

Summary of the Second Meeting of The Lifelong Learning Network held in Tokyo, Japan, 13-14 January 2004

The focus and need for research on life-long learning emanates from both societal and biological pressures and demands. With societies struggling with their ageing populations, there is a turning toward neuroscience to understand what is appropriate for age groups and when. Additionally, with rapid globalisation, there is a need for human brains to adapt to and assimilate changes. The Lifelong Learning Network is one of three networks that comprise the OECD-CERI "Brain and Learning Sciences" project. Together with the Literacy and Numeracy Networks, it aims to integrate findings from basic brain research into educational policy and practice. The purpose of this network is to investigate the development of brain activity in children and to stress the functional reorganisation of the brain of mature adults with an emphasis on enhancing the cognitive vitality and learning capacity of older adults.

The Lifelong Learning Network met for the second time on the 13th and 14th of January 2004 in Tokyo, Japan. This meeting was attended by over 40 participants made up of scientific researchers and educationalists from Australia, Canada, Finland, Germany, France, Japan, the Netherlands and the USA. The purpose of the meeting was to update on the research work from the ten member laboratories of this network, to increase dialogue between educators and scientists, and to foster the bridge-building activity that CERI is striving to achieve in this project between neuroscience and education by coming up with ideas and positive suggestions on how to go about how to make this knowledge accessible to a global audience of educators and policymakers. The meeting was divided into four sessions. Findings from the network laboratories were presented and discussed in the first three sessions: "Learning in Infancy", "Learning in Childhood", and "Learning Across Life". Session four was on "Issues in Integrating Brain Science and Education." Discussion with educators took place after each session in order to debate hypotheses and to seek out the implications of the work presented for education.

The Chairman of the Network, Dr. Masao Ito, outlined the 3 educational challenges that this network aims to address:

- How does environment influence the early stages of brain development in terms of neuronal structure, sensory function, and behaviour?
- How do children grow in terms of speech, sensorimotor and cortical function, and learning of art and music?
- How can learning be sustained in the aged, function be restored to damaged brains, and quality of life be enhanced in an increasingly information driven society?

A provisional 4-part matrix was presented to the network at this meeting for the first time in order to help structure and filter the dissemination of findings into an educational framework, and by aiming to link these results to other OECD work such as PISA; the International Adult Literacy Survey Adult; Adult Competences; and to Gardner's 7 forms of intelligences:

- *Periodicity*: marking discreet biological, socio-cultural, and chronological periods in the lifespan of a human being, with regards to learning.
- *Skills and competences*: identifying the basic functional elements that need to be acquired such as language and numeracy.
- *Conditioning factors*: such as nutrition, sleep, and environment that generally have a significant impact on learning.
- *Neuronal plasticity*: its relevance for education and learning.

Summary of the sessions

Learning in infancy

In this session preliminary data was presented showing that children strategically employ learned morpheme (smallest unit of language) categories to assist in language acquisition at two years of age and phonological (rhyming, alliteration) awareness at three and four years of age. There were two presentations on sleep: one showing that newborns can learn to discriminate sounds during sleep, which indicates the possibility that learning is enabled during infant sleep; and the other exhibiting how sleep consolidates memory and facilitates learning, is involved in (and shaped by) synaptic changes in the developing brain. Although the latter is based on animal models it indicates the plasticity of the sleep state with further implications for learning. A presentation showed how the effects on maternal care in the raising of pups which received more tactile stimulation (licking and grooming) contribute to neuronal survival. However, these effects can be reversed by cross-fostering the pups in enriched environments, which may have broad effects on cognitive development and education.

Learning in Childhood

A presentation on the effects of music which appears to improve memory call might have a modulating effect on learning, was given in this session. Another presentation on the expression of negative emotions as being mediated by an individual's interpretation of events showed that children may not be effectively able to down-regulate negative emotional responses. From a longitudinal study undertaken in the Netherlands, evidence was shown in the difference in ability and rate of cognitive decline were apparent across education levels and between sexes and that memory decline does not occur at the same rate for all adults or for all aspects of learning. A presentation on motor skill learning showed that for learning to be effective, it is essential to know what tasks interfere with memory and how to facilitate better learning. The final presentation in this session, given by one of the educationalists, was on learning in school and lifelong learning. It stressed that learning is more successful if the educator understands each learner as an individual, and does so by first locating each learner on a map of concepts and ideas and teaching within that domain. Thus, having established solid conceptual frameworks, learners can direct their own learning based on personal experiences throughout life.

Learning across life

From non-invasive imaging techniques, evidence that damaged brains exhibit plasticity was presented, with the example cited of a stroke patient who lost language capacity in the dominant hemisphere of the brain, and who showed consequent brain re-organisation to regain this function. A lifelong approach to physical activity in schools was advised after a presentation showing evidence that cardiovascular fitness increases brain connection activity in cross-sectional and longitudinal studies. The final presentation in this session showed that adults are more competent in enhancing critical thinking and strategic problem-solving whereas children adapt faster to new technology and on-line tasks. The challenge that emerges from this is to develop learning paradigms that improve these deficits in both groups and enhance overall performance.

Issues in Integrating Brain Science and Education

This session was made up of two special lectures. One introduced a novel project in Germany establishing a new learning institute to facilitate transfer of brain science findings into education; the other addressed emerging ethical issues in neuroscience and potential impact on education.

Implications for education

The research presented at this meeting begins to provide important information on how the brain processes at different stages in the lifecycle, its plasticity, the impact of the environment etc. Although no clear policy implications can be drawn from this meeting yet, some insights on learning across the lifespan were evident which may provide some awareness points for educators and policy makers to already take home as messages and which indicate areas for further research:

- The effects of environmental enrichment on rats could possibly produce comparable stimulation in humans but this would vary cross-culturally so, more research is needed.
- Emotional control should be seen as a learning goal that encompasses social development to facilitate learning
- Tapping in on learning capacity of infants during sleep (and whether these learning effects might be durable), should be more fully explored. Practical advice about sleep and consequent arrangement of the school day could possibly also be formulated from such studies
- Indications of the effects of watching television appear to have results on making children more detached and less motivated at school the next day, but more cross-cultural studies are required to evaluate the impact on learning.
- It was suggested that activities such as badminton, golf and racquetball which could be played later in life be introduced rather than basketball and football which are less age-friendly.
- Relationship between mental rehearsal and performance should be tapped and practiced and could be potentially simulated in video games.
- Design presentation of knowledge, techniques that contribute to the development of better applications for learners needs to be explored.
- Developing awareness of brain functions for teachers and learners was discussed; however, it was warned that there is no guarantee that knowing how one learns will improve learning behaviours and increase learning

motivation. Teacher motivation to learn and incorporate brain science findings into education practice is essential to ensure that reliable, biologically based learning methods would be adapted. Teachers appear to be receptive to brain science when it is presented in a way relevant to education, but caution should be exercised in applying these methods too quickly without first developing empirical methods to determine the overall benefits.

Although much more dialogue remains necessary between education and brain researchers to facilitate the work in this network, it was felt that this meeting made good ground in this area. Some practical suggestions to move further forward were to:

- Demonstrate social relevance of research in all future grant proposals (this suggestion was made based on the research funding policy in the Netherlands).
- Create two categories of educational implications: brain scientists could (1) suggest implications of their research for both policy and practice, and (2) could pose relevant questions to practitioners.
- Call for hypotheses from educators to be made known to brain science researchers.
- Create a lingua franca in order to unify the terminology between the two camps of educators and neuroscientists, which is necessary in order to facilitate better discussion.
- Develop a more brain-friendly curriculum which uses new technologies in the classroom.

Masao Ito summed up the meeting as well-focused in integrating first-hand knowledge emerging from ten world class laboratories (all deeply interested in the brain's learning mechanisms across the lifespan). A growing understanding of the importance of the network's efforts to confront the challenges associated with learning across life was clearly demonstrated at the meeting.

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