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Comparative Knowledge(s)

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ABSTRACT This paper looks at the structure of knowledge as represented in the school curriculum and the academic traditions that divide knowledge into separate disciplines, each with its own distinct content and methods. In contrast with that traditional view of knowledge as separate and incommensurable areas, the author argues that different areas can inform each other, even though one area may not directly impact on another. Thus history and literature can have an impact on art appreciation event thought they do not actually affect what is seen in a work of art. The end point of this argument is that education can enrich experience by creating more complex interconnections between different areas of knowledge, and that ultimately, learning more and creating interconnections is, in turn, a foundation for further learning and understanding.

Keywords: Knowledge, comparative, curriculum, reductionism

Introduction

In this paper I want to look at the nature of knowledge, and especially the nature of knowledge as it is presented in schools. There is a long tradition in curriculum design of looking at knowledge as composed of separate, identifiable bodies of knowledge, each of which has its own methods and its own standards for what counts as knowledge (Phenix, 1964; Peters, 1973). This raises the question of whether there is one form of knowledge or many, and if many, how do they compare. For example, if the different modes of knowledge conflict, which commands more respect.

According to this traditional approach to the curriculum, there are distinct ways of knowing things: mathematical, scientific, historical, religious, aesthetic, kinaesthetic and emotional. Authors differ as to whether there are five, six or seven different ways of knowing things, but each distinct form of knowledge is supposed to have its own standard of truth, its own methods and its own form of argument. Thus the way in which one supports the assertion that Richard III was a bad king who died on the battlefield at Bosworth Field is quite different from the way in which one would support the

claim that water boils at 100°C or that Rembrandt was a great painter. These distinct ways of knowing can clearly have no common ground; scientific evidence carries no weight in areas where the standards of religious revelation are considered relevant.

This theory of the school curriculum is completed by the placing of a duty of educators to introduce the young to each of the different realms of meaning, at least in their rudimentary form, so that they can understand the full range and scope of knowledge before they specialise, or before they make choices about which area of knowledge they will devote their intellectual lives to.

I am reminded here of a cartoon of the curriculum that I once saw in the Education Department of Simon Fraser University, depicting an ocean liner, cut through in the style diagrams in boys' comics, to show the inner workings of the vessel, and sections labelled "mathematics", "music", "English", ""geography" and so on. Underneath the picture was the title, "watertight compartments", and on the prow of the ship the single word "Titanic". The inference was clear; the idea that the realms of knowledge were completely separate and the boundaries impenetrable was the vanity which doomed the curriculum.

I intend to pursue this argument further, and to make the case that those various areas of knowledge are indeed connected, although not in orderly or predictable ways, and that their complete separation is not merely impossible, but also highly undesirable.

Art and Aesthetic Experience

"I do not know much about art, but I know what I like." This is the archetypical statement of the view of isolated realms of knowledge. Indeed, it is archetypical to the point of parody. But it implies that when one looks upon a painting by Vermeer or Constable, one has an aesthetic experience, an immediate apprehension that it is beautiful (or not) and there is nothing more to be said about it.

Take that painting by Vermeer; the Girl with the Pearl Earring (http://en.wikipedia.org/wiki/Girl_with_a_Pearl_Earring), for example. One might make some observations about composition, noting that the pearl earring in question focuses the attention to a particular point in the painting. However, we might go well beyond that, since the painting has inspired a novel and a film. The novel reports the circumstances of Vermeer's life through the prism of the author's imagination (Chevalier, 1999). It gives a sense of the historical conditions in Delft at the time, and portrays the processes of grinding minerals, such as lapis lazuli, to powder and mixing them to make the pigments. It speculates as to what a servant girl could be doing wearing such a pearl earring, and builds on that a domestic drama and the tensions between the wife of a painter who produced so very few great paintings with painstaking slowness and a fa-

voured servant girl who was admitted to the secrets of the artist's studio. In short, the novel indicates how historical and literary knowledge can impinge on our understanding of the aesthetic, and even at how the chemistry of pigments might also enhance our understanding. The painting will never look quite the same again to those who have read the novel.

Or consider the paintings, like the Music Lesson, that were pained in what was evidently Vermeer's studio—a long room with high windows. How did he manage to paint such detailed, photographic paintings without—as x-rays of his paintings reveal—preliminary sketches. There has long been speculation that Vermeer used a camera obscura, a technology that was then at the cutting edge of science, the grinding of lenses having recently reached the level of usefulness. From the various paintings of his studio one can work out the proportions of his room, the position of the lens and the canvas, and the resulting size of the canvases that would result, all of which agree with the actual size of Vermeer's paintings (Hockney, 2006; Steadman, 2002). These calculations in optics, as well as the use of x-rays, suggest that physics can also inform our understanding of art.

While I was musing over these thoughts, and the way that science, history and literature can seep through the boundary into artistic appreciation, I happened to see the film, *Tim's Vermeer* (https://www.youtube.com/watch?v=CS_HUWs9c8c). This film is a documentary that reports the efforts of Tim Jenison to recreate the Music Lesson. He starts from the simple idea of the camera obscura. This simple idea suggests that, using a lens, Vermeer projected an image of what was in front of him onto a canvas, and then proceeded to reproduce the image in paint. It had never occurred to me before, although once one has seen it, it is obvious, that such a scheme has a fatal flaw. You could not paint a realistic picture in this way, because the coloured light projected on the canvas would distort the colours of the paint that was applied, so that it would be impossible to reproduce realistic colour in this way. It would be like trying to paint a picture of a stained glass window while viewing the painting through the stained glass window.

Jenison adds a simple device, a mirror tilted at 45 degrees, to produce a comparator that allows him to see a part of his painting next to a part of the image he wishes to paint. He adds paint until the boundary between the two images disappears. Then, over the course of the next three years he paints the Music Lesson in an exact mock up of Vermeer's studio, to show that Vermeer might have produced his paintings this way. Nobody can know for certain that this is what Vermeer did, but it does provide compelling answers to a number of questions about Vermeer's work. Why was he so secretive about his work? Why did he produce so few paintings? Why are his paintings so startlingly distinct?

Nothing in this line can ever be proved, but one thing is certain; presenting Vermeer's work in this way does have an impact on our artistic judgment. As the com-

ments added to the website for Tim's Vermeer make clear, many people believe this devalues Vermeer's status as a great artist. He becomes a "mere" technologist, converting himself into a machine, and being no more artistic than a camera, recording accurately, but soullessly, what is before him. And whether one dismisses the notion that he might have painted this way because he was a great artist, or dismisses the idea that he was a great artist because he painted this way, it is clear that artistic judgement does not rest in splendid isolation from historical knowledge and scientific reconstruction.

It seems odd in the twenty first century, when we are so well acquainted with conceptual art and conceptual artists, that we have difficulty recognising the unimaginable conceptual leap of a seventeenth century artist who imagined himself to be a camera two hundred years before the technology of photography was developed. Vermeer may well have been a great technician and a brilliant artist, but the mistaken idea that these two achievements belong in different realms is so deeply rooted in our thinking that many people are inclined to see this as a zero sum game, where increased prowess as a technician necessarily means decreased prowess as an artist; he was cheating.

Or take the painting by Constable, The Hay Wain (http://en.wikipedia.org/wiki/The_Hay_Wain). I was lucky enough, in my first year of teaching, to meet an enthusiastic biology teacher who was very fond of the Essex / Suffolk border—Constable Country. He explained to me, and I have never had reason to verify this, that the important thing about the painting is that it is not a hay wain. It is an ordinary cart, showing that in the time of the hay harvest, every vehicle with wheels was pressed into service. This was the result of the growing harvest, the industrialisation of farming, which was forcing tenant farmers off the land and giving way to agribusiness. And this, of course, is ironic, because the painting is now viewed as emblematic of a bucolic past that has gone forever. Through Constable's eyes, this was a symbol of the rape of the countryside by modern industrial methods. Imagine it as a giant, bright red, combine harvester of the day.

As I say, I have no idea whether that is true or not, but it indicates that the title of a painting, and how we interpret the title, can have a profound influence on how we interpret the painting itself. What we know affects how we feel, and even what we see.

Another example of this last point is the demonstration by Richard Lavoie in the Fat City Workshop that knowing what we are looking at can actually influence what we see when we look at a poor quality image (Lavoie, 2013). Lavoie shows how anyone can see a poor photographic image, but they may need to be taught in order to perceive it, to bring meaning to the image.

And on the question of the curriculum, I think that this provides a different justification for what and how we teach in schools. The basic physiological apparatus that we are born with can be shaped and developed by learning. Vygotsky looks at the way in which we incorporate culturally-bound knowledge to build upon the reflexes that we

are born with (Reiber, 1997). What starts as a reflex response to loud noises becomes, through years of training and development of the attention, speech and logic. If we had no reflexes in the first place we would not be able to build the cultural and cognitive edifice that we now inhabit, but nor should we be fooled into believing that the basic reflexes are all that there is to understand.

Basic drives of sex and passion can be developed and refined through association with the sonnets of Shakespeare or the poetry of Donne. And this, I think, is why we teach what we do in the process of education; we teach how to become fully human by developing in the mind a range of associations that enrich our experience. Of course, everybody will have slightly different, and unpredictable associations, depending upon his or her personal history. In extreme cases individuals will have synaesthesia, and will see the colour of smells or the shape of musical chords. But all of us will develop more or less strong connections across the realms of knowledge.

Reductionism

It would hardly be necessary to make all these points about the ultimate interconnectedness of knowledge, except that the alternative view seems to be in the ascendancy at the moment. The world appears to have been overtaken by a fundamentally biological view that knowledge is composed of atoms of knowledge, which can be related at a basic level to brain function; learning is a process that involves changing the synapses that fire when we are presented with a particular stimulus.

This world view is the culmination of a long process of thinking of the brain as a sort of computer, and that mental function is therefore about information handling, which can be recognised as being linked to the brain correlates of thinking. In this way of thinking it becomes pointless to think about the mind and the brain as being separate; we have brain structure that is shaped and possibly determined by our biology, and therefore our mental functions must also be shaped in the same way.

Sometimes this line of argument is taken so far that it is hard to parody. It involves a sort of self-parody; if we know that a certain area of the brain is involved in a certain function, then we can recognise how actively a person is engaged in that activity by looking at the level of brain activity in that region. (This line of reasoning actually involves two fallacies. In the first place, we rarely are able to link a specific activity to a specific area of the brain, and the further we move from direct sensory input or direct motor output the harder it becomes. And, second, areas of the brain are rarely linked to one limited function, so it is erroneous to argue from brain function that we know what mental function is being performed.) A typical, if extreme, example, can be seen in the Love Competition (http://www.karmatube.org/videos.php?id=3036), where "contestants" are put in an fMRI scanner while they reflect on, remember, feel, or

think about love. The person with the highest level of activity in specified areas of the brain is judged to be loving most.

This reductionist agenda has been driven by a concept of the brain as a data-processing engine, the computational brain (Prinz, 2013). Ironically, one of the papers at the conference that started the pursuit of the computational brain was a paper by George Miller (1956), which noted that, in relation to the active working memory of the brain, the magic number 7 appears to crop up again and again, whether this is in relation to distinguishing remembered tones, or retaining a number of digits in mind.

But Miller was very careful not to present this as a set physical limit to the capacity of the mind. He noted that experts can keep more information in memory, by chunking it in different ways. A person who counts in the normal way can keep approximately seven digits in mind, or a number up to 10,000,000. That is to say, they can pick our one number from among ten million. However, a person (a computer programmer, say) who counts in hexadecimal, would be able to retain a number on mid up to 16^7, or one in 268,435,456, in mind. The informational content would, therefore, be much higher. While somebody who remembered letters from the standard 26-letter alphabet would be able to store a number up to 26^7, or 8,031,810,176.

What Miller provides is evidence of separation of the mind and brain functions. The expert "chunks" his or her knowledge in different sized pieces from the novice, and as a consequence can store richer and more varied information, even though the brains of the expert and the novice alike must eventually encode their knowledge with the same biological mechanisms. Similarly, as noted above, the physical correlates of love may be similar in the youth and the adult, but that does not mean that what love means cannot be enriched by other experiences, among which poetry and literature may play a role.

In *The Structure of Scientific Revolutions*, Kuhn (1962) suggests that different frameworks for understanding the world are "incommensurate", which is to say that what counts as evidence in one framework does not count as evidence in another. From this it follows that clear cut refutations, of the kind envisaged by Popper (1959) do not happen; one scientific theory is eventually overthrown as its followers die out, and a new generation arises that is committed to the standards of the new theory. Since Popper proposes the refutation or death of a theory as a preferred outcome to the death of a person, he clearly has an interest in maintaining that theories can impinge upon each other, even if talking across the boundaries to compare the relative merits of theories is difficult.

The question here is whether one can talk and provide evidence across boundaries, or whether, in order to engage with a system of knowledge, one has to be so immersed in it as to make it impossible to see any other point of view. For example, I have been raised within an understanding of medicine that is Western. I think of bacteria and microbes, of immune systems and antibodies and so on. When I get a cold in China, my

friends and colleagues talk of the balance of hot and cold in the body. And they prescribe treatment accordingly.

One way of dealing with this is to say that these are two completely different realms of meaning, and that a person immersed in one cannot understand a person who is immersed in the other. An alternative view is to treat them as two ways of expressing the same underlying knowledge, and to look for "translations" from one to the other, for example by seeking Western explanations of how Chinese medicine works. These two simple approaches are both wrong, however. The former is wrong, because we clearly can try to grasp what it is like to think in a different way about common phenomena, while the latter is wrong because it is really an insistence on levering all understanding into my own framework; Chinese medicine is only to be valued when it can be confirmed by Western medicine.

What we need is a more complex understanding of different approaches to knowledge, analogous to the approach to the curriculum that I set out above, that recognises that there are links between different frameworks, but that these links are uncertain and very difficult to specify. So we have different systems of medicine, different systems of logic (two value logic or three value logic, or fuzzy logic) and different systems of analysis, and these have to be able to connect in some way, sufficient to enable communication, but without enabling complete reduction of one to another. Neither complete commensurability nor complete incommensurability is satisfactory.

Again, we see a strong tendency in the world to aim for complete commensurability and complete reduction of one scheme to another, normally on the assumption that there is an underlying structure that distinct conceptual frameworks attempt to interpret. For example, we have reading tests from around the world, and a score can easily be provided to indicate the literacy rate of a whole country. We are therefore inclined to reify the notion of "reading" and assume that facility in reading can easily be determined. In fact, however, reading is a much more complex matter, requiring the loose and complex connection of several elements.

Some time ago I was in a restaurant in Japan with a friend. The waitress wore a badge which said, "西山". I recognized the symbols as meaning "western mountain", so I asked my friend whether "western mountain" was the name of the waitress or the name of the restaurant. She said, "It says, 'Nishiyama', and that is the family name of the waitress. It means western mountain".

Sometime later, I went to China, and mentioned the incident to a friend there. She said, "Oh yes, it says, 'Xi Sian' and it means western mountain". So the question arises as to which of us could read the symbols on the waitresses badge. Is reading the ability to convert ink symbols into sound? And if so, which sound has to be produced to count as reading? Or is reading the ability to bring meaning to the symbols without the intermediate step of converting the symbols into sound (a process which is more or less impossible in a European language, although obviously possible in Chinese and Japanese)?

I do not know the answers to these questions, which suggests to me that the conclusion that country X does particularly well in reading tests when compared with other countries is much more problematic than it at first appears.

These questions proliferate when one spends any time working across different cultures. To the European observer, China, Korea and Japan have much in common; they are societies with a strong cultural background in Confucianism, they are societies that have a collectivist orientation, and the opinions of older people are respected. In contrast with that, the Asian observer sees only differences; China, Korea and Japan have very different histories, they are organized on different principles of collectivism, and they have very strong senses of cultural identity which mark them out as different.
We might make similar observations in relation to European culture, where the European sees sharp differences between German philosophy and French philosophy, while the Asian observer may see similarities—perhaps a tendency towards sharp dichotomies and individualism, in contrast to Asian perspectives.

Obviously, history is the most difficult case. History, and an understanding of history, is not the same as a sense of personal identity, but the two are closely linked in some way. I remember taking a French friend to Monmouth. In the centre of Monmouth is a memorial noting that the city was the birthplace of Henry V. "Do you know who Henry V was?" I asked, and I was ready to deliver Shakespeare's account of the noble king. "Oh, yes", she said. "He burned Joan of Arc at the stake". Fortunately, most people do not get too exercised about history that is four hundred years old, but more recent history, and interpretations of it, can underpin international disputes and disagreements. Not the least important aspect of this is when "history" is understood to begin.

The Japanese and the Chinese, at least in the quasi-official version, take very different views of twentieth century history. The Japanese have learned the history of the Second World War from the Americans. The Second World War started on 7 December 1941, with the attack on Pearl Harbour. If we went back further that 1941, we would have to take into account such events that contributed to the animosity between the United States and Japan as the parking of naval vessels in Tokyo Bay in 1853 and forcing Japan to open to western trade. Those events can be seen as the stimulus that inspired the Japanese to aspire to create an empire that would make them as powerful as the USA, and able to resist such expressions of brute force. But the Americans do not wish to see themselves as an imperial force either, so they are happy to see history start rather late.

That narrative serves the purposes of the Japanese quite well, who wish to draw a very sharp moral distinction between nuclear weapons and conventional weapons, to the extent that they are completely incomparable. What the Japanese want to resist, because it would weaken the absolute stand they take on nuclear weapons, is that they contributed to the bombing of Hiroshima and Nagasaki through their actions before

1941. It is not legitimate, they maintain, to argue that two or ten invasions of Singapore are equivalent to the bombing of Hiroshima. The occupation of Manchuria, the sacking of Nanjing, a whole string of war crimes, cannot be placed in the balance and weighed against the instant destruction of a city. Unfortunately, that means that they are not well prepared to come to terms with events before 1941, which are very much on the minds of the Chinese, who want an expression of regret over those earlier events.

Of course, these accounts are generalisations, and it is by no means true that every Japanese person, or every Chinese person, signs up to the official line. But as generalizations they can help to explain why incompatible views of history can lead to such serious tensions in the present day.

So how do we, as researchers, come to terms with such different perspectives? Certainly not by feeling that we have to decide who is right and who is wrong. The situation is more complex than that. We can simultaneously maintain that the use of nuclear weapons is terrible and not justifiable on any grounds *and* that the forced occupation of another country and the use of violence against the civilian population is a war crime. We can understand both sides of the argument, and the justifications on which they rest. We have to recognize the grain of truth that is in any interpretations, and also to recognize that the existence of different interpretations, the clash of interpretations, is itself a fact in the world. But that does not necessarily mean that we do not have our own opinions about the validity of the different arguments.

The *Devil's Dictionary of Education* (Burgess, 2002) gives the definition of "intelligent" as "being able to hold opposing ideas in mind at the same time and not be paralysed". It is intelligence of that sort that we need when trying to evaluate different claims that cut across different realms of meaning or different cultural backgrounds. That does not mean that the researcher is always forced suspend judgement. I can be fully convinced that the bombing of Hiroshima and Nagasaki was a dreadful act for which there is no justification, without at the same time agreeing to the notion that they exonerate the Japanese from looking at their earlier history. But at the same time, coming to my own moral judgements should not be allowed to obscure my understanding of the way in which other people assemble the elements of their understanding.

This requires, not only a clear understanding of the rationale that other people provide for themselves, but also a much sharper understanding of our own rationales, a better understanding of ourselves as researchers. We need to be able to locate ourselves in the processes of constructing understanding and knowing. We need to be able to understand our own history, and to deal with our own history, however unpalatable.

In conclusion, I offer a metaphor for how this loose-coupled model of education might be understood. John Conway's "Game of Life" is a cellular automaton. Think of it as a matrix of squares, each square having eight neighbours. A square is either "alive" or "dead", black or white. In the next generation the square will be alive or dead ac-

cording to some simple rules. If the square is alive and has two or three neighbours it will live in the next generation. If it has only one neighbour or none, it will die of loneliness. If it has four or more neighbours, it will die of overcrowding. If it is not alive, it will remain so unless it has three living neighbours, in which case it will be "born".

One very special shape in the Game is called a "glider", which consists of five living cells. It goes through a sequence of four generations and returns to its original shape, but in the process moves in a very characteristic way.

Starting with a random pattern of living squares, over quite a wide range of initial conditions, if the Game is set running, a similar pattern is produced, in which some areas are very active, fizzing and buzzing, while other areas are relatively settled. Occasionally an active area will give rise to a glider, which will move away and impinge upon an inactive area, either giving rise to a new area of activity, or being swallowed up in inactivity. (It is very difficult to convey the sense of dynamism in a verbal account or in a static picture; there is no substitute for downloading the simple program and watching it at work. It can be found at http://psoup.math.wisc.edu/Life32.html.)

For me, this is an interesting metaphor because it suggests that, most of the time, most of our areas of knowledge are relatively stable. However, once in a while the addition of a new piece of information will make it necessary to reorganise everything that we know in a particular field, and exactly how that reorganisation takes place will depend jointly on what we had already learned and the new stimulus that obliges us to reorganise. In addition, interdisciplinary interactions will be particularly fruitful, when a glider, or inspiration, from one area impinges on another, setting of a train of activity.

There is nothing deterministic about this proposed process; in order to function optimally, a researcher or learner will need to choose when to hold on to established mental functions and when to embark on radical reorganisation. In the end being able to locate himself or herself in his or her own history of development will be crucial.

It follows that learning about another culture means that we have to learn about ourselves. Learning in a new field of endeavour will possibly cast new light on what we already thought that we knew. Understanding the history of scientific development, for example, presents the scientific knowledge itself from a new perspective, possibly changing our perceptions of which developments are radical and which merely incremental. This is a process that is never complete. To develop a mature understanding in any field of knowledge, we have to take into account other perspectives / other frameworks, but we should not take any framework too seriously (even, or perhaps especially, our own). Learning more means a loss of certainty.

By trying to bring our understanding, or different competing understandings, into alignment, we create more abstract and complex patterns of knowledge. Following Miller, this means that we can understand more, and work with more complex understandings. At the same time, those attempts to align diverse fields of knowledge will

produce more conflicts and difficulties, stimulating us to continually reorganise our body of knowledge. It is this complex relationship between stasis and change, between separate realms of knowledge and the interconnectedness of all knowledge that constitutes the excitement of learning.

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