Learnus®

MEDIATED WORKSHOP SERIES

Understanding Learning - is it all in the brain?

MEDIATED WORKSHOP REPORT:

The Science and Art of Reasoning

15th October 2013

18:00 to 20:30

Institute of Education
University of London

INTRODUCTION

LEARNUS is a recently formed think tank which aims to act as a bridge between the latest academic research and the classroom and to share our findings with education policy makers. A key element in working towards this objective is the need to provide opportunities for the wide range of interested parties - neuroscientists, teachers, psychologists, policy makers and commentators - to come together to explore the issues and share their knowledge and understanding of the field. This mediated workshop is one of a series of such events that is being held by LEARNUS in order to provide such opportunities and inform subsequent developments.

PURPOSE AND STRUCTURE OF THE MEDIATED WORKSHOP

Within the context of the overall mission of LEARNUS, the purpose of the mediated workshop was:

- to explore the question in the overall title - Understanding learning: is it all in the brain? - by bringing together a range of stakeholders to share their expertise and understanding of learning;
- to consider at this workshop, The science and art of reasoning
- to draw out from the discussions key issues which need to be addressed as part of the future dialogue.

The workshop included a presentation by Professor Denis Mareschal (Director, Centre for Brain and Cognitive Development, Department of Psychological Sciences, Birkbeck College, University of London) followed by roundtable discussions. The full programme for the workshop is attached to this report as Appendix 1.

Forty participants attended and contributed to the discussions.

Keynote Presentation

Professor Mareschal set the scene for the roundtable discussions by considering the basis of reasoning. In particular he explored the following.

- What reasoning involved and the historical context by referring specifically to the work of Piaget on logical thinking. Using examples of knowledge-based inferential reasoning he emphasized how difficult logical reasoning was and how much we relied on pre-existing knowledge and experience in coming to conclusions.

- The main section of the presentation provided an overview of the outcomes of brain studies using:
    - Functional imaging (e.g. fMRI) which measures "current processing" in the brain within an individual
    - Structural images which appear to reflect "learning", "ability" and possibly "potential" differences between individuals.

Three aspects of reasoning were considered.

1. Deductive inference which, based on Imaging studies, appears to require the engagement of both language-based and visual spatial modes of brain function. Especially in tasks involving the integration of prior knowledge the DLPFC (Dorsal Lateral Prefrontal Cortex) seems to be a prominent area of activity.
2. Causal inference for which there are relatively few studies available but these suggest that there are different processes going on in the brain. Where the reasoning was consistent with prior beliefs parts of the parahippocampal cortex (associated with semantic knowledge) are active. On the other hand the when a hypothesis was inconsistent with prior beliefs the DLPFC (Dorsal Lateral Prefrontal Cortex) and Anterior Cingulate (AC) appear to be the main areas involved.
3. Analogical inference may be developed through the use of verbal or perceptual analogies and so have different sites of activity. The indications are that the frontopolar cortex (part of the Prefrontal Cortex -PFC) and the right lateral PFC are particularly sensitive to the integration of multiple systems of relations (either abstract or concrete) between ideas.

- The overall findings to date are consistent with the idea that executive functions can be dissociated into Evaluative and Executive components of reasoning involving the AC and DLPFC respectively. AC identifies conflict and DLPFC resolves conflict and the findings to date are consistent with the centrality of conflict monitoring in classic theories of reasoning such as Piaget's reflective abstraction. Furthermore, the late maturing of the DLPFC may partially underlie the prolonged development of reasoning skills.

- There is much work still needs to be done especially need for increased numbers of developmental studies but two possible messages for educational practice were identified. The first was that further consideration might be given to increasing domain knowledge as a pre-cursor to teaching inferential techniques (e.g., hypothesis testing). The second was that improving "conflict monitoring" will have knock-on effects on reasoning in the brain.

Outcomes of the roundtable discussions

The groups at each table were invited to use the question prompts below (see also Appendix 1) to reflect on the points made during the key note presentation.

a. How does the functioning of the brain affect the ability to reason?
b. What influences our ability to think logically and solve problems successfully?
c. How do reasoning skills develop?
d. How can reasoning skills be improved?
e. What are the implications for teaching approaches?
f. To what extent are reasoning skills transferable?

The lively discussions that ensued inevitably raised many more issues ranging from matters relating specifically to the structure and function of the brain to the how the reasoning skills of students might be improved. Rather than trying to summarise all their discussions, groups were asked to identify and question that they felt came from their conversation particularly strongly. These headline questions were:

- What is the role of emotion in reasoning?
- Is open-mindedness a disadvantage in the context of conflicts in thinking?
- Can the maturation of PFC be speeded up; or do we have to wait until students are ready to undertake certain functions?
- How do you get students to be able to transfer knowledge from one domain to another?
- How do you get children to stop worrying about making mistakes?

Professor Mareschal commented on each of the questions, indulging in a little speculation, but emphasising that while we have some pieces of the jigsaw there is still much work to be done to improve understanding of the processes of reasoning and hence the implications for classroom practice.

In summary

The workshop demonstrated again that there is a healthy interest in exploring how, by bringing neuroscience and education together, our understanding of learning can be improved further. There is a multitude of factors involved in the development of good reasoning skills but it could be argued that there is scope to use what is known more effectively.

Thanks

LEARNUS wishes to thank Professor Denis Mareschal for the thought provoking presentation and to all the workshop participants for their willingness to share their ideas and experience so willingly. Thanks also go to everyone who helped to organise the workshop and we hope to seen as many as possible at future events.

Reference

In preparation for the workshop the following article was circulated to participants:
The cognition and neuroscience of relational reasoning, by Daniel C. Krawcayk:
http://www.brainhealth.utdallas.edu/pdfs/The cognition and neuroscience of relational reasoning.pdf

Derek Bell
Director of Learnus
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