LEARNING, THINKING AND ASSESSMENT

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INTRODUCTION

In this broad overview paper I will share my research, practical experience and reading in the areas of learning, the direct teaching of thinking and the myths and realities of assessment and evaluation. Here I paint with a broad brush, for those of you interested in going more deeply into these issues I have provided a detailed reference list, or you can contact me directly.

My aims in this paper are threefold:

- **to share with you my research findings and personal practical knowledge from almost thirty years in the field,**
- **to share the implications I see for your work, and**
- **to challenge and support you.**

I have passionate beliefs about education, as I am sure do you. Let me begin by sharing some of these as they relate to the topics I address in this paper:

- **Schools that are not already joyful places for principals, teachers and students need to be restructured so that all concerned can get back in touch with the joys of teaching and learning. I believe that people in schools already know how to do this and should get on with it and be trusted and supported in doing so.**

- **Teaching and learning have a strong knowledge base, which should be made available to all teachers, students and parents (see Saphier & Gower: 1997).**

- **Teaching and learning are also shrouded in unproductive "myths" which should be challenged. These relate to: honest analyses of the worklives of teachers and principals (which I have addressed elsewhere, Edwards: 1994b); to habits and expectations which can destroy teachers - particularly to do with pedagogy, lesson preparation, and marking, some of which I will address today; and to structures and practices that are outdated yet clung to.**

- **Independent learners who can work well with others are best developed by focussing on the individual, on constructivist approaches, on co-operative learning, on formative evaluation and on self-assessment.**

- **Learners starting with little or no experience need rules to help them survive while they develop their own personal practical knowledge. Those starting with experience should be helped to articulate that and have it respected in their learning. As learners develop their own personal practical knowledge, independence and self-responsibility should take over.**

- **If learners are listened to, trusted and respected, then if they have the processes they need they will always deliver.**

- **Learning comes through action, and the lived reality seldom matches the theory. What we are doing here together today is a preparation for learning, which can take**

place if you act on something when you get back to work. Once you make it your own, learning has occurred.

- **Learning, skill acquisition, action and growth are context-based. Only you know your context. So be wary of researchers like myself who, of necessity, have to talk and write in generalities to general audiences. I have never been to your school and do not know your individual context. It is from the basis of your personal practical knowledge and beliefs that you drive your behaviour, in the same way that your teachers and students do.**

STUDENT IN-CLASS THINKING

The first research I want to share with you I began with Perc Marland fifteen years ago. We have done extensive research on what goes on in children's heads while teachers are teaching (see, for example, Edwards and Marland: 1982 and 1984, and Marland and Edwards: 1986).

The way we get these data is by using a technique called **stimulated recall** (Marland: 1984, O'Brien: 1993). A video camera placed at the back of the room follows the teacher wherever the teacher goes. A second camera at the front of the room is focused on the children we are studying, and a microphone is placed so that the talk of both students and teacher is recorded. The two images are put through a video mixer so that both appear on the same screen. At the end of the lesson we make rapid copies of that split screen tape and use it to interview individual children about what they were thinking during the lesson. So I interview one child while fellow researchers separately interview others. The child presses play on the tape and says what they were thinking. For example, the teacher says something and the child presses pause and says "When he said that I was thinking this and that and the other". They then restart the tape until they pause it again: "see there, when I was reaching down into my bag - I was getting so and so out of my bag and thinking ...." or "There I am talking to my neighbour, she said this to me and I said this to her, and I was thinking this and then that" and on it goes...you get a stream of consciousness recall of their thinking in the lesson. These interviews are recorded and transcribed. It is very rich illuminative data.

Let me take you for a gentle stroll through the minds of some children in a grade eleven Biology classroom in North Queensland (Edwards and Marland: 1982).

> Yvonne says: *"There's just bits and pieces of it that do sink in but most of it just kind of doesn't register. I do usually get the important bits, 'cause you just learn to kind of half listen and half not listen, just in case he does ask you a question, and you just learn to do it,* ***'cause there's always his voice there****."*

Isn't that delightful, - "There's always his voice there."

It is like a security blanket. What I call the sea of blah. The teacher stands at the front of the room and blahs all over the place - blah, blah, blah, blah, blah. The sea of blah fills the room and the students bob up and down in this sea. Every now and again they go under and take a gulp then bob up again for air, and then down again. The gulps are somewhat random. So **students spend their days gulping from the sea of blah**.

What do they ingest from the sea of blah? Well here is one example from this classroom. The teacher is teaching a Biology lesson about the jawbone of an ancient horse. He says: "Today we are going to study the jaw bone of an ancient horse." Yvonne is a horse enthusiast and she

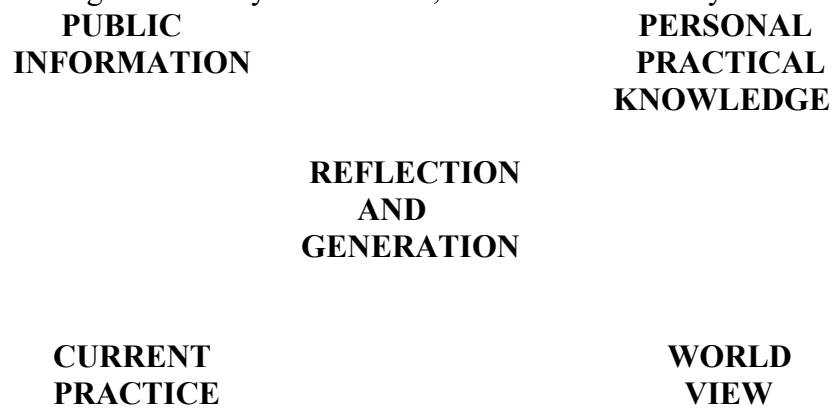
“goes off” jumping hurdles on her horse, on a mental tangent, she's gone. In the post-lesson interview she cannot remember the teacher's words and instead describes to me the feelings she gets as she goes over the hurdles, during her mental tangent in the lesson. The teacher then says: "The Latin name for this horse is...." and one of the other students is a Latin enthusiast, so off he goes thinking about all the Latin words he knows. All the while the teacher continues to teach Biology - Yvonne is mentally jumping hurdles on her horse and Oscar is thinking about Latin words. What we found was a bewildering array of attention patterns. When a teacher says "I've got them with me", I would suggest the teacher needs to think again - you never have them all with you! Just as I do not have all of you with me constantly today.

From every delivered lecture using the sea of blah technique **each listener takes home a different story.** The reason is that when you come back from your mental tangent, all that I have been saying has gone. You can't press rewind and then play it back. All the words have gone. This is where books and computers have a great advantage over us as information givers. The best analogy I can give you is to imagine you are reading your favourite novel, you go off on a mental tangent, when you come back half of the page has just vanished. Imagine the frustration. That is what sea of blah learning is like for the listeners. Yet teacher talk is the major mode of instruction still in schools (see, for example, Goodlad: 1984) and universities across the world, even though we all know better.

If you must use sea of blah techniques I recommend that **every 7 to 10 minutes you stop and give the students what I call a one-minute perception check**. One minute where you stop and let the students think about what you have been saying. They can wake if they have been sleeping or dreaming, check understanding with their neighbour, reflect for themselves, or just take a break from intensive information processing, whatever. The point is, they will take the breaks whether you offer them or not. So why not use them to everyone's advantage? Students can have the technique explained to them, and then learn to use it powerfully in teacher-centred lessons. It is also great for teachers as it helps them to plan and monitor the flow of their lessons. Allowing students time for mental processing encourages **a new technique I am trying to introduce into Australian classrooms: it is called learning**.

A MODEL FOR EXPLORING LEARNING

Butler (1994) has developed a powerful new model of change and professional growth, which we are using successfully in education, business and industry.



This is an alternative to the transmission model of learning where public knowledge is seen as being dumped directly into current practice.

Public information is information which is available in the public domain through reading, training programs, the Internet, lectures and the media in general. It is what most people have learned to expect to receive in most educational settings. Public information is external to the self.

Personal practical knowledge (PPK) is the knowledge you own. It comes from your lived experience and your reflections on that experience. This knowledge is internal to the self. Some key characteristics of PPK are:

- **Your PPK is unique to you.**

You are the only person to have done the things you have done and thought the thoughts you have thought. This makes each of us, teachers and students, a unique resource for any group or classroom we are in. It also makes you the most valuable resource for your own development. The critical resources for your growth lie inside you, not outside.

- **Your PPK is largely implicit and difficult to articulate**.

While most of us carry an enormous store of PPK, it is seldom in an explicit useable form. If I asked you to stand in front of a group and explain what it takes to do your job successfully, you would probably find it difficult to do. It is not that you do not know, but seldom are you asked to articulate what you know. Giving time for this, and helping students learn to do this, is critical for learning.

- **Your PPK is resistant to change**.

Your PPK is the store of experiential knowledge that has got you to where you are today. So obviously you will not be inclined to change it easily, nor should you be. This goes for every student in your classrooms. Their life has taught them! Respect for the lived experience of each child is a fundamental starting point for learning. Roger Osborne and his team at the University of Waikato in New Zealand in the 1970's did wonderful research on the PPK of children through their Learning in Science (LISP) Project. They suggested that children construct their own knowledge, and they described the characteristics of the "conceptual change classroom". Constructivist philosophy is the current flavour in the U.S. and in many academic disciplines in our part of the world.

There is a great undervaluing of the PPK of Australian workers and Australian students. From my experience it is the single greatest underutilised resource in Australian business and industry, and Australian classrooms. Jack Welch, the CEO of General Electric, (in Belasco: 1990, p.6) expressed it well:

> *We have found what we believe to be the distilled essence of competitiveness, it is the reservoir of talent, creativity and energy that can be found in each of our people.*

This applies equally well to our schools and classrooms. Classrooms, schools and business workplaces are all impoverished when the skills of all are not used to the maximum. The results we have had in industry from setting free the PPK and creativity of workers has surprised experienced managers.

For Butler, world view is derived from tradition and our experiences and consists of beliefs, assumptions and 'a tablet of values and rules that the self holds as true at this stage of its development'. **Our world views wash through everything we do.** They are the foundation

for human behaviour, take many years to form, and are largely sub-conscious. They usually contain a mixture of rational and irrational beliefs. While it is a difficult area to work in, because many people regard it as totally private, it is important to encourage people to become more aware of their world views at an explicit level and to explore their influence on thinking and actions. Our experience has been that if trust is developed through the careful forming of the group, and if the activities are at the right level of openness, most people are willing to look at some of their world views. Senge (1992) refers to the mental models that people have, and to the value of bringing these to the surface.

Looking at how your world views have formed, and understanding the processes and experiences involved, enables you to identify the assumptions and beliefs that are driving your behaviour. If you see some of these as inappropriate you can then work on changing them. This is particularly important for teachers since their world views are constantly transmitted to the students. I believe that no-one should enter the profession without a reasonable level of self-awareness. **Children should not have to deal with the "personal baggage" of under-developed teachers.** Teacher training institutions, and their supervising teachers, have a strong responsibility to make the profession self-regulating, and not to let through people unless we would be comfortable with them teaching our children, and being our colleagues.

Senge et al (1994) use "the ladder of inference" to help people see how they develop their own selected version of an event based on their beliefs, values and assumptions. This determines how they make meaning of the event, which in turn leads to conclusions which drive behaviour. These conclusions then act to reinforce the person's beliefs, values and assumptions, which feed back into how the person forms their selected version of future events.

Reflection is a critical process. While many people are reluctant to make the time for it, few deny its power. Bruner (1986, p.132) provides one such view:

> *If one fails to develop any sense of reflective intervention in the knowledge one encounters, one operates continually from the outside in - knowledge controls and guides you. If you develop a sense of self premised on your ability to penetrate knowledge for your own uses, and you share and negotiate the results, then you become a member of the culture-creating community.*

We provide periods of reflection in our work and encourage the keeping of learning journals. This is not a typical narrative journal; it is a journal of thoughts, action strategies, perceived outcomes, reflections, and designs. We often refer to them as Think Books. Reflection is not just a formal academic process. "Chewing or mulling things over" is common for most people. Becoming more aware of such processes and how to use them effectively strongly facilitates learning. Bruner (1986) sees reflection and distancing as crucial to opening up possibilities: **'a metacognitive step of huge import'.**

Generation or design of new ideas is also critical for growth and change. Most people are locked into familiar thinking strategies and familiar ways to identify and solve problems. These may work well for them. However my many years of research on the direct teaching of thinking (Edwards: 1991a, 1991b, 1994b&c, 1995) have shown me **the powerful benefits of teaching people new thinking strategies.** The strategies of de Bono (1987, 1993, 1994a,b) provide a very practical basis for teaching generative thinking.

When public information, PPK, world view, and the generation and reflection processes,

are mixed in with an exploration of current practice, a solid basis for learning exists. Students' current practice is what they do now, the strategies and skills they bring to the learning.

When new public information is presented, it is matched against PPK, world views and current practices. Through reflection and generation: the public information could be incorporated into PPK; it could influence world views or practice; it could be totally rejected; or left as "inert" public information, which is held in parallel with the PPK on which the person acts, and will slowly fade away (particularly after the exams).

Revans' (1982) concept of **action learning** offers an alternative to the traditional concept of learning as sitting and listening or reading first and then acting. In action learning you learn by studying yourself, what you do and think. You become self-aware, and then you work on learning. This is based on the idea that nothing ever becomes real until it is experienced. Knowledge from direct experience of the world is different to academic knowledge. It is more singular, unique, and specific to the particular context. This is its power. It has the flavour of reality that is very convincing to people. **We argue strongly for an "act to learn" approach**. A continuing cycle of act - gather data – reflect - design new action...and then into another cycle. Knowing how to spin oneself through successive iterative cycles is central to professional growth and learning. Many of the people we work with left school as failures in their early 'teens. To see them blossom through action learning projects based on their own PPK, world views and practice is a rewarding experience.

IGNORANCE AND LEARNING

I was the sole Australian representative at the First International Conference on Ignorance. Which surely ranks me as one of Australia's leading ignorami. The theme of the conference was medical ignorance. It was based around the highly successful and innovative Curriculum on Medical Ignorance at the University of Arizona, Tucson (Witte et al 1989). Here young doctors in training are encouraged to focus on the role of ignorance in their profession and learning.

In education we operate as if knowledge is the big and important area and ignorance is some tiny insignificant appendage off the side. In actual fact, **ignorance is the huge and massively expanding area** and knowledge is a tiny appendage off the side. If the truth were known most of you, like me, know nothin' about nothin'. The sooner we accept that and the humility which goes with it, the better education will be. The Dean of Harvard Medical School reputedly expresses it well. In his welcoming address to the students each year he states: "50% of what we will teach you in your degree will have been proven wrong within 10 years of your graduating. The only trouble is we don't know which 50%."

I believe that if we focussed more on ignorance and less on knowledge, not totally, but just shifted the balance, we would be better off. Ignorance and knowledge are not two sides of a seesaw, so that as one goes up the other goes down. What I find is that the more I know, the more I know that I do not know. **As my knowledge grows, my ignorance grows even further.** Teaching students to be aware of their own ignorance, and developing in them techniques for what to do when they don't know the answer, are important skills for the life ahead. These issues are discussed in much greater detail in Edwards: 1990.

The philosopher Sidney Jourard (cited in Kerwin: 1987, p.1) offers sound advice in this area:

We begin life with the world presenting itself to us as it is. Someone, our parents, our teachers, our analysts, hypnotises us to see the world and construe it in the right way. These others label the world, attach names and give voices to the beings and events in it so that thereafter we cannot read the world in any other language or hear it saying other things to us. The task is to break the hypnotic spell so that we become undeaf, unblind and multilingual. Thereby letting the world speak to us in new voices and write all its possible meanings in the new book of our existence. Be careful in your choice of hypnotists.

Kerwin (1986) provides a useful map of ignorance which is the basis for the Curriculum on Medical Ignorance. She divides ignorance into four areas:

1 **The things we know we don't know** - for example, we know we don't know a cure for AIDS.

2. **The things we don't know we don't know** - these are the things yet to be discovered - for example, we didn't know we didn't know about DNA 30 years ago because it hadn't been discovered yet.

3. **The things we think we know but we don't** - this is where we have a misconception or where knowledge will change, and

4. **The things we think we don't know but we do know.** - deep intuitive or implicit knowledge that we don't know is there. This is not currently strongly valued in our culture, it is more valued in other cultures, has a history of being valued in our culture, and its importance is becoming much more recognised through the work of researchers such as Benner: 1995.

They ask their "knowledgeable" medical students to explore each area of ignorance. They use visiting professors of ignorance to share things they do not understand, their questions and how they are addressing them. Topics begin, not with expositions by lecturers, but rather with students' questions on the topic, which are then classified, analysed and refined. The students keep ignorance logs where they record their own questions, their search for answers and their progress. They learn the difference between powerful questions and weak questions through experience. The best way to learn if a question is weak is to try to find the answer to it. How can you frame the question better? Try a different question. If we worked on this with children right through their school years what wonderful question askers they would be. The thing is to get them to refine their natural question asking skill (remember when your children were young?) until they are brilliant question askers - not just answer givers, but also question askers and solution seekers. As Russell (1996) puts it: **How often in your schooling did you get the opportunity to pursue a question of your own, right through to a satisfying conclusion?**

So what would it be like if we started to give more of a focus to ignorance? Let me share with you a quote from Lewis Thomas who is the godfather of the ignorance programs being developed in the United States. This comes from his delightful book *Late night thoughts on listening to Mahler's Ninth Symphony* (1983). It is a beautiful book. It is a small book. Put it by your bedside, read a chapter each night. Thomas said:

And maybe, just maybe, a new set of courses dealing systematically with

> *ignorance in science might take hold. The scientists might discover in it a new and subversive technique for catching the attention of students driven by curiosity, delighted and surprised to find that science is exactly as Bush described it: "an endless frontier". The humanists, for their part, might take considerable satisfaction watching their scientific colleagues confess openly to not knowing everything about everything. And the poets, on whose shoulders the future rests, might, late nights, thinking things over, begin to see some meanings that elude the rest of us. It is worth a try.* (p.155)

I know some people would say, "If you try to do that, it takes too much time. We've got to get through the curriculum". Well at Bleyl Junior High School in Texas they won an award as a national school of excellence by putting thinking right at the centre of their curriculum. What was the first thing they did? They undertook what they called the Herculean task: **they threw out one third of the curriculum. I believe we could throw out more than that.**

QUESTIONING TESTING

Do you remember questions like this?

> *If Carlos is older than Lisa, Lisa is the same age as Karen, and Karen is younger than Diana, which of the following is also true?*

(You then have 5 alternatives to choose from.)

I gave questions like this to students as part of my research on teaching people how to think. To assess whether their thinking had improved, I used IQ tests or scholastic aptitude tests. I walked around while students were doing the tests and saw many of them thinking "who cares?" Carlos, Lisa, Karen and Diana are not high on their list of interests. The well-socialised students, and those who are successful, will plough along happily, but as for the rest...many just roll their eyes and sigh.

I also used the Torrance Test of Creative Thinking (Torrance: 1966), the most widely used creativity test. The students work through a series of exercises. In Form B they eventually get to:

Activity 5: Unusual Uses (Tin cans)

> *"Many people throw their tin cans away, but they have thousands of interesting and unusual uses. In the spaces below and on the next page, list as many of these interesting and unusual uses as you can think of. Do not limit yourself to any one size of can. You may use as many cans as you like. Do not limit yourself to the uses you have seen or heard about; think about as many new uses as you can."*

"OK class, you have 10 minutes", click goes my stopwatch. And I walk around the room. It is a hot November afternoon in Townsville and someone has forgotten to turn the fans on. I can hear most of them silently moaning: "Tin cans? The guy's got to be joking!" After the 10 minutes I say "Stop, don't turn the page until I tell you to" and what do we have next?

Activity 6: Unusual Questions.

'In this activity, you are to think of as many questions as you can about (You guessed it!) *TIN CANS.....* '.

Even the students that went along with the last one by this time are thinking: "He really has got to be kidding". **Questions like these simply do not cognitively engage most children.** So I decided to design some questions that really would. We questioned over 300 children on "What is it you think about?" and then surveyed over 1200. This gave us a database for designing questions based around what children told us they think about. These questions had the potential to be cognitively engaging. But I have learned never to trust such surmise. So we studied children doing our questions, which did prove in general to be cognitively engaging. We used stimulated recall - with one camera over the shoulder of the child focused on what they were writing, and a second camera looking up at them to capture every grimace, scratch of the head, and every word spoken.

What did we find? Well, **the most important thing is that what is written on the paper is a poor reflection of what is in the child's head.** We were measuring their home life, their personal habits, their cultural background, and their school experience. We may also be measuring their underlying potential, but for the most part this is masked by many other layers.

The real learning about the thinking of the child comes from the interview, when the child tells us about their thinking. This is what Piaget was telling us: if you want to understand children, observe them closely and listen to them. Taking away written scripts and marking them provides only a very poor description of the child's thinking. **I believe group testing and standardised testing as currently practiced are massively dishonest.** Since schools rely so heavily on such testing and scoring, questioning these practices is fundamental. We need to get to one-on-one testing of children with skilled interviewer/observers, somewhat akin to what Feuerstein does with his Learning Potential Assessment Device (see, Hirsch: 1994).

We should replace paper and pencil tests by situations that may be paper and pencil but are followed by one-on-one debriefings of children. That is how you really find out how and what they think. If you have them in a high school for 5 years or a primary school for 7 years, you have got a lot of time to explore, reveal and improve their thinking in such ways. Teachers could do this comfortably if it became a focus. Systems for incorporating such testing could easily be developed. **Formative evaluation is where the action is.** It should have a major role in driving the curriculum for each child. Of course there is an important role for summative evaluation, but you have twelve years to get there.

I believe we should give less emphasis to paper and pencil testing and focus on a range of techniques to help children reveal their thinking and then use one-on-one and small group interviews with children. If you believe you have a great paper and pencil test that really does show how a child thinks I offer you a challenge. Bring your test and a child of your choosing to me, I will videotape them while they do the questions, you take the script away and mark it. I will interview the child, then we'll compare notes. I guarantee you maximum embarrassment. What is on the paper is only a very pale reflection of what is in their thoughts and while the ability to express oneself in writing is important and should be developed, it is the real quality of the thinking that matters most. And at present we do not tap that very well!

How such approaches can be incorporated into schools I leave to your creativity; but if they

were used over the twelve or thirteen years of a child's schooling how much richer our understandings of, and insights into, individual children would be. Teachers already carry an enormous store of information about all the children they teach. We need to develop ways to articulate and use this information. **I believe that the collective faculty of the school should decide students' exit ratings from schools**. Those who shrink in horror at this prospect often either do not appreciate the skills and knowledge of teachers or are beguiled by the myths of so-called objectivity. To suggest that three hour public examinations are better, fairer, or even equivalent, measures of a child's skills, knowledge, and understanding, when compared with the collective wisdom of the teachers of the child is such a joke that I find it hard to believe that any sane person would argue the case.

Our procedures for evaluating and valuing people are in need of a major rethink. Self-assessment skills are the major ones children need to learn. The myths of objective testing and of validity have supported a huge testing industry for many years, an industry that now forms a very powerful and influential pressure group in the education debate. **Teachers and schools should take back control of the assessment of their students**. They are well able to moderate their work across schools, and can put assessment back where it belongs, as an essential aid to learning and growth. Many people would probably be surprised to learn that before 1792 there was no such concept as awarding marks or grades to human performance and qualities. The first case recorded was William Farish awarding grades at Cambridge University (cited in Postman: 1993). Many people now operate as if this is the only way to see things.

LEARNING AND THE DIRECT TEACHING OF THINKING

It is assumed that students learn to think as a by-product of learning academic disciplines. However research suggests that from such traditional approaches they mainly develop the ability to regurgitate information.

The debates on teaching thinking have been competitive rather than co-operative. So we see strong proponents of higher order thinking, or critical thinking, or logical thinking, or philosophical thinking, or lateral thinking, or accelerated learning, or brain-compatible learning. Publishers and salespersons push their products to the exclusion of all others. New thinking programs emerge, promising much and seeking disciples. **For any person serious in the field, dealing with the oversupply of information and making reasonable decisions is difficult.** Many of these decisions are currently based on limited experience or hearsay.

A good place to begin is with each school department listing the thinking skills and processes they teach in their discipline. A matrix can then be established to reveal the practical degree of generalisability or domain-specificity of any thinking process. Such a matrix provides a valuable structure and highlights the best areas for infusion of thinking skills into the curriculum (O'Brien et al: 1994).

Infusion of thinking skills, once you have learned them, is crucial to the effective and widespread use of the skills. Without thoughtful, continued and varied experience in use of thinking skills, students will not attain mastery. Whether schools choose to teach the skills embedded in academic disciplines or teach them separately and then infuse them is a major decision. Powerful content and powerful process have been taught intertwined for generations. This seems to have produced a dominance of content over process. In this respect schools could well explore the other approach, or at least **give explicit focus to the thinking processes being taught within disciplines rather than leaving them implicit**, buried in

discipline content. This also highlights the value of having a common and widely used language of thinking in a school.

Costa (see, for example, Costa: 1991) argues that teachers should teach for intelligent behaviours and provides broad and sound advice to teachers to facilitate this. He sees the school as "a home for the mind" (Costa: 1994). Baird's action research PEEL Project (the project for enhancing effective learning) similarly helped Australian teachers develop the metacognitive skills of their students (see Baird: 1994). Over the last ten years the focus on teaching thinking has increased.

This brings me to my **research on teaching thinking in schools**. Cognitive process training has a long history, dating at least from the Ancient Greeks (Mann: 1979). Despite this there are masses of research studies from around the world to show that even our best students master little more than the art of regurgitation of knowledge. As Perkins (1992, p.7) recently stated:

> *The bottom line is that we are not getting the retention, understanding, and active use of knowledge that we want.*

I began directly teaching children to think in my classroom in 1977. This was through using de Bono's (1987) CoRT (Cognitive Research Trust) Thinking Skills program in our science curriculum. Practical results in the school were very positive, with strong supporting anecdotal evidence from teachers, parents and students. Research data (reported in Edwards and Baldauf: 1983) also revealed strong benefits from this direct teaching of CoRT thinking.

Edwards: 1991a, 1991b, 1994b and 1995 review most of my research on CoRT. This series of studies indicates that student thinking can be improved in a range of respects through the direct teaching of the CoRT program. Improvements in scholastic aptitude scores, scores on the Torrance Tests of Creative Thinking, scores on self-perceptions of use of CoRT thinking approaches, and often improvements on heavily content-based school exams, were found for students taught the ten lessons of the CoRT-1 program when compared with control groups. However the effects were often short-term.

A major study begun in 1987 looked at teaching a group of 12 year olds, in their last year of primary school, all sixty lessons of the CoRT program - two lessons a week for thirty weeks. The teacher was helped to infuse the CoRT thinking skills, once learned by the students, through all disciplines of the curriculum. Once again **the students showed improved scores on a range of quantitative measures.** In addition, the teacher showed growth on a range of measures (Clayton and Edwards: 1989). Both the teacher and the headmaster, who also regularly took the class, reported impressive benefits. The teacher noted that her teaching style had become much more interactive; she now used group work more; she knew her students and their thinking at a much deeper level than ever before in thirteen years of teaching; the students had achieved outstanding and unexpected results on a set of standardised national tests; and the students now contributed many more ideas of a far higher quality than they had done before CoRT instruction.

The teacher who taught them the year before reported: "there are a couple of good workers, the rest you have to really push hard ...to get anything out of them." The headmaster agreed they had been like this, but **now they were more responsive and more confident in their thinking than any group he had taught**. He referred to 9 lower ability students in the class

who had seldom contributed in class during their six years in the school:

> *It's marvellous. Not just a minor miracle to change that sort of behaviour, six years or more of habit forming and then in the eight months to change it to 'I have something to contribute'.*

When asked to compare this class with other grade 7 classes, he replied:

> *If I look back over eight years of Grade 7s there would be two other classes that I would have rated far, far better than any other class that we have had and if I was to rate these out of eight on a number line they would probably be four or five.*

When the results on the standardised national test arrived near the end of the school year he reported: "I was thrilled ... they were certainly startling and outstanding". The test (ACER-TOLA) consisted of five sub-tests; each designed to produce a standard distribution. This meant that 31% of the students tested would normally fall one or two standard deviations above the mean. The results for the CoRT trained group, and for the mean scores from the previous 6 years of grade 7's at this school were, in relation to proportion of students above the mean, as follows:

	Proportion of Students Above the Mean		
	National Norm	School Mean	CoRT Group
Test of learning abilities	31%	39.5%	52%
Study skills	31%	31.2%	48%
Mathematics skills	31%	24.8%	52%
Language vocabulary	31%	42.8%	62.4%
Language comprehension	31%	35.8%	50%

Feedback from the children themselves was also positive, with the majority reporting big improvements in their thinking and self-confidence, and many reporting wide use of the CoRT skills across the curriculum and in their everyday life. These students completed their secondary schooling in 1992. In the state of Queensland all students are given an overall level of achievement, based on school ratings moderated through a statewide set of standardised tests. The scores allocated to students range from a high of 1 to a low of 25. The CoRT trained group had a few hours of CoRT reinforcement outside of school hours in their second and third years of secondary school, but nothing in the other three years, and no reinforcement from their teachers in secondary school. Their scores had a mean of 10, compared with a mean of 15 for the other students in the school. A score of 15 would not get you into university, a 12 would get you into education. Most parents in the state would kill for a one point jump in Overall Performance score. **These results reinforce the obvious potential of programs such as CoRT for improving the thinking of students**, particularly if the skills are infused broadly through the curriculum and reinforced once learned.

Adey (1994), Feuerstein et al (1985) and Lipman (1994) report similar long-term benefits from their thinking programs. Collections of research can be found in references such as Segal et al (1985), Nickerson et al (1985), Perkins et al (1987), Maclure and Davies (1991), and Edwards (1994a), and in journals such as *Cognition and Instruction and Educational Leadership.* **Despite such results these programs, in total, probably influence less than 5% of schools across the U.K., U.S., and Australia.**

We have recently been involved in a major study to infuse the CoRT program through the curriculum of a large secondary school in Brisbane. (see O'Brien, Stapledon, Edwards and Diamond: 1994). It is studies such as these that are needed to convince educational authorities that the teaching of thinking should be one major focus for the curriculum. The results being achieved by the Cognitive Acceleration through Science Education (CASE) project in the U.K. (see Adey: 1994) are another promising start.

Matching this research is an extensive body of research on teacher thinking and teachers' implicit theories or craft knowledge. This has been well reviewed by Marland (1994). What these researchers are pushing towards is a theory of teaching which grows out of the lived experience of teachers rather than out of pre-determined theoretical or philosophical models. I am confident that most teachers would support this. However, once again, neither educational policy, teaching practice nor teacher training appear to have been significantly influenced.

Principals, experienced and beginning teachers, and teachers-in-training complain that much teacher training is out-dated. **Teaching, particularly in secondary schools, has largely become force-feeding ever-growing chunks of prescribed curricula into young heads. This has produced a level of dissatisfaction in the profession that robs some schools of an atmosphere of creativity and love of learning, and of joy in teaching.**

Teachers do not need new expectations in their already over-filled lives. Most are losing faith in the value of what they do daily. **Few people take the time to analyse the lived lives of teachers** (see Edwards 1994b), and so the myths and unrealistic expectations live on. As I impress on my secondary teacher trainees and on any practicing teachers with whom I interact, a conscientious teacher has on average ten minutes to prepare each lesson, and nine minutes per month per child they teach to do all marking and planning at home for that child. This equates to twelve hours per week work at home on top of school hours. To put in more time than this leads to potential damage to the personal and professional growth of the teacher and to their family life.

It is time for a rethink, for some restructuring of schools, and for some refocusing of what we expect in the graduates of our schools. Many management structures have fatal flaws built into them, and it is easy to get locked into counter-productive management loops. The work of Senge et al (1994) on systemic loops would be a valuable resource for anyone exploring alternatives to the current systemic structures of schools.

For a change it would be a pleasure to have a "forward to basics" movement based on what teachers know and would like to do, rather than yet another "back to basics" movement. **Until the creativity of teachers is let loose we will not get creative graduates. A powerful way to teach students to think is to have thinking teachers.** Principals have a crucial role in ensuring that the necessary challenge and support structures are in place for staff and that they are operating effectively

LEARNING, PROFESSIONAL THINKING AND CHANGE MANAGEMENT

I want to end by reporting briefly on my current research on professional thinking and the creative management of change in business and industry (Edwards: 1994c, Edwards et al: 1997) and its relation to school learning.

Peter Senge, from the Center for Organizational Learning at Massachusetts Institute of Technology in the U.S., following years of research on organisational change, predicts:

> *The organizations that will truly excel in the future will be the organizations that discover how to tap people's commitment and capacity to learn at all levels in an organization.*
> (Senge: 1992, p.4)

The current developing focus on companies as learning organisations opens possibilities for creative associations between educational institutions and businesses. Both have much to learn from the other. It is interesting that **notable recent business successes have grown out of what has been known in education for some time**, and yet businesses seem more ready to capitalise on what is essentially educational research.

Improving thinking in workplace settings offers potential for growth in most companies that is not commonly tapped. Part of this is learning to powerfully use the personal practical knowledge of the workforce, helping people to value their experience and to use it effectively. The other part is providing people with explicit generative thinking skills that can be practiced, shared and worked on. These two starting strategies can lead to workers being more aware of their thinking and how to improve it, to the language of thinking being used widely, and to workers feeling the power of their own thinking and performance.

Maybe the teaching of thinking would be more effectively done in recultured workplace settings rather than in schools. With workers seeing it as a natural part of an effective work life the motivation would be strong to give thinking the attention it needs.

The companies with whom Jim Butler and I have been working for over five years now have achieved great success through our programmes. The company with whom we have worked most, Queensland Magnesia (Hill: 1994), last year won the Queensland Exporter of the Year Award and the Australian Mineral Processor of the Year Award. After three years with them, the culture of the company had changed to one where the PPK of workers at all levels is valued and used, where empowerment rather than policing is the basis for supervisory practice, where new thinking and problem identification and solution strategies are explored, where the language of thinking and learning permeates the workforce, and where taking the time to reflect is a growing habit. We are currently working with the Copper Refineries of Mount Isa Mines on a $0.3 million joint government funded project to improve professional performance and thinking. **It would be a breakthrough to be invited to do similar projects in Australian schools.** There is more international interest in such a project than there is in Australia. I am currently working with two New Zealand schools along these lines,

Most staff development and management training is piecemeal and works on the naive belief that if you present people with new knowledge they will change their current thinking and practice. For most people, in most situations, that simply is not the case. Similarly, while rule-driven behaviour is an important component in training novices, it will never produce expert performance. It is thoughtful lived experience that gets one to expert performance (Dreyfus and Dreyfus: 1986). Experts read the context and then act accordingly (Benner: 1984, 1995).

The Dreyfus model of skill acquisition (Dreyfus and Dreyfus: 1986) provides a valuable framework for understanding learning. Benner (1984 and 1995) has used the Dreyfus model to describe growth to excellence in clinical nursing practice in a way yet to be done in other professions. Benner and the Dreyfus brothers argue that we have focussed in education too

much on detached deliberation, to the downplaying of everyday know how and involved deliberation, which is what skilled practitioners use. Their work reveals what nurses have know about their practice for years but have found it difficult to articulate. Just as for nurses, **the practice of the expert teacher goes well beyond rational theory.** Both nurses and teachers work in an unstructured world where there are very complex interactions of multiple factors. Such a world can never be captured by precise rules. Theoretical language can never adequately describe the concrete manifestations and qualitative distinctions that are central to true teaching expertise. It is important that we start to teach about teaching as a practice which has a different structure and set of concerns than any other career choice. To do this **we first need to help teachers map the profession as it is lived.** We also need to look at how technology will be changing our workplaces (see, for example, Melchior et al: 1996 and Papert: 1993)).

The Dreyfus model postulates a series of metaphorical stages in growth from novice to expert performance:

- At the novice stage the person has no practical experience, so they rely on rules to help them. This is where most of our students start. They need generalisable rules to help them get by while generating their own PPK.

- At the advanced beginner stage they think that someone, somewhere knows **the** answer. Here they typically ask for books with definitive answers or expect you to provide them. They are recognising patterns, but have limited experience and still rely on rules.

- At the competent stage, which commonly requires two to three years of relevant experience, the person is analytical and planful. They now take personal and emotional responsibility for the outcomes of their work.

- The proficient person moves beyond analysis to synthesis, begins to trust their intuition, starts to see things as wholes, and develops maxims to use in their work.

- The expert is highly intuitive, they just do what needs to be done. They understand context and do the right thing at the right time. Their practice is not governed by rules. They know the rules well, but they know when to obey them, when to bend them, and when to ignore them. Their actions are contextual and so can be confusing to novices. **Unless the expert can remember the generalised rules that help novices, they can make very poor teachers of novices.** Often competent people, who are highly analytical, make good teachers of novices and beginners. Since expert knowledge is highly intuitive it is also difficult to adapt to common staff appraisal procedures, and to write into quality standards.

The Dreyfus model is helpful for understanding the stage of development of a teacher or student and also for identifying their learning needs. Benner's latest book (Benner et al: 1995) is the most moving celebration of a profession, read it! We badly need such research in education and a book to celebrate our profession. I am currently working with the staff of Auckland College of Education to set up such a major study in New Zealand.

The only way to achieve expertise is through thoughtful lived experience, to move beyond the basic rules. So schools need to provide teachers and students with the basic skills to start, and then the time, freedom and supportive environment to develop their own experience and

personal practical knowledge about their own thinking and learning. This is not easy within present secondary school structures and curricula.

I want to leave you with a quote from Krishnamurti, which summarises my beliefs on learning. He says (Krishnamurti: 1974, pp. 18-19):

> *I think you should put these questions to yourself, not occasionally, but every day. Find out. Listen to everything ... to the birds, to that cow calling. Learn about everything in yourself, because if you learn from yourself about yourself, then you will not be a second-hand human being. So you should, if I may suggest, from now on, find out how to live entirely differently and that is going to be difficult, for I am afraid most of us like to find an easier way of living. We like to repeat and follow what other people say, what other people do, because it is the easiest way to live - to conform to the old pattern or to a new pattern. We have to find out what it means never to conform and what it means to live without fear. This is your life and nobody is going to teach you, no book, no guru. You have to learn from yourself, not from books. There is a great deal to learn about yourself. It is an endless thing, it is a fascinating thing and* ***when you learn about yourself from yourself, out of that learning wisdom comes. Then you can live a most extraordinary, happy, beautiful life.***

And that is what I wish for you all.

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