A CASE FOR THE INCLUSION OF VISUAL THINKING UNITS ACROSS THE ACADEMIC SECTOR

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Abstract

This paper argues for the re-introduction of drawing across the university sector. It also posits that modern university education is too limited in the its educational reach across intelligences, focused as it is on textural and logical-mathematical systems of assessment, communication, unit coursework and expected outcomes.

The argument for the re-introduction of drawing is also a call for the development, use and study of studio-based education in the tertiary sector. The skills and knowledge acquired in a studio are particularly pertinent to scientific study; being a range of skills and knowledge too often neglected, through the over-use and reliance on digital technology.

It must always be remembered that undergraduate students, by and large, are young, often naive and have limited physical, hand,-eye, visual or intrapersonal skills or experience. That is not to say they are unintelligent, but their experience and knowledge is limited, a lack of knowledge and understandings too often forgotten by course writers. Students come to university to learn, but the academy is still caught up in presenting information, a commodity easily acquired in the present on-line, globalized climate. What students lack are observational and spatial skills, analytical and comprehension skills, hand-eye and visual intelligence and knowledge and the ability to communicate verbally and visually, outside of the realms of the computer.

Drawing and studio work are both focused on the utilization of multi-intelligence learning. If drawing and studio work were re-introduced into the general tertiary curricula then universities would be graduating much more rounded, more broadly educated and more adaptable graduates and in the end, better scientists.

Keywords: Applied, Visual, Intelligence

Introduction:

The argument for the inclusion of visual and/or creative, studio-based units across the university sector has not been clearly articulated nor heard. I have argued this case before, at both conferences and in the published article *The Importance and Loss of Studio-based Education in Australian Universities.* Some of this present discussion draws in part, on this published paper. The previous argument however, was mounted in the context of pressures being bought to bare on the provision, servicing and use of creative studios within the Australian university sector. This present paper is specifically concerned with the wider university and the benefits studio-based, multi-intelligence education would have across the student cohort, particularly in the case for drawing.

The lack of recognition and implementation of multi-intelligence studio use is possibly due to the fact that studio-based knowledge and education cannot be easily assessed, quantified, nor accessed on computers. Studios and studio-based activities often have no computer linkage to the rest of the university, nor should they have! So the activities taking place in these learning environments are often hidden from the wider academy.

Studio experience benefits all student learning. Studio work has light, sound, colour, depth, experience, phenomenology and weight. They also encourage interpersonal and intrapersonal communication and deal with physical materiality. To encourage, deliver, finance, and sell creative, visual, studio-based units to a range of non creative-industry* based programs, would not only benefit general tertiary education but would be a profitable point of departure for all universities. Indeed, because of numbers this would help finance and cross-fertilize expensive to run Art and Design schools.

Sitting within the tertiary education sector as a privileged academic, it is easy to forget that the almost blanket penetration of global digital technology and digital communication systems are in historic/social terms, a very recent innovation. For a number of years universities were far in advance of the rest of society, in implementing these technologies.

It was only a little over twenty years ago, that the first general and graphic computer labs (outside the fields of science and technology) were installed in one of Australia's leading universities. As a mature age student in the early 90s I had a number of highly experienced, and talented lecturers who were completely digitally illiterate. The whole technology was a complete mystery to them. Indeed I've attended conferences, over the past ten years, where some of the older, liberal arts and humanities academics have had not a clue, concerning digital technologies. In terms of graphic software and multi-media we began our studies in the early 90s, using some of the very first versions of the now ubiquitous Photoshop and Illustrator. The web had still not escaped the confines of the research labs, and multi-media was still in its infancy. Ideas of hyper-texturality and digital identity were burning issues of the day.

As we have become immersed in and surrounded by the technology, issues such as the use and power of manipulated images; of detached, simulacra communications; immersive digital environments; instant, hyperlinked and globally accessible information have become mundane and prosaic, not interesting or revolutionary.

* Creative industry-

'Advertising, architecture, art, crafts, design, fashion, film, music, performing arts, publishing, R&D, software, toys and games, TV and radio, and video games (Howkins 2001, pp. 88–117).

The Problem

Today, for a range of economic and apparently good, although questionable educational reasons, many entire degrees and post-graduate courses, around the world, are being offered on-line and the digital revolution is both changing the fundamental reasons for, and the structural workings of education as a whole. Academic, university-based education has been particularly changed by the influx of digital technology. Changes, as we can all attest, that have not always been in a positive or even useful manner.

As academics rise further away from the teaching front their time is taken up more comprehensively with computers. They become immersed in a bubble of on-line, textural/ logical-mathematical communication- they write and read endless e-mails, write policy and decipher spreadsheets. Undergraduate students are a long way from those places of authority and responsibility, or even educational vision, which is why it is important to educate a multiplicity of intelligences and creative processes in undergraduate and early postgraduate studies. These young minds are already socially immersed in decontextualized digital space, with their mobile phones, smart pads and Internet connectivity; their learning environments should embrace something more.

Unfortunately, as ambitious young academics rise through the ranks to positions of authority and policy power, they never get to understand nor experience the need for nourishing more than their linguistic, logical-mathematical intelligence. They become less likely to recognise the importance of multi-intelligence education and the roles studios and creative workshops play across the academy, in the education of younger generations. As chancelleries fill with these younger, digitally immersed academic leaders, the narrower the academic vision becomes.

Much has been researched and written about the interplay between the perceiver and the perceived, the nexus between mind and body. Jacques Chevalier begins his trilogy on the mind by asking: *"What is the mind compared to the brain? What is an idea compared to a word, a picture, a sign? One is 'mental' and the other is 'physical'? One consists in thought and the other is a thing that contains thoughts about things? One is the kernel that hides and the other is the tangible shell or outer covering that does the hiding?"* (Chevalier p3)

Gardner talks about seven intelligences and gives this conceptualisation as a definition of intelligence: *"Intelligences are bio-psychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture"*. (Gardner, p33) Note that he regards intelligences as potentials, implying that they need to be activated, nourished, guided and trained. Since Gardner the importance of training all intelligences has been recognised, yet tertiary education focuses almost exclusively on the linguistic (textual) and/or logical-mathematical to the exclusion of other defined intelligences, particularly the visual and kinesthetic. Gardner identifies seven intelligences: *"linguistic, logical-mathematical, musical, bodily kinesthetic, spatial, interpersonal, and intrapersonal"*. (Gardner, p33-34).

In terms of the educational matrix, research gains considerably from integrating a range of intelligences, both physical and mental. Gardner used the term *"frames of mind"*, when first proposing his theory of multiple intelligences in 1983. West writes: *"Those who learn with great difficulty in one setting may learn with surprising ease in another. This fresh perspective suggests that we should be more concerned with results than with trying to get everyone to learn things in the same way, especially if we are more interested in creating new knowledge than in merely absorbing and passing on old knowledge"*. (West p11)

In the multi-source, information rich world of today, passing on 'old knowledge' is a self-defeating educational exercise and is the root problem to solve, for all education systems.

The questions have become, 'what are we actually trying to teach and why?' The acquisition of old knowledge is not the answer, when so much of it is freely and easily accessible to all students.

The argument for including a wider educational matrix is not an argument about the worth of one form of intelligence over another, as is the present case with the dominance of academic linguistic (textural), logical-mathematical education, but an acceptance and recognition that the brain and hence the education of the mind is a far more complex, multi-faceted activity than is presently found. It can be argued that it is visual, musical, bodily-kinesthetic, spatial, interpersonal, and intrapersonal intelligences that actually produce physical culture, designed space, and human experience. Despite the present obsession of academia with virtual space, virtual life and digital education, human beings still perceive and act in the world, physically. We also behave intuitively, a very difficult attribute to measure in any acceptable academic way.

Because of the lineal nature of computers, university administrations and organisations have become increasingly lineal. Lineal, text-based and logical-mathematical assessment paradigms do not fit comfortably with visual and physical studio work and assessment.

Timetabling becomes highly problematic, as multiple-intelligence learning uses a range of diverse teaching spaces and learning durations, other than lecture theatres, tutorial classrooms and laboratories. Lineal, compartmentalised unit study methodologies do not fit neatly with multiple-intelligence learning. Bodily-kinesthetic and spatial understandings and knowledge takes longer to acquire with some students than with others. Hand-eye skills and knowledge often require longer teaching times, than single subject, twelve-week duration units allow. Alternatively, certain skills require short intensive workshops. So the actual pattern of learning in these areas does not fit neatly into computersed institutional time frames. In some workshops students need to have a settled place to work for the entire duration of a project, (physical model making for example) quite unlike a computer-based project, whereas at other times, the workshop is utilised for very short periods of time.

Computers force lineal assessment criteria, lineal knowledge constructs, lineal progressions through courses, and the overwhelming use of a lineal machine to both communicate and to construct knowledge. Studios nourish a range of intelligences. They also cherish experimentation, and learning outcomes from failure. There is no right or wrong in these spaces, only the acquisition of skills, the process towards appropriate solutions, the gathering of experience and trial and error.

There is a creeping, uncontrolled overload of textural information happening across all institutions. It is not just that administrators are clogging the system; information itself is changing and thus changing the academy. A place for experimentation and multiple-intelligence- studio-based learning is becoming harder to find or argue for, yet the case for wider modes of thought and practice are becoming ever more pertinent.

Where once students needed to be on campus to access libraries, hold discussions and be in lecture theatres, today they access a far wider range of research material; engage with well constructed, commercially made documentaries and watch lectures given by a globally diverse range of media savvy educators. They can also interact in globally connected discussion forums; write their opinions, research, and blog their thoughts, all from their bedrooms. They don’t actually need to be physically on campus; indeed they don’t actually need to be at school at all, if acquiring information, learning to read, write and doing mathematics is the sum total of what is deemed, education.

Whole areas of human endeavor are struggling to come to grips with the effects of easily available, connected, textural, visual and audio information and communication. These digital technologies are creating major changes to a range of social organizational systems such as governance and democracy ; national security; law and order; science; news and information gathering; environmental issues and more widely, knowledge itself.

In terms of education the entire way of teaching and the reason for teaching has been thrown into turmoil. Originally universal school education was built as an intrapersonal, (teacher/student) instructional system for training literacy, numeracy and the old liberal arts of

History and Geography. The reasons for universal education were either religious (so holy books could be read {the Scottish and to an extent the American model and increasingly parts of the Islamic world}) or to train a population of bureaucrats and administrators for empires, increasingly complex nation states and/or increasingly complex business models.

During the late nineteenth and early twentieth century, science, vocational education and later social sciences were added to the mix, although studio learning such as arts and craft, performance and sport where more often than not treated as an after thought, a hobby; they certainly were not front and center of most curricula. Up to the very early 1990’s school education was still very much a place of intrapersonal instruction, a place for the teacher and a class, although by the mid-1960s television, film and in the 1980s videos began to change educational methodologies. However these technologies were neither interactive nor connected, in the same way digital communication technologies are. Today, around the world the classroom is becoming increasingly globally connected.

In universities; products of medieval monastic traditions built on the ancient Greek academy, the first major changes, away from textural and numerical research and study, occurred around the middle to late 19th century, as scientific laboratories took over real estate in the academy and specialised disciplines such as chemistry, material research, biology, engineering and physics became academically recognised disciplines in their own right. For example it was only in 1872 that the first purpose built physics laboratory was opened at Oxford. This of course does not imply that these disciplines were previously either unknown or ignored, but they were not part of the mainstream of university education. Many of these disciplines were taught in polytechnics, specialist schools, through apprenticeships or under the banner of disciplines such as mathematics, natural philosophy and astronomy. In terms of academic institutions and university education, science and the scientific experimental laboratory are both very new additions. It was only the work of Liebig, in late 19th century Germany, that brought both experimental science and the commercialisation of results into the body politic of universities. And this introduction was certainly not universally welcomed. McNeely and Wolverston write: *"Liebig charged that traditional academics denied not only the practical value of laboratory science but its true status as a discipline reaching the highest philosophical standards. They (academics) 'consider chemistry as an experimental craft…useful for making soda and soap, or for manufacturing better iron and steel, but they are unacquainted with chemistry as a field of scientific research.' University professors replied, with good Humboldtian reasoning that 'the university must represent primarily theoretical instruction in chemistry, (or any other subject) in which students of all disciplines can take part without any practical-chemical orientation to laboratory apparatus and hands-on techniques. Lectures and seminars should suffice"* (McNeely and Wolverston, p220).

It is ironic, in light of the present thesis, that one of the great achievements brought about by the introduction of scientific experimental laboratories, was the inclusion of …*"artisanal techniques,* (crafts) *a species of informal knowledge, into formal academic disciplines"* (McNeely and Wolverston, p 209). The history of this dichotomy between artisan skill and knowledge and formal academic intellectualism and worth is the dichotomy between Hook the artisan, and Newton the scientist, or Humboldtian science and pure laboratory science, or barber surgeons and medical doctors: the Mr. of medicine and the Dr. of medicine.

It is baffling why the idea of creative workshops and studio spaces have to justify themselves, in the same way as scientific experimental laboratories had to fight for their existents a hundred and eighty years or so ago.

The next major change to occur in tertiary education was the introduction of the social sciences as legitimate areas of social study outside of medicine, archeology and anthropology. Indeed in the 60s, 70s and 80s these areas of research and study, driven by psychology, sociology and critical theory, over-whelmed the old liberal arts and humanity disciplines, such as history, geography, literary studies and the like, spreading out across the academy, touching disciplines as diverse as medicine and the fine arts.

In the 1980s, particularly in the English-speaking world, universities were again rocked by the introduction of what had traditionally been regarded as vocational and often craft and visual-based disciplines, such as design, fine and performance arts, advertising and marketing, accountancy, nursing, education and business. In a similar way to the introduction of experimental science and the research laboratory, these disciplines often found it difficult to adjust to the textural/mathematical-logical nature of the academy and very soon went down the roads of theoretical and critical social science thinking as a way to legitimacy. Leaving behind the studios, the craft skills, and knowledge built up over hundreds of years. The academic attitudes of '*theoretical instruction in which students of all disciplines can take part without any practical orientation to laboratory apparatus and hands-on techniques with lectures and seminars sufficing'* still held the academic high ground, as they still do in too many institutions of today. But an artist without craft or a musician who can not play music or a business student who can only think and write about business are not actually educated in their disciplines. These forms of knowledge need to be applied not simply written.

Even though the academy invited these applied disciplines into the body politic of the university, they have largely turned they're backs on addressing the teaching and skill training requirements in these multi-intelligence disciplines. These intelligences, much as in secondary schools, are too often corralled into under-resourced areas of specialization, and are kept isolated from the university as a whole. Visual, musical, bodily kinesthetic and spatial intelligences are treated as hobbies and pastimes, not areas for serious academic or even social practice across vast swaths of the academy.

Not only has contemporary education and society, as a whole, been fundamentally changed by the onset of the digital revolution; society and education has been increasingly immersed in a scientific mode of thought and methodology of organisation. West writes:
"…the overt concerns of modern culture appear to be almost entirely dominated by modes of thought most compatible with the left hemisphere, that our view of the world, our educational system, our system of rewards, our aspirations and our value systems are all effectively focused on reinforcing the operation of the left hemisphere (while the more basic contributions of the right are largely ignored or seen as primitive".(West p15)

The ascent of scientific laboratory thinking and methodology, coupled with ideas of social science has had a profound effect on Western modes of thought. McNeely and Wolverton explore the growth and limitation of the application of scientific measurement and methodology on human social and intellectual ability and life. They investigate the ideas behind the development of the IQ test, which still has influence over educational thinking (McNeely and Wolverton, pp 228-250).

They, like West, make the point that the sciences dominate modern institutional thinking and practice: "*By the mid-twentieth century, the laboratory had ascended to an almost impossibly dominant status as an institution of knowledge"* (McNeely and Wolverton, p251). This possibly explains the capture of the humanities' in the Western world, by such research as critical and literary theory and postmodern social theory. The latter are theories built solely on the book, not on the synergy between physicality and observation and the discipline of recording and communicating. Graham Turner writes: *"Once the humanities were fundamental to the idea of the university. Now science is at the core of the research mission of a* great many universities *(the Australian university), and professional training at the core of its teaching mission"* (Turner).

Writing in 1967 Lynn Wright in her well-known essay, 'The Historical Roots of Our Ecological Crisis' wrote:
'But it was not until about four generations ago that Western Europe and North America arranged a marriage between science and technology, a union of the theoretical and the empirical approaches to our natural environment. The emergence in widespread practice of the Baconian creed that scientific knowledge means technological power over nature can scarcely be dated before about 1850, save in the chemical industries, where it is anticipated in the 18th century. Its acceptance as a normal pattern of action may mark the greatest event in human history since the invention of agriculture, and perhaps in nonhuman terrestrial history as well'. These thoughts are just as relevant for knowledge, information and education, particularly tertiary education.

The Importance

So what is the importance of multi-intelligence education? All the signs point to the success of the textural, logical mathematical left hemisphere weighted world of today. However, human beings don't just use one hemisphere of their brain or two out of at least eight, identified intelligences in their daily lives, so why only educate and train one half of individual human potential? The mind requires the educated function of both hemispheres of thought. Intuition, holistic analysis, visual intelligence, physical skill and hand-eye coordination, amongst other human activities, are all areas that can be trained and educated.

One does not need to be an artist to communicate visually or be an elite sportsperson to throw and catch a ball accurately or a concert pianist to make music. Drawing, hand eye coordination, visual analysis, intuitive processing and the making of music can all be taught and at least some of these intelligences should be taught to all university students. The relationship between learning music and learning foreign languages is a well-known example of the benefits of multi-intelligence education. Google will give the reader 1,000,000,000 hits to back up this claim. There is also a well-researched relationship between physical exercise and mental agility. There are 5,100,000 Google sites for this proposition.

It can be argued that traditionally universities saw no need to include these activities in their curricula, but today is not yesterday. Today students do not spend a great deal of time moving books around or physically searching amongst the dusty corridors of libraries, using an intuitive, learned, spatial experience to hunt down research material. They often hold tutorial study groups from a distance, disconnected from face to face, interpersonal conversation and discussion. They lineally search on-line and seldom physically transpose notes by hand from their research material. They tend to cut and paste or digitally highlight, which leaves out the contemplation and physical observation of the ideas written; they sit in front of screens.

Is that a problem? Not entirely, but it is limiting. In terms of the transmission of knowledge, it is certainly problematic. Using a computer is really a two dimensional learning environment. Physically, the machine only needs the repetitive use of a body's fingertips to work. Visually, a screen and keyboard, in other words the visual plane, are quite unlike books.

The digital visual plane sits unmoving, at under a meter in distance from the eyes and the range and colour are constant. The light is artificial and digital images are two dimensional with no phenomenology of texture, weight, bulk, smell or age.

The computer is an enclosed, self-contained learning environment. Taking vision as an example: In his book *Frames of Mind*, Gardner calls vision, spatial intelligence (Gardner p42) and visual thinking (Gardner p189); others call it visual intelligence or visual literacy (Moore, Dwyer). De Bono calls it a component of Design Thinking (De Bono). They all regard multiple focus vision, an intelligence at the heart of knowledge and understanding. So the very great difference is in the exercise and use of the eye over varying distances and light intensities, directions and sources whilst reading printed matter. However, it goes beyond just the reading of the words when talking about the differences between book and digital reading.

Digital reading always remains constant, whereas book reading has other narratives- the age and smell of the book, the touch of the pages, the weight and colouration of the book, the style and publication, whether the book is a hardback or softback and the context in which the book is read, are all processed as part of the knowledge transfer.

The content of books is also contained, digital reading allows for hypertext outside of the structure of the material being read. This leads to a break down in the argument, as multiple voices from hot links to other sources start to appear in a single reading session. Nicholas Car in his book '*The Shallows'*, spends a considerable amount of time discussing the changes screen reading is having on thought, memory and the way information is being processed. The eye, the visual intelligence, actually takes in more when reading a book than reading from a computer screen. There is physicality to a book. How it is held, how the reader turns the pages, the movement of the book whilst being held, how information is sought, how information is transferred from a book, all require a number of different intelligences- spatial, kinesthetic, visual, literary, hand-eye. Indeed the printed matter becomes an immersive reading environment while a computer screen remains a computer screen. What is even more important is that the brain and the mind move, from one intelligence to another, as a different intelligence is required.

Visual literacy, apart from reading, can best be taught in a studio. On a computer screen the experience is limited and enclosed; on a computer, information remains constant.

In the phenomenological world it is in a state of constant flux.

What becomes more interesting when considering studio learning is if we consider what neuroscientists call peripersonal space. This is the provable idea that human existence actually exists beyond the physical manifestation of the body (Merleau-Ponty), within the space taken up by the reach of our arms, legs, breath and movement through physical space.

This peripersonal space expands exponentially if further areas are mapped in our mind (Blakeslee & Blakeslee). For example we drive a car as an extension of our being; if a driver cannot perceive or sense exactly where the parameters of the passenger side of the car is, then they could not drive a car. In an accident, a car crash victim will personalise both themselves and their car as a single entity, 'I was hit from behind!' Blakeslee & Blakeslee contend that crane drivers extend their peripersonal spatial reach to include the crane's hook, perhaps thirty meters from the crane driver's mind, in the same way as we are conscious of our finger tips when touching something while the rest of the arm becomes unconscious (Blakeslee & Blakeslee, p4). A more extreme example of mapping beyond the confines of the body is found in Wade Davis' book *Wayfinders*. He tells of deep-ocean Pacific Island navigators who extend their being across vast distances of empty ocean by conjuring, or more accurately, mapping their destination in their minds; they seem never to get lost (Davis). In many ways drawing works in peripersonal space. The act requires an extension loop between the object being drawn and the pencil nib making the mark. It is as if the physical body, the intelligence and the space taken by the object being drawn become one complete environment.

The evidence is strong that the physical plane of itself is too limiting: the mind can extend beyond the body and beyond the immediate physical space taken up by the body. Shankar Vedantam talks about the 'hidden brain', an unconscious brain that makes us fall in love, choose something or someone on the basis of a name, breathe without being conscious of breathing, and act on an improvable belief (Vedantam). The foregoing suggests that it is time to take stock of what we are doing educationally, by relying so heavily on both a tool of such limiting experience as the computer and the almost exclusive education of just two intelligences. There is absolutely no doubt that human beings function and learn on a multitude of levels and in a complex matrix of perceptual, physical spaces. As a character in Neil Stevenson's wonderful novel *Quicksilver* states, *"No linear indexing system is adequate to express the multi-dimensionality of knowledge"* (Stephenson).

The Proposition

What this paper is proposing in regards to actually implementing visual, studio-based learning paradigms across the textural, mathematical-logical weighted disciplines of academia is relatively simple. I believe profoundly that all students should learn to think and process visually, that is to be able to draw competently and communicate visually. Drawing, the making of marks is humanity's oldest cultural activity. It has been used to tell stories, record events, create and embellish identity, record observation, make social and political comment, clarify complex ideas, rationalize organizational structures, effect human emotions, capture fleeting thoughts and idly pass the time. It is also the basis of all design be it a film set or a public building, a poster or a computer circuit board. Scientific illustration has been an integral and crucial part of the scientific process across the centuries, yet today it has largely fallen into disuse, particularly in undergraduate programs. Stephan Bayley and Terence Conran titled their 2007 book, *Design is Intelligence made Visible*, it is just as correct to say that drawing is intelligence made visible.

By being discarded, an important analytical and observational tool and indeed a vital educational tool is being neglected. All students should be competent in three forms of drawing- Observational drawing, freehand perspective drawing and visual process and communication drawing and this paper posits that these three forms of visual thinking should be taught across the academy, to all university students. A single unit per semester or even a unit per year would suffice. If it were to be every semester (six units per degree) then each form of drawing would have two parts. An introductory, exploratory, skill and knowledge based level and an advanced, sophisticated application of the newly learnt intelligence.

Visual process and communication drawing should begin this program. Drawing comes in many forms and is used for many different reasons. This unit or units should be an introduction to mark making and the keeping of organized, sequential visual diaries. It should include research into a range of drawing materials, mark-making tools and drawing styles.

From doodling ideas and simple cartoons to drawing exercises in observational drawing. I have personally never yet met a student who can't be taught to think visually and draw what they see in a manner that communicates their idea, to another person.

Observational drawing is self-explanatory. Julia King writes, *Scientists like Bakker and Folkens as well as Harvard biologists Bert Höldobler and E.O. Wilson—all of whom routinely reproduce their visual scientific observations on paper—once were the rule. Today, they are the exception Up until about the mid-1950s or so, basic illustration courses were a regular and required part of a scientist's education. Today, by contrast, science training as well as funded research is focused on the design and implementation of experiments, leaving students and practitioners alike precious little time to hone sketching and illustrating skills.*

There are signs of a renewed interest in science illustration, however. The University of California at Santa Cruz, for example, now offers scientists a graduate certificate in scientific illustration. Other schools, including the University of Michigan and San Francisco State, offer scientists undergraduate courses' in basic illustration.

What's more, scientists themselves are realizing, that illustrations produced by sophisticated photographic and electronic duplication equipment, such as scanning electron microscopes, are often inferior to the ones they produce themselves. "The SEM sees too many details, giving an almost surrealistic picture rather than a picture of what it is you need to explain," says biologist Holidobler. As a result, many scientists, including Harvard's Wilson— an accomplished biological illustrator as well as a noted sociobiologist—consider drawing to be one of the most valuable and irreplaceable analytic tools available to them.

Observational drawing, '*makes scientists better scientists because it requires them to closely scrutinize an object or artifact, which works to sharpen their observational skills and improve their accuracy'.* (King)

King concludes her article by quoting the following, *The lack of emphasis on drawing in today's science programs is "absolutely egregious," according to paleontologist Bakker, who like Folkens, regards drawing as an indispensable scientific tool. "A basic illustration course is as indispensable to a scientist as a basic nutrition course is to a medical doctor," says illustrator and scientist, Folkens. Adds Bakker: "Drawing is part of thinking and observing. It is what distinguishes us from other species." Further, he says, "I urge all scientists to take at least a seminal course in drawing- from someone who knows the objects they are studying".*(King)

Freehand perspective drawing teaches students how to represent space, volume and depth and adds to the quality of their visual communication. It teaches the effects of light, shade and proportion and gives them a powerful communication tool. Having observed the emotional effect of students gaining confidence in this task, the analytical and intellectual benefits of offering this drawing technique to students is immeasurable.

Visual process and communication drawing is basically ways of visually processing ideas and communicating ideas. It can take many forms, using a range of visual techniques and methodologies.

Regardless of whether the program was three units or six units, a range of supporting knowledge constructs and subjects should be added into the curricula units above and beyond drawing. Much of this material could be added as components of visual process and communication drawing.

A thorough introduction to colour, colour use and colour mixing would benefit society generally. Too many members of society are colour ignorant or essentially colour blind. Colour is one of the most important attributes of the human condition, affecting everything from emotion to recognition and intelligence. Learning and applying knowledge of colour also has great educational benefits. It trains the eye, thus improving observation; it improves hand eye co-ordination and lends depth to the human experience by adding knowledge to the many facets of a ubiquitous element of everyday life.

Mixed, mark-making materiality is crucial in the experimental nature of visual process and communication drawing. The use, experimentation and mastery of different materials are an intellectually broadening and emotionally fulfilling activity. Because the experimentation relies on trial and error and outcomes are not predicable there is a freeing of intellectual engagement and the constructing of experimental curiosity. The process of learning the mastery of various mark making tools and materials allows the student the freedom to fail, as there is no right or wrong answer. By succeeding by failing a student becomes a better risk taker and explorer.

Finally as part of the freehand perspective drawing curricula I would recommend an introduction to physical 3D model making techniques as a further tool of analysis. To understand and build structure and form is an invaluable understanding for all students. It is also an activity that teaches hand eye co-ordination, attention to detail, intellectual planning and methodology. By making physical models and drawing from observation; touching and feeling and handling an object and turning it over and over and tracing it out with your fingers, you discover its physicality and utilize a range of intelligences.

Conclusion:

Although university undergraduate curricula are already under intense pressures concerning content construction and subject inclusion, and individual disciplines mount legitimate arguments for more time being spent by students on discipline-specific knowledge, methodology and information requirements, this paper posits that there is an underlying imbalance between the specific education of textural and logical-mathematical intelligence and the dearth of multiple-intelligence education, particularly visual and bodily-kinesthetic intelligence, across the university sector.

As business and science methodologies increasingly dominate chancelleries and influence the core philosophies and missions of tertiary education, the case for studio-based, craft-focused, multi-intelligence education across the academy is being ignored

Information transferal is no longer the preserve of the academy and as digital technology continues it's ever more invasive takeover of human communication, the case for the education of physical craft skills and physical intelligence becomes ever more relevant. It is the overriding argument of this paper that all disciplines would benefit by having graduates who have been trained to use their eyes and spatial sense, to observe and who can communicate what they observe, using the sophistication of their own physical beings.

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