qualities and irregularities: those qualities that exist and which we can't classify using the particular set of patterns we are trying to impose. The imposition of theories--generalizations, patterns--enables seeing the phenomenon in new ways because of the abstracting qualities of the process and also because this process is situated in a creative act, in this case trying to make something out of something else. When the qualities of the phenomenon that don't fit the pattern begin to demand our attention, stop being invisible, the assessment of the object or the pattern or the task will be revised.
Reducing the fox into geometric shapes and then seeing similar shapes in the leaves is an abstraction, as a process it involves abstracting a generalizable ideal and fitting it to a pattern. Patterns are substanceless descriptions of relationships. Patterns, both seeing and making them, are compelling in science and in general because they cause us to see the totality of a phenomenon in new ways. The parts of the phenomenon that don't fit the pattern become both invisible and are thrown into relief. Pattern is compelling because the act of bringing order to disorder is infused with romantic mystery and with power. But the parts that are left in disorder are even more mysterious and maintain the phenomenon's own power.

Hofstadter acknowledges the phenomenon’s mysterious power but is uneasy about such romantic mysteries, as are the curriculum designers who wish to monitor standards in education by omitting creativity. In a discussion between Achilles and the Tortoise as to whether molecules can determine our behavior, (Hofstadter 1985, p.605) Achilles responds to the tortoise's claim that molecules is all he is, by saying

Oh yes, I know I'm made of molecules. Nobody could deny that. It just seems to me that my molecules are at my beck and call - not individually of course, but in large "chunks", such as my fingers, when I play my cello or sign a check. So that when I decide to do something, my molecules are forced to come along" Is't it really the case that I shove those molecules around, and not vice versa?"

Tortoise replies as Daniel Dennett and the Churchlands would, that this "I" is nothing more than a set of preferred pathways for neural activity to flow along. Your free will constrains the motions of molecules inside your brain and those motions in turn are reflected in the patterns that your fingers will trace out. On this view the self, the creative "I", the mind's I, is part of a huge internalized set of external public, aural conventions - the English words attached to particular states of my own brain, states that were correlated with things " out there, and not only things but actions and styles and relationships. Awareness of one's own imaginings and one's own processes is a complex sort of self-referencing feedback loop, a jump into an abstracted level that can pull things at the lower state together differently. "Self", to shift metaphors, is a collective phenomenon. A brain is a collection of some 100 billion neurons. These parts are connected to each other in fantastically complex ways.

Hofstadter, using statistical mechanics, asks us to imagine a three-dimensional lattice in which a particle can sit with its spin pointing either up or down. Each particle directly affects only its immediate neighbours through the magnetic field created by its spinning. So now each particle must decide if it "wishes" to be pointing up or pointing down. Its decision is "deterministic", being governed by the state of its neighbours. But the strange thing is that their states are in turn governed by their neighbours, and so the whole thing turns out to be interconnected in a vast interlocked way, despite the fact that any particle "feels" only its immediate neighbours. If that is too abstract to follow in relation to creativity it is nonetheless a similar type of system to that proposed by the neo-Kantian Piaget in his solipsistic genetic epistemology. Like all systems theories it presumes that the whole is greater than the sum of its parts and that you can only understand complex phenomena like self or creativity, or like a hurricane or a traffic jam (Hofstadter, 1985, p.787 ) by contemplating the whole, not any individual part of the pattern.

The mind is the organiser which attempts to find patterns, to make meaning, in the unfamiliar, or as we shall see in the second paper, to "make sense" of the world. Mind may be nothing more than an accidental assemblage of our associations of past experiences as the behaviorists held. Hofstadter seems to think it arises out of conflicting lower-level
"selves" in our brain, lower levels or organisational capacity, in which case mind emerges out of the attempt to resolve tensions between conflicting "views of the world. This attempt to find equilibrium between competing systems is consistent with a Piagetian model, but as Hofstadter shows in his attempts to have a computer create a universal alphabet font, it is a closed system in which even the Mind at the highest possible level of organisation is little more than a chance or random resolution of tension of subparts. If Hofstadter could reduce the creative act to a mechanical twiddling of knot-twiddling the atomistic subparts of the brain, it would make it easy to provide the classroom environment, or whole, which could pattern our knot-twiddling towards clearly articulated ends. There is no need for programmed instruction in creativity in the classroom other than to provide an environment which creates the tension to be resolved by knob-twiddling. This is what the Suzuki method of training violin does, or the art of having thirty-five students transform 35 flat pieces of paper step-by-step into 35 identical origami frogs. The instructions can be provided by detailed instruction on the internet or programming the machine (Britton, 2001). I do not think that is the sort of creativity desired by curriculum framers in the arts key learning area. We can reassure educators that creativity does not mean total chaos, and is bound by and depends on abstracted generalisations, but we have somehow to prevent the recognition that creativity depends on structure from denying the openness and freedom of the creative connection.

The teachers that spoke of the child making a fox out of leaves say (Osborne and Brady, 2000):

The children's creations amaze and amuse us. They do cause us to think new ways about the possibilities in trash but when we talk about "social and cultural critique," that occurs as we look at the children. When we see the possibilities in allowing them the "space" to be creative they challenge our assumptions about what they are capable of doing. As teachers the site of critique and creativity is there, in seeing new potentials in the children, in seeing the children in ways we haven't imagined them to be. We "bump" against our ideas of the child and also our ideas of what constitutes teaching for here teaching is an act of discovery. It is surprising.

To even speak of the possibility of social and cultural critique moves us outside the individual child's head in a way that neither Piaget nor Hofstadter has the courage to do. How is this concept of creativity different from Hofstader's systemic structure of moving up and down a feedback self-referential loop of holistic abstraction to atomic particulars? It is human and open, it contains an ability to delight in the unexpected and to adapt to it in unexpected ways. It includes feelings in the parts that are re-connected, and allows for delight in the unexpected in a way that computer programming cannot. The most important criticism of Hostadters's model, is that, while it might be self-generating, it remains a closed system. We could just enlarge the whole/part relations several steps further, but the teacher's view of a child being a sub-part of a classroom, and the classroom being a sub-part of a democratic social system, suddenly presents us with parallel processing not of different computer-like associations, but a chaos of people trying to see similarities in their complex systems of representations of the world.

**Senge's open learning organisation**

Peter Senge (1992) also employs the notion of systems theory to encourage more creative business institutions. What he has to say about the importance of the whole exceeding the mechanistic sum of its parts is similar to Hofstadter's, but Senge's is a more human vision. He is still trying to move the traditional management hierarchy of power implicit in many educational programmes beyond control. His five disciplines are systems thinking, personal mastery, mental models, building shared vision and team learning, but they are dynamic and
interactive and his main claim (1992, p.140) is that adaptive learning must be joined by "generative learning". Learning that enhances our capacity to create. In a chapter titled "Openness" (Senge, 1992 pp.273 -286) he argues for the need to move beyond the politics of power and control and recognise that most people want to be a part of something larger than themselves and want to contribute towards building something important, offer their personal visions to something that reaches far beyond their personal self-interest. To build such a community of inquiry they will need to be able to communicate their personal vision, that requires reasonableness and openness. To me that is the relevance of knob-twiddling, that one's personal vision must follow "the rules" closely enough to be comprehensible to others.

Making meanings together

The arts are to me are more about an open-systems manner of checking to see how individuals have consciously chosen to represent their life-world and the meaning they have made of it. Meaning, not truth. And meanings are chosen social things, tied flexibly to abstract systems of language which may be mathematical, musical, humorous, English, or not. They have been socially and intentionally constructed in a way in which computer programmes have not. In the Haynes and Haynes model of critical and creative thinking, often the critical thinking column represents the accretion of "molecules" of knowledge and values that have built up over past history and that our society accepts without conscious processing, as if it were fixed. But it gains its flexibility by being subjected to the intentional gaze of the individual who seeks to make personal meaning of the social rules. Individuals get corrective feedback not only from the standardised canons, like the paradigm letters of the alphabet, but from the community around them which can accept and understanding minor knob twiddlings, given enough cues to be able to justify changes to the system. Mind is not an abstracting pattern-maker at the most abstract level rearranging the molecules into sym-balls by recognising similarities and differences. In an open system, mind operates from bottom-up and, after a suitable preparation in social conditioning, from top-down and needs critical reflection and social evaluation to keep it within what Plato called "the tether of reason". It is not as machine-like as a computer programme, nor simply intuitive and invisibly beyond the pale of reason, but a process which consists of Mind trying to find equilibrium between the dominant structure of society, especially linguistic structures, and the knobtwiddling that tries to adapt past systems to individual meanings. Curriculum writers are right to seek authenticity because without it, society cannot change or improve. We stop it getting completely out of control by encouraging social comment and reflection which is what makes it possible to evaluate it. Its systematicity however is continuously open and adaptive to novel contexts - meeting someone from a different culture or, as we shall investigate in the next part of this dual paper, by confrontation with the constraints of the physical world.

The development of a self seems to us to be one of the important aims of schooling. Neil Brown (1997, 2000) argues that most school assessment of the arts implies that the student has "authentically" created the artwork only when the student fulfils the teacher's value prescriptions. In that sense the artwork is not "authentic" but done mainly to fulfil the teacher's requirements. What we are looking for is a classroom situation that openly allows the development of authentic student voices without the imposition of institutional control or power. But there are many paradigms of education which have no place for authenticity, including the economic rational or behavior management ones which shriek control and management. The removal of creativity from the curriculum mapping exercise betokens a fear of change and a fear of losing control. In our map of critical and creative thinking, we show ways of recognising that creativity in the classroom is never totally out of control but that its very dependence on knobtwiddling existing rules is a mechanism for moving forward to new meanings together in an open learning organization.
References


Brown, Neil C.M (1997), The meta-representation of standards, outcomes and profiles in visual arts education *Australian Art Education* 20, 1&2; 34-43.

Brown, Neil C.M (2001), The imputation of authenticity in the assessment of student performance *Educational Philosophy and Theory* 33: 3


Haynes F.A. (1976) *Metaphoric thinking* *Educational Theory*


Hofstadter, Douglas (1985) *Metamagical themas: Questing for the essence of mind and pattern*


Robinson, Ken (1998) *All our futures: Creativity, culture and education* National Advisory Committee on Creative and Cultural Education Report to UK Minister for Education and Employment and for Culture Media and Sport.


<table>
<thead>
<tr>
<th>Critical Analysis</th>
<th>Making meaning</th>
<th>Development of a community of inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>connect ideas and frames</td>
<td></td>
</tr>
<tr>
<td></td>
<td>show awareness of relevance</td>
<td></td>
</tr>
<tr>
<td>express ideas verbally</td>
<td>classify, use concepts to make meaning</td>
<td></td>
</tr>
<tr>
<td>assess argument</td>
<td>generalize from particulars</td>
<td>show awareness of group dynamics</td>
</tr>
<tr>
<td>(be disposed to consistency)</td>
<td>show awareness of structural relationships</td>
<td>understand causal, temporal and spatial concepts</td>
</tr>
<tr>
<td>choose rationally</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plan/predict</td>
<td>interpret meaning of others</td>
<td>accept responsibility for actions</td>
</tr>
<tr>
<td>problem solve</td>
<td></td>
<td>consider long-term consequences of actions</td>
</tr>
<tr>
<td>be disposed to seek reasons</td>
<td>interpret signs</td>
<td>show sensitivity to cultural differences</td>
</tr>
<tr>
<td>give reasons for beliefs and actions</td>
<td>show awareness of the contextual dependency of understanding</td>
<td>understand the social basis of reasonableness</td>
</tr>
<tr>
<td>problem seek</td>
<td>show awareness of purposive activity</td>
<td></td>
</tr>
<tr>
<td>be disposed to inquire after truth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>generate new ideas</td>
<td>embody meanings</td>
<td></td>
</tr>
<tr>
<td>develop a sense of humour</td>
<td>develop a personal style</td>
<td>develop a communal style</td>
</tr>
</tbody>
</table>