



Implications of Recent Developments in Neuroscience for Research on Teaching and Learning

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Given the interest today among teachers in our schools in how the brain affects learning, MENTOR sought the permission of Dr Sarah-Jayne Blakemore and Dr Uta Frith, both of the Institute of Cognitive Neuroscience in London, for permission to reproduce below a summary of the report entitled "The Implications of Recent Developments in Neuroscience for Research on Teaching and Learning", which Dr Sarah-Jayne Blakemore and Dr Uta Frith co-authored. This summary first appeared in "Research Intelligence" (No.75, April 2001). The full 58-page report gives a clear picture of the state of the art concerning what is popularly known as brain-based learning. As brain science becomes popular material in newsmagazines, etc., it is important for us as teachers to separate the science from the speculation.

How the brain acquires new information and how this learning process is affected by age, emotion and context are questions that have fascinated neuroscientists for centuries. Recent advances in technology have enabled neuroscientists to discover more about how the brain develops and how the adult brain learns. Techniques such as functional neuroimaging (fMRI and PET), which measures activity in the brain as humans perform a certain task have significantly pushed forward our knowledge of the brain and mind. This report is a selective account of developmental and cognitive neuroscience studies that

are informative about learning and might be of relevance to research on teaching and learning.

The report is split into three main sections. The first section covers advances in our understanding of brain factors in early childhood. We consider the relevance of these factors to learning that takes place between the ages of zero and seven years old. There is a serious lack of neuroscientific research on how the brain develops after the early years and before adulthood. In particular we know little about how processes such as learning and memory develop throughout adolescence. Recently, neuroscientific research

has shed light on how the adult brain learns new material, how learning is affected by emotion, context and individual differences. The nature of learning throughout life will be the focus of the second section of this report. The third part addresses individual differences and learning problems. At the end of each section, we will list a selected number of research questions that could be addressed jointly by educators and neuroscientists. These questions arose out of extensive discussion with a wide range of experts in the areas this report spans. Some of these questions might feed into research initiatives in a future multidisciplinary research programme on teaching and learning.

Before we discuss these aspects of brain research, we address the need for caution when considering the implications of neuroscience research for teaching and learning. Despite the remarkable progress, brain research has not yet found an application in theory or practice of education. Misconceptions about neuroscience, what neuroscientists are interested in, and how far

neuroscience can extend in terms of its application to education, are only too easy to foster. What is needed to avoid such misconceptions is a new interdisciplinary approach.

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If there is to be a new interdisciplinary approach, then what is needed most urgently is a common vocabulary between brain scientists and educators. The starting point for building a common understanding could be through brain research into areas where educational research has already established a working hypothesis. Cross-disciplinary discussions have value in both process and outcome terms, but it is usually difficult to find common ground from which to launch the interaction, and shared criteria against which to judge its progress. The one-sided approach (can brain research be applied to classroom practice?) can lead to dangers. Therefore taking an interactionist approach (what do educators need to know that can be informed from brain science?) is more appropriate. To this end, active and empirical collaboration between neuroscientists and educators would be beneficial. Such collaboration will benefit from a concerted effort to find common ground. A forum in

which neuroscientists and educators discuss and distinguish their research questions and clarify terminology and methodological differences would be a crucial step. The goal of developing an interdisciplinary 'science of learning' cannot be usefully pursued by one or other of the disciplines taking the lead, but depends on each challenging the other with ideas and hypotheses to test and refine. For this task a mediator is needed. Cognitive psychology is tailor-made for this role. This is not to exclude developmental psychology, social science, education, sociology, anthropology and evolutionary psychology, which all could be represented in an interdisciplinary forum. However, we believe that brain science can impact most readily on research on teaching and learning through cognitive psychology. If this is the case then the public's and teachers' conceptions of psychology may need attention.

It might be hazardous to suggest that educational research itself does not or could not provide the best approach to many of the issues from its own resources and sound scientific thinking. Instead of asking how neuroscience can inform educational research, it might be more useful to think about how brain science challenges common sense views about teaching and learning. Instead of verifying what educators already know, it might be more useful to ask where research on the brain can offer information about learning and cognition that is counter-intuitive to the educator's. Two such areas, which will be

discussed in more detail in the report, are implicit learning and plasticity in the adult brain. Briefly, research on implicit learning has shown that the brain extracts information at a level that is neither attended to nor noticed. This tendency of the brain to do things 'behind one's back' is pervasive and might have repercussions on theories of teaching. Many different areas of neuroscience research have demonstrated that the adult brain is 'plastic' and capable of a remarkable amount of change and relocation of function, depending on how the brain is used. This research suggests that the brain is well set up for life-long learning and adaptation to the environment, and that rehabilitation is possible and worth investment. On the other hand, it suggests that there is no biological necessity to rush and put the start of teaching earlier and earlier. Rather, late starts might be reconsidered as perfectly in line with findings from brain research.

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With more active discussion and collaboration between neuroscientists and educators, there is potential for totally new questions to emerge that so far could not be answered and hence were never asked. Such an approach will help to stimulate new research in an interdisciplinary 'science of learning'.