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Culture and Learning: Reconstructing Research on Learning for Students in Asia and the Pacific

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Preface

This paper takes as its starting point the need for greater synergy and interaction between scholars, researchers and educators who have a collective responsibility for enhancing our understanding of learning and its development in educational contexts. Interdisciplinary approaches to learning will in the end benefit students the most across the region.

Learning as understood in this paper is culturally situated and thus research findings from neuroscience have to take into consideration the cultural context in which learning is taking place as well as for their application in classroom practice. There is evidence that suggests cultural values play a significant role in influencing students in East Asia – values that might be described as "traditional".

Despite this general understanding, but perhaps also because of it, learning success and learning opportunities are not equally distributed across the region. It is important to understand the root causes for this situation, including the socio-cultural dimensions as one way to address the inequality issue.

This paper concludes with a suggestion for a future research agenda involving the regions' universities and research communities. This ranges from supporting an action research agenda to building evidence-based practice in schools, to cutting edge cultural neuroscience research that can inform basic understanding about learning. Both kinds of research are needed and both can help move the learning agenda in the region forward.

The paper is Discussion Document No. 2 in the Education Policy Research Series, published by UNESCO Bangkok. This series of publications aims to contribute to the debate around the most pressing education policy issues in the Asia-Pacific region, with an objective of supporting education policy reform in Member States. The documents in this series also contribute to the knowledge base of UNESCO Bangkok on education policy and reform issues.

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List of Acronyms

AI	Artificial Intelligence
CHC	Confucian Heritage Culture
EEG	Electroencephalogram
ERI-Net	Education Research Institutes Network in the Asia-Pacific
fMRI	Functional Magnetic Resonance Imaging
ICCS	International Civic and Citizenship Education Study
IEA	International Association for the Evaluation of Educational Achievement
OECD	Organisation for Economic Co-operation and Development
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
TIMSS	Trends in International Mathematics and Science Study

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1. Introduction

Learning scientists, sociocultural theorists and neuroscientists all do important work in advancing agendas on understanding learning. It often appears, however, that these specialists are not always aware of each other's work or of any potential for synergy. There has been some movement to bring down the barriers between learning scientists and neuroscientists (Tokuhama-Espinosa, 2011) but socioculturalists seem to remain isolated. Educators stand at a distance from all of these and seek ways to improve student learning, often relying on either their own intuitions about learning or drawing on those theories of learning that were part of their professional preparation. While all of these groups – learning scientists, neuroscientists, socioculturalists and educators – agree about the centrality of learning, there is no agreement about optimal models of learning for particular students to achieve relevant learning outcomes. Learning undoubtedly occurs in schools – but how it occurs, how it can be enhanced and how it might become supported in diverse contexts remain unanswered questions as we progress in the second decade of the twenty first century. In the current environment, macro social and economic contexts have become more important in relation to learning:

> "Modern growth theory … requires quite a specific kind of curriculum and thus the proliferation of education reform proposals. Modern growth theory is not satisfied that students simply spend longer at school – they must spend time in areas that have the potential to enhance economic growth in a knowledge economy. Technology, science and mathematics take on a new significance. They are important not because they represent an older tradition of academic rationalism but because such knowledge can add value to problem solving and thinking skills. New forms of human capital must not only 'know', they must 'know how' and they must be able to apply this 'know how' to new and different contexts." (Kennedy & Lee, 2008)

Thus learning is not just confined to the school premises – it is an activity throughout life which refers to the concept of lifelong learning. There are still poorly paid jobs in the global economy but many of these require higher level skills such as language abilities (e.g., in tourism and service industries), interpersonal and social skills, problem solving skills, creativity and innovation. Young people require access to higher level skills that are needed in a "knowledge economy" or variants of it in developing countries. This process of skills acquisition will not necessarily create more jobs but it will equip young people with the potential to become job creators and entrepreneurs who can develop new opportunities for themselves and new ways of contributing to their well being and that of the societies in which they live. Developing creative, critical, problem solving citizens for the future is now a strategic priority for all countries. Yet how can this be done given the state of learning and teaching theory and the walls that appear to divide researchers from different traditions and the diverse contexts in

which learning takes place across the Asia-Pacific region? This question cannot be answered in a single paper but it will be the focus of what is to follow. Four broad areas will be addressed:

1. Learning in Asian contexts: The case of "the Chinese learner";
2. New ways of understanding learning – Cultural neuroscience and the case of dyslexia in students learning alphabetic languages;
3. Dichotomies in Asian learning: East Asia and South East Asia; and
4. Moving forward – A research agenda for the future to meet the needs of the region.

2. Learning in Asian contexts: The case of "the Chinese learner"[1]

There is now a significant range of research that has focused on the characteristics of Confucian Heritage Culture (CHC) learners (Chan & Rao, 2009; Watkins & Biggs, 1996, 2001; Salili, Chiu & Hong, 2001). At the same time there has been a body of work undertaken by psychologists that has focused on the unique cultural characteristics of different societies and, in particular, Chinese societies (Bond, 1986, 1996). It is from this substantial body of work, and much more in a similar vein, that we can start to discern what might be called the "value addedness" of the East. The basic principle is that learning is culturally situated and that if we want to understand why students in East Asia attain good performances in international assessments we need to understand the culture in which learning is fashioned.

This might seem to be an obvious statement but it is not at all obvious to many Western researchers who continue to produce so called "generalizations" when the only samples they ever use are from the West. Neither is it obvious to many Western policymakers who attempt to identify classroom practices that can be transplanted from one cultural context to another without any recognition that "culture" cannot actually be transplanted. In addition, it is not obvious to many regional policymakers who seek to adopt Western ideas in local contexts without any idea that local contexts are culturally constructed and contain within them the seeds of resistance to foreign "transplants". The main point made by the body of research which has been referred to above is that culture needs to be respected if we are to understand deeper processes such as learning. So what are the characteristics of cultures in East Asia that affect learning?

This complex question cannot be easily summarized. Perhaps the first point to make is that it should not be assumed that there is one single way that all Chinese students learn – an

[1] In this section I draw on my article, "Teacher quality and its cultural contexts: What can the West learn from the East?" *Journal of Research, Policy & Practice of Teachers & Teacher Education*. 2011. *1*(1), pp. 8-15.

impression that is often given by phrases like “the Chinese learner”. A second point is that the so called “myth” of the Chinese learner (Watkins & Biggs, 1996) has been well and truly exposed. Memorization strategies can lead to deep learning. Passive students are not necessarily disengaged students and teachers in Chinese classrooms have a deep sense of caring for their students. However, perhaps more important than all of these points is the view advanced by Li (2009, p.49) that for Chinese students “perfecting oneself morally and socially” is a fundamental purpose for learning. It is not the only purpose but it is ranked as the first purpose. This is consistent with Lee’s (1996) description of Confucian learning values that are common to East Asian cultures in which self-perfection plays a very important role. Thus not only the immediate classroom context, but also a tradition that has existed for thousands of years supports East Asian learners. Li (2009, p.61) talks about “learning virtues” and “resolve, diligence, endurance of hardship, perseverance and concentration”. In summary this means that learning is characterized by the following factors:

1. Attention;
2. Effort;
3. Practice;
4. Extrinsic motivation linked to Confucian values; and
5. Achievement motivation linked to family.

Herein lies the “value addedness” of learning in East Asian classrooms. Students attend class with a set of learning virtues and teachers make use of them them to get the best out of their students. There is not much talk here of ability, but more of effort. We hear little about “developing the mind” but more about becoming a “good person”. We hear less about engaging students but more about students’ responsibility to themselves and their families for doing well. We hear less about problems with the teaching profession but more about respect for teachers. The above demonstrates that the values underlying education in East Asia are distinctive and directly relevant to the development of learning cultures that are embedded in a macro culture backed by thousands of years of tradition.

3. New ways of understanding learning – Cultural neuroscience and the case of dyslexia in students learning non-alphabetic languages

3.1 Introduction to Cultural Neuroscience: Neuroscience and culture

The research referred to above is traditional psychological research within a cross-cultural cognitive framework. It utilizes behavioral measures to assess what influences students' learning, under what conditions, and with what results. It has been an important step forward in understanding the cultural contexts of learning in "Confucian Heritage Cultures". A more recent development has been the application of cognitive neuroscience to understand the specific learning needs of Chinese students. The Organisation for Economic Co-operation and Development (OECD) (2008) has made the case for the application of this new science to education:

> "Neuroscientists have well established that the brain has a highly robust and well-developed capacity to change in response to environmental demands, a process called plasticity. This involves creating and strengthening some neuronal connections and weakening or eliminating others. The degree of modification depends on the type of learning that takes place, with long-term learning leading to more profound modification. It also depends on the period of learning; with infants experiencing extraordinary growth of new synapses. But a profound message is that plasticity is a core feature of the brain throughout life."

Educational responses to the advent of cognitive neuroscience and its links to education have not all been as positive as the OECD's. The voice of Bruer (1997, 1999) has been a loud one warning against the inappropriate application of neuroscience research findings. It is an important voice to understand because there have been many attempts to commercialize so called "brain research" to convince parents of this process that will enhance brain development for their children. Yet others (such as Tommerdahl, 2010; Geake & Cooper, 2003; Byrnes & Fox, 1998; Atherton, nd) have been more optimistic about the possibility of neuroscience research applications to education. Tommerdahl (2010) proposed a model that shows the distance between basic neuroscience research and the classroom. It is a helpful way to illustrate that the steps from basic research to application are arduous – but at least the pathway is highlighted and the difficulties acknowledged. Geake and Cooper (2003, p.11) proposed a way of looking at education through a "bio-psycho-social model" to bring educators and neuroscientists together in dialogue so they might learn from one another. Byrnes and Fox (1998, p.337) echoed this view earlier when they argued that "there is much to be gained by constructing an interface between educational psychology and cognitive neuroscience" and specifically pointed to the way that the theories of educational psychologists could be tested against what is known in the field of cognitive neuroscience.

Atherton (nd) called for classroom "field trails" of emerging ideas from cognitive neuroscience to test their ecological validity. His rationale for this approach was largely that it takes too long for clinical neuroscience to validate its findings but promising ideas suggesting specific interventions in classrooms can be taken up and feedback can indicate how successful those specific interventions are. These areas of possible interventions are summarized in Table 1.

Table 1: Suggested Areas of Interface between Cognitive Neuroscience and Education

Byrnes & Fox (1998)	Tommerdah (2010, p 106)	Atherton (nd, p. 5)
• Attention • Memory • Reading • Mathematics	• Reading • Bilingualism [linguistics] • Mathematics • Special education	• How are memory, perception, reason and emotion represented in the brain? • What is the interplay between cognition and emotion? • How are social behaviors regulated in the brain? • Is human cognition a modular or global process? • How do developmental changes affect cognitive and emotional processes?

As important as this new direction in learning research is, there might be several caveats that need to be stated, especially in terms of the region and the needs of students. Table 1 above outlines an essentially Western research focus that may or may not be applicable to culturally situated learning in Asia and the Pacific. It is for this reason that researchers, such as Ansari (2011, p.93), have highlighted the cultural dimensions of brain functioning:

> "The available evidence is revealing striking cross-cultural differences in the brain mechanisms underlying a wide range of cognitive functions including, for example, arithmetic, reading and self-representation. Even comparatively lower-level perceptual brain processes related to object processing and attentional control have been found to be modulated by culture."

Goh and Park (2009, p.108), who used brain imaging techniques to investigate the ways Westerners and East Asians perceive contexts and the visual environment, concluded that:

> "At the very least, these findings point to a need to consider the role that culture plays in sculpting perception and some aspects of visual experience. The data

presented suggest that the assumption of the invariance of cognitive processes across groups of individuals has to be objectively reevaluated."

Thus before cognitive neuroscience can be embraced as a tool for understanding learning better, especially in Asia and the Pacific, cultural influences on learning must be integrated to the work of cognitive neurosciences. As Goh and Park (2009) pointed out, whether these influences are biological or experiential, they need to be untangled and better understood.

3.2 Cultural Neuroscience and Learning: Dyslexia in children learning non-alphabetic languages

One area where cultural neuroscience is having an impact is on understanding dyslexia in children learning non-alphabetic languages. Dyslexia affects between two to 10 per cent of children. Many studies using Western samples have identified phonological deficits in processing for dyslexic children. Ho et al. (2002) and Chung et al. (2010) used traditional behavioral studies to identify orthographic deficits as a problem for Chinese children. Chung et al. (2012), using techniques of cognitive neuroscience, which is an electroencephalogram (EEG) study, showed that a control group exhibited negative activations at N400 (an activation spot in the brain that normally reacts to words or different kinds of visual stimuli) when correctly processing tasks related to orthographic identification. Dyslexic students, on the other hand, showed no such activation when they incorrectly identified pseudo characters. This suggested that their capacity for identifying characters correctly was limited. As such, interventions for assisting Chinese dyslexic students should not be targeted too much on the phonology of a character (say, for English words) but on the meaning or morphology of the character since it is the meaning or structure of the character which seems to be the source of the problem. This research has very significant implications for the treatment of dyslexia for children learning non-alphabetic languages. If the problem is phonological in nature, the intervention for improvement will be determined based on phonological needs. But if the problem is orthographic, a different intervention is needed. Hong Kong children with dyslexia are now being treated in an entirely different way based on this research.

This is a cultural finding of some significance and it could well be that dyslexia manifests itself in other non-alphabetic languages such as Thai, Vietnamese, Hindi, etc., although the application of the findings for Chinese students needs to be tested in each cultural context. Nevertheless, the benefits of cultural neuroscience can be seen, especially where it is linked to accompanying behavioral measures and outcomes rather than which can be correlated or associated with brain measurement or imaging.

4. Dichotomies in Asian learning: East Asia and South-East Asia

While students in East Asia are ranked consistently at the top of international testing assessments, students from South East Asia consistently rank low. See the Programme for International Student Assessment (PISA) 2009; Trends in International Mathematics and Science Study (TIMSS) 2007 (Grade 8 Mathematics); and the International Civic and Citizenship Education Study (ICCS) 2009. See also the results for two Indian cities in PISA 2009+ in which the same discrepancies in achievement are revealed. Yet very little seems to have been done to address this issue.

Each major international study, whether it is run by OECD or the International Association for the Evaluation of Educational Achievement (IEA), makes the data publicly available for analysis once the major reports have been written. Technical reports are also made available to assist researchers to use the respective databases. Yet very little, if any, secondary analysis is conducted to explore the reasons for this major learning dichotomy within the region. Countries such as Indonesia have undertaken significant reforms (e.g., increasing teacher salaries) to address what is seen as a problem. But what is the problem? It could be any of the following:

1. National examinations?
2. Cultural issues related to learning?
3. Biased tests?
4. Teacher and curriculum quality

Ischlinger (OECD, 2012) has given a relatively simple answer:

> 'The OECD indicators suggest a need for more ambition in many OECD countries to overcome poor educational outcomes and aspirations. By contrast, in Japan, Korea or Hong Kong-China, students, parents and teachers, whatever their socio-economic context, invest their time and resources in achieving the best possible results in school and university. A recent survey carried out in China also suggests that 15-year-old students there spent an average of nearly 3,000 hours in learning activities in 2002 – in school, extra tutoring classes or preparing homework – nearly twice as much as their peers of OECD countries."

In the Asia-Pacific region we might need a much more nuanced analysis than this simple response that ignores cultural issues and assumes that "one size fits all" when it comes to improving learning. Importantly, the data is available to be explored because both IEA and OECD provide public access to their large scale assessment studies. Secondary analysis is

encouraged and should become a priority, keeping in mind that over a decade ago it was urged in relation to TIMSS that "scholarly communities with an interest in TIMSS explore the hypotheses suggested by TIMSS, the data that have been collected, and the methodological issues the study has raised. This work will be important not only to scholars, but also to the teachers, administrators, and policymakers who need to draw inferences from TIMSS. Although much, but not all, of the existing data have been made available through a variety of channels, the Board [of Testing and Measurement] believes that the needed scholarship should be encouraged and facilitated in several ways". (Board of Testing and Measurement, 1999).

Secondary analysis of data from TIMSS, PISA, ICCS, Progress in International Reading Literacy Study (PIRLS), etc., will not provide responses to all the issues identified but it will provide a foundation for further research work. Once the respective databases are explored, further questions will be posed and new research can be commissioned. Without these processes, the learning gap will remain and young people in key parts of the region will remain disadvantaged. This can be avoided with timely action and expertise brought to address the issues.

One of the advantages of secondary data analysis using data bases from IEA and OECD is the possibility for cross cultural research. Because the data has already been collected there are constraints on the questions that can be asked but the range of variables in the different studies traverse a great deal of ground. In the International Civic and Citizenship Education Study (Schulz et.al., 2010) for example, students from Latin America, Asia and Europe answered local surveys as well as an international survey so it was possible to investigate very local issues as well as compare students across cultures who answered the same questions. Where additional questions need to be asked, the quantitative data from the large scale assessments can be supplemented with qualitative data using interviews as Au and Chow (2012) have recently done. The exploration of cultural issues can be an important aspect of secondary data analysis.

5. Moving forward – A research agenda for the future to meet the needs of the region

There are a number of issues that need to be addressed in the future:

1. Partnerships with regional research institutions;
2. Building evidence-based cultures in schools;
3. Supporting cutting edge research; and
4. Developing new ways of looking at learning.

5.1 Partnerships

The issues raised in this paper are not the domain of any single institution or set of institutions. Schools will benefit from all new research given that they are firmly embedded in the research process. It is important that they utilize all available research while it is ongoing, as opposed to waiting for it to be supplied after long periods of development. At the other end of the spectrum, universities and related research institutes cannot continue to develop research agenda in isolation from the real needs of society, including schools. Thus, as it has been pointed out in different parts of this paper, research partnerships are needed to draw on the contributions of all those who can help with research.

The Education Research Institutes Network in the Asia-Pacific (ERI-Net) – which was established by the UNESCO Asia and Pacific Regional Bureau for Education in 2009 to facilitate regional collaboration among education research institutions in conducting research work on education issues that are particularly pertinent to the Asia-Pacific region – can be very useful here and can provide a platform for different parties to meet over an agreed agenda. The issues to be pursed need to be relevant to education and within the frameworks of research institutes. Learning is an obvious area that comes to mind whether it is exploring the cultural contexts of learning, the application of cognitive neuroscience to learning, or the way learning develops across the life span. ERI-Net can be used to support this research process.

One clear outcome from this review is that educators are not the only ones interested in learning. Psychologists, cognitive neuroscientists and sociologists are all interested in learning from different perspectives. Tokuhama-Espinosa (2011) has shown how several of these groups have successfully come together with a common interest on brain function and its relationship to education. Ansari (2011, p.93) pointed out that "neither animal models nor studies of basic sensorimotor plasticity in the human brain can provide insights into the plasticity associated with uniquely human learning and experiences". This is perhaps the biggest challenge facing neuroscience and education. There is a pressing need to focus on learning that is carried out in real contexts in order to make generalizations for other similar possible contexts. That is to say, education takes place in the real world not in a laboratory, so communicating across disciplinary boundaries will always be challenging yet it needs to be a priority. Thus, extending ERI-Net to become a broader network bringing in all those interested in learning would be a new direction to consider and one with considerable potential for breaking new ground.

5.2 Building evidence-based practice in schools

Samuels (2009, p.45) has pointed to the different concerns and mindsets that educators have had with attempts to apply scientific processes to classroom practice. With particular reference to neuroscience, she refers to the proliferation of what are called "neuromyths" –

unsubstantiated and extravagant claims for the application of neuroscience. She goes on to provide an analysis of the historical, philosophical and epistemological differences between education and neuroscience, including the difference between scientific and humanistic views of the world; the reluctance to accept, let alone understand, the neurobiological bases of learning; and its applications and the difficulties of applying complex scientific results to equally complex daily instructional activities. While all of this needs to be taken into consideration, it should not be allowed to stand in the way of progressing our understanding of learning and its scientific bases.

This would be a big shift for the teaching profession that already labors under great social pressure as well as academic pressure to produce results. This is particularly true in Asia and the Pacific. Yet an evidence-based culture where research results can be tested in ecologically valid contexts can be one way for teachers to identify new ways of doing things and new ways of supporting students. This does not mean that all research results are equally valid but it does mean that they can be tested in practice with results fed back to researchers or discussed in meetings of teachers and researchers. It also means that teachers can become researchers themselves. The Finnish experience is instructive (Sahlberg, 2010):

> "Until the mid-1970s, primary school teachers were prepared in teacher colleges. Middle and high school teachers studied in subject departments of Finnish universities. By the end of the 1970s, all teacher education programs became university-based. At the same time, scientific content and educational research methodologies began to enrich the teacher education curriculum. Teacher education is now research-based, meaning that it must be supported by scientific knowledge and focus on thinking processes and cognitive skills used in conducting research."

This research orientation and its scientific basis is probably not the experience of the majority of teacher education programmes – but perhaps it should be. This orientation where teachers are not only prepared in a research context but themselves are encouraged to become researchers may well be the way to encourage the development of evidenced-based cultures in schools.

5.3 Supporting cutting edge research on learning

What research is needed to enhance learning? As suggested in this paper, one possible direction is cognitive neuroscience – although there are many hurdles to cross before there is a natural pathway between education and cognitive neuroscience. But it is worth pursuing this area even though at times the distance between the two seems immense. There are some promising developments that seem to be setting a direction for the future. Kelly (2011) has identified a number of promising studies with direct relevance to school education. In addition,

Obersteiner, Dresler, Reiss, Vogel, Pekrun, and Fallgatter (2010) have used an EEG to measure brain activation while students were performing arithmetic tasks. Furthermore, Thomas, Wilson, Corballis, Lim and Yoon (2010) used Functional Magnetic Resonance Imaging (fMRI) data to investigate the role of algebraic and graphical representations in understanding function. Interestingly, for both studies, the results were not particularly striking with no significant variability across tasks or methodologies. But this in itself is an important point – cognitive neuroscience is not a magic bullet and the development of a relevant research agenda will be demanding.

Byrnes and Fox (1998, p.318) make the helpful distinction between "domain specific processes" such as mathematics, reading, bilingualism and special education and "domain general processes" such as attention, memory and emotion. Thus, if the focus on single school subjects such as reading and mathematics seems to be restrictive, as Byrnes and Fox (1998, p.336) pointed out, there are many general processes such as motivational constructs (e.g., self-efficacy, academic self-concepts, intrinsic motivation) or metacognitive constructs (e.g., comprehension calibration, epistemic beliefs) that have been the traditional concerns of education psychologists. Thus, an agenda needs to be constructed and explored by educators in order for them to take advantage of this new science.

Yet it should not be thought that neuroscience is the only "cutting edge" research to be pursued. As shown in this paper, culture related research is of particular significance for the Asia Pacific region. This may be of a traditional psychological kind, or it could be comparative but outside the discipline of psychology, or it could be sociological in nature but with a cultural turn (e.g., the influence of socioeconomic status on learning across the region). It may be that the cultural invariance thesis so much loved by cultural psychologists needs to be questioned and the distinctiveness of cultures and their impact on learning needs to be highlighted more. This may well be one way to explore the dichotomies in learning referred to earlier in this paper. Once the invariance thesis is abandoned (even as it applies to measurement issues in large scale assessments), there will be a different way of looking at learning outcomes. Chow and Kennedy (2011), for example, have used secondary analysis to show that there is much more heterogeneity in large scale assessment data than the official report of the International Civic and Citizenship Education Study (Schulz et al., 2010) suggests.

Action research should not be discounted from a future research agenda. Teachers in classrooms experimenting on a day-to-day basis with learning approaches can play an important role in developing new understandings of what will work in specific contexts. Linked to mainstream research agenda and working in partnership with research institutes, teachers can play a very significant role as practitioners and researchers, a role that can be seen as fundamental in renewing teacher knowledge and skills for the new learning challenges.

5.4 New ways of looking at learning

As we look towards the future, there is little doubt that we must consider learning in a new light. Bereiter (2002) has argued that much thinking about learning has regarded the mind as a container – it just needs to be filled up with facts. He refers to this as a "folk psychology" that often characterizes learning as the ability to retrieve ideas, facts and concepts. Many aspects of teaching and assessment seem to support this approach to learning – so teaching often consists of providing "the information to be stored" and assessment consequently becomes "repeating in one form or other stored information". This, of course, is a caricature (although not an extreme one!), but it is probably recognizable in many parts of the world. At the same time it is consistent with the early views of cognitive psychologists as described by Western and Gabbard (2002, p.65):

> "In the older view, storing a memory meant placing it somewhere – in the long-term memory – and attaching an address or code to it so it can be readily retrieved, like a catalogue number or a call number for a book at the library. From a neuroanatomical point of view, this led to the search for the 'engram' – the "spot" in which a given thought or image was stored."

They go on to point out that "cognitive scientists are less likely today to think of representations as located in a particular memory store. Instead they are more likely to see representations in memory as *potentials* – as patterns of neural firing that occur under certain conditions, which are more or less likely to occur depending on their past occurrence". The significance of this change cannot be overestimated. In the first place it is a change of metaphor – from "the mind as computer" to "the mind as brain" (Western & Gabbard, 2002, p.65). But in reality it is more than a change of metaphor – it is a fundamental change in considering the very nature of learning.

This view of learning – "the mind as brain" has led to a connectionist theory of learning that is too detailed to rehearse in full here. Medler (1998, p.63) describes connectionism this way:

> "Connectionists adopt the view that the basic building block of the brain is the neuron. The neuron has six basic functional properties. It is an input device receiving signals from the environment or other neurons. It is an integrative device integrating and manipulating the input. It is a conductive device conducting the integrated information over distances. It is an output device sending information to other neurons or cells. It is a computational device mapping one type of information into another. And, it is a representational device subserving the formation of internal representations."

This may seem like a simple description of a system "built for learning". Yet both the complexity of the neuronal connection process as well as its interpretability should not be underestimated. There are over 100 billion neurons in the brain and Byrne (2012) has indicated that "any one neuron can contact up to 10,000 postsynaptic cells". Thus, the potential for activating "the system" is almost infinite and the outcomes from wholesale activation are entirely unknown or at least unpredictable. This explains why much of neuroscience research is localized so that specific areas of the brain are more likely to be the subject of experiments than unfocussed searches throughout the whole system. The connectionist issue is always to identify what area of the brain facilitates learning and then how much learning can be routinized – whether it is learning about visual processing, mathematical understanding or for an Alzheimer's patient for whom memory of faces is so important.

Bereiter (2002, pp.174–175) is a connectionist but he stresses that connectionism is not a new "theory" of learning:

> "I must try to get you off the theoretical track, because it is a track that can lead to endless quibbling about definitions, demands of 'how to explain such and such', and counter arguments of greater or lesser theoretical weight. Instead, I have to convince you that there is a payoff in making the conceptual shift – that it will help you in your work."

His point here is to stress the importance of moving away from the idea that the mind is a "container" to be filled – rather it is a system of interrelated connectors that can be activated to facilitate learning. This is a basic metaphor of the learning process (rather than a theory) and it has won some support amongst educators.

Karaminis and Thomas Michael (nd) have shown how some aspects of language understanding, especially in a second language context, can be explained by connectionist principles. Yet the explanation is complex and the "metaphor" is not always the brain, but rather artificial intelligence (AI) that also uses connectionist principles to explain learning in that particular context. Ghaemi and Faruji (2011) also highlighted the possibilities of connectionism in relation to language learning and they provide a helpful description of how such learning is assumed to work:

> "…processing takes place in a network of nodes (or "units") in the brain that is connected by pathways. As learners are exposed to repeated patterns of units in input, they extract regularities in the patterns; probabilistic associations are formed and strengthened. These associations between nodes are called connection strengths or patterns of activation. The strength of the associations changes with the frequency of input and nature of feedback. The claim that such

> learning is not dependent on either a store of innate knowledge (such as Universal Grammar) or rule-formation is supported by computer simulations."

Glisczinski (2011, p.13) put the implications this way:

> "So the implication for rich learning is clear; cycles of multi-sensory stimulation, critical reflection, situated analysis, and active experimentation create neuronal networks adept at further whole-brained learning."

There is much more to be said about connectionism – both critical and supportive. What should be clear from this brief exploration is that learning should be seen as more than "filling the container" and this is what connectionist supporters try to show. Such an approach is open to all kinds of learning – practice, repetition, direct instruction as well as stimuli of different kinds, sensory experiences and engaging discussion. It can encompass listening to the teacher, listening to each other and observing the environment. Active and engaged learning takes on a new meaning in a connectionist framework. As Glisczinski (2011) highlighted; learning is about activating the mind. This could be a sound mantra as well as a true reflection of how learning is to be understood in the 21st Century context.

6. Conclusion

This paper has argued that learning needs to be viewed in the cultural contexts that construct it. Learning is not some objectified process that works the same way for all learners. Social and cultural contexts provide inputs to learning and these factors need to be acknowledged. Connectionism may provide one metaphor for considering the importance of "activating the mind" although it may not provide a complete theoretical framework to view learning. Understanding learning better will help to address learning disparities in the region and this needs to be made a priority. Learning that produces knowledge is the requirement for success and everything needs to be done to ensure that access to learning is equitable and outcomes are fairly distributed. Hopefully this paper might contribute to this important objective.

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