Cognitive science in education

Teachers' priorities for research

Lisa-Maria Müller and Victoria Cook

CHARTERED COLLEGE OF TEACHING

About the Chartered College of Teaching

The Chartered College of Teaching is the professional body for teachers. We are working to celebrate, support and connect teachers to take pride in their profession and provide the best possible education for children and young people. We are dedicated to bridging the gap between practice and research and equipping teachers from the second they enter the classroom with the knowledge and confidence to make the best decisions for their pupils.

Acknowledgements

We would like to thank all teachers who have contributed their questions to our survey. This report would not have been possible without you and your contributions were truly fascinating and eye-opening, showcasing the high level of expertise among the teaching profession. We would also like to thank the Chartered College of Teaching research ethics panel for taking the time to review our application and grant ethics clearance. Moreover, we highly appreciate the guidance and feedback we have received from our steering committee during this process. Finally, our thanks go to Amit Kulkarni and Hamish Chalmers for their time and guidance during the initial stages of this project.

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How to cite this publication: Müller LM and Cook V (2023) Cognitive science in education: Teachers' priorities for research. London: Chartered College of Teaching.

First published: 29th June 2023

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Foreword

As CEO of the Chartered College of Teaching, I truly believe in the power of using evidence to inform and improve teaching practice. I also believe that it is essential for our sector to recognise the crucial role expert teachers play in the process of adapting and implementing research evidence to make it fit for their students and classrooms. If we are to succeed as a sector in becoming more evidence informed, we have to ensure that research is academically rigorous and practically relevant – a vision that can only be achieved by bringing research and practice closer together.

I am therefore delighted to present to you the results from the Chartered College's first research priority partnership, which I hope will inform research in the cognitive sciences in the years to come. Research priority setting approaches are a popular tool in many disciplines to help define the areas that research should focus on to make it more practically relevant. In preparation for this research priority setting activity, we have worked closely with colleagues within and beyond education who have previously conducted similar activities and we are grateful for their insights and expertise.

Findings from the cognitive sciences have rightly received much attention over the past years for their potential to improve our understanding of learning and memory processes. As a recent report by colleagues from the Education Endowment Foundation (EEF) (Perry et al., 2021) showed, we are still only starting to understand how some of these findings can be implemented effectively across settings, phases and subjects. We therefore wanted to find out from teachers what questions they have when they use some of these findings to inform their practice, with the aim of informing new research going forward.

We were very pleased to have received over 400 questions in response to our call. These questions truly highlight the complexity of the classrooms in which teachers operate and the need for future research to take this complexity into account. We hope that the 15 questions we present in this report will provide food for thought and guidance for anyone wishing to conduct research in the field of applied cognitive sciences.

At the Chartered College of Teaching, we will be using the 15 priorities identified as part of this first research priority setting activity to help guide our own research work, disseminate research findings from other organisations and work with funders to inform new funding schemes that will allow researchers to investigate some of these questions through their work.

Evidence has the power to transform practice. Teachers have the power to transform lives. We hope that these priorities will bring us a step closer to narrowing the research-practice gap in the interest of the students we serve.

Professor Dame Alison Peacock

The Chartered College of Teaching research priority setting activity

The aim of the Chartered College of Teaching is to support evidence-informed practice in education by narrowing the research-practice gap.

The use of research evidence in education has the potential to improve teaching quality and student outcomes but the relationship between research and practice is not linear. It requires the careful combination of high-quality research evidence, teacher expertise and context-specific implementation (Scutt, 2019).

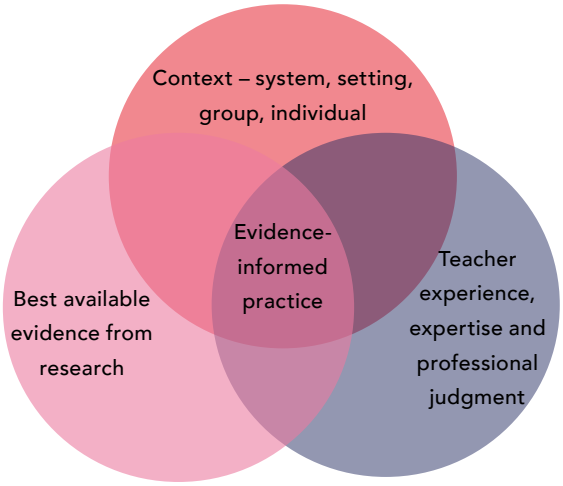

Figure 1: Evidence-informed practice (Scutt, 2019)

Cognitive science research has received particular attention in recent years due to its potential to improve our understanding of memory and learning. Findings from basic cognitive science can indeed teach us a lot about the principles underlying memory retention and information processing. However, the application of these findings in classroom contexts remains complex and under-researched. Findings from applied cognitive sciences, i.e. studies that aim to test the effectiveness of different teaching strategies within authentic classroom environments, remain limited to specific contexts, subjects and age groups (Perry et al., 2021). This means that key gaps persist in our understanding of how cognitive science principles can best be applied across different contexts.

Teachers therefore have to use their professional judgement and expertise when trying to implement and adapt research findings to their complex classroom contexts. This process generates important questions that highlight some of the issues and potential barriers relating to the implementation of research findings in practice. Teacher voice is central to ensuring that the focus of research is relevant for classroom practice. However, research agendas are often shaped by researchers and funders, rather than teachers themselves, and therefore may fail to address educational priorities (Swanwick and Marschark, 2010).

We asked teachers to share the questions they have when implementing findings from the cognitive sciences in their classrooms, with the aim of sharing the most pressing issues that can inform new research in applied cognitive sciences. If research is to have an impact on classroom practice, it is important that these questions are answered, or at least considered as part of new research.

This report presents the top 15 questions teachers have when implementing findings in their classrooms, with the ultimate aim of informing future research and reducing the research-practice gap.

#CogSciResearchPriorities

Cognitive science in education

This report focuses on cognitive science due to the increased interest that has been accorded to this area of research in education in recent years. This increased interest, together with its inclusion in important guidance documents such as the most recent education inspection framework in England (Ofsted, 2019), meant that we were confident that many teachers will have tried to implement findings from the cognitive sciences in their settings – a prerequisite for submitting meaningful questions.

The report builds on a recent systematic review summarising the current available evidence on the use of cognitive science strategies in the classroom (Perry et al., 2021) and focuses on the following seven strategies, drawn from the report:

- spaced learning
- interleaving
- retrieval practice
- managing cognitive load
- working with schemas
- dual learning
- embodied learning.

Spaced learning is concerned with the spacing out of learning and retrieval sessions and has been shown to be generally more effective than massed practice.

Interleaving describes the mixing of different problems during study sessions and has been found to be generally more effective than repetition of the same types of problems.

Retrieval practice describes the active retrieval of knowledge (e.g. via quizzes) during learning sessions and has been found to be generally more effective than repetition only.

Managing cognitive load is concerned with supporting students to focus on key information instead of overloading them.

Schemas help students to organise information and connect new and existing knowledge.

Dual coding combines verbal and non-verbal information to improve learning and has been found to be generally more effective than using just one channel.

Embodied learning describes strategies that make use of physical movement to support learning.

The aim of the research priority setting activity was to capture questions teachers have when implementing these strategies in their contexts.

The top 15 research priorities

The following 15 research priorities were deduced from the 424 questions teachers submitted to our survey.

Implementation

01 What does effective implementation of different cognitive science strategies look like across different phases, subjects and student groups, especially for younger students, practical subjects and students with special educational needs and disabilities (SEND)?

02 How can cognitive science strategies support the retrieval and application of complex information, for example in literature or history teaching?

03 How do different cognitive science strategies interact with each other and other teaching strategies during the learning process?

04 What is the optimal frequency of different cognitive science strategies for best outcomes?

05 How are different cognitive science strategies best combined and integrated into learning sequences at the micro (i.e. lesson) and macro (i.e. curriculum/school) level?

06 How can teachers effectively adapt cognitive science strategies as students move along the novice to expert continuum in their learning?

07 What is the optimal balance between the learning of new content and revisiting of past learning, especially in the context of crowded curricula?

08 What are the most effective and informative approaches to measuring the impact of different cognitive science strategies?

09 How are cognitive science strategies best implemented to ensure a balance between appropriate cognitive load and challenge?

Students

10 How does the use of cognitive science strategies impact students' motivation?

11 How can teachers develop students' agency in applying cognitive science strategies to their independent learning?

12 To what extent does students' understanding of cognitive science strategies impact outcomes?

Teachers

13 What are the most effective approaches to developing teachers' knowledge of cognitive science strategies and their application in the classroom?

14 What are the most effective approaches to improving teachers' attitudes towards using cognitive science strategies in the classroom?

15 What is the optimal balance between fidelity to original research designs and teacher expertise in the context-specific application of cognitive science strategies?

How did we identify these priorities?

A research priority setting approach was used to identify the top 15 questions teachers have about implementing findings from the cognitive sciences in their settings. Research priority setting approaches are frequently used in healthcare and aim to establish consensus among knowledge users and researchers in order to shape the research agenda (Bryant et al., 2014). An adaptation of the Research Priority Partnership approach developed by the James Lind Alliance (JLA) was used here (James Lind Alliance, 2021).

Following an open call, a steering committee comprising teachers representing Early Years (EY), primary, secondary and Further Education (FE) as well as academics was put together to guide the development of the survey and refine the final list of priorities. While research priority setting approaches typically involve practitioners, patients and carers, it was deemed appropriate to only focus on practitioners as part of this activity due to its focus on implementation of findings in practice. In other words, the 'lived experience' that was the focus of this activity was the implementation of findings in teaching and planning and any uncertainties relating to this process, rather than the 'lived experience' of being a student or parent.

An online survey was developed based on Perry et al.'s (2021) systematic review of cognitive science approaches in the classroom. The survey started by asking teachers three questions about their current use of each strategy in their teaching, how confident they felt about implementing them and how effective they perceived them to be. Then an open question asked teachers to share any questions or uncertainties they had about implementing findings from the cognitive sciences in their classroom. Respondents could submit up to three questions/ uncertainties.

The survey was shared with members and followers of the Chartered College of Teaching via newsletters, social media and a button on the member website as well as members of partner organisations (e.g. BAMEed, Teach First, Centre for Teachers and Teaching Research at UCL, DiverseEd) via their communication channels between November 2022 and January 2023.

383 individuals responded to the survey, submitting a total of 424 questions. 22 questions were removed due to lack of relevance (i.e. not related to cognitive sciences or how other teaching approaches interact with cognitive sciences) or unclear formulation, leaving a final corpus of 402 questions.

All questions were coded according to a coding framework developed jointly by the two authors and grouped to formulate 58 indicative collated questions. The final top 15 priorities were extrapolated from these questions by the two authors with support from the steering committee.

An academic article outlining the methodology in more detail is in preparation and will be hosted together with this report after its publication.

Next steps and how you can get involved

In order for these research priorities to have the most impact, it is important that they are shared as widely as possible. This will ensure that anyone looking to conduct research in the field of applied cognitive sciences can consider them in their work, ultimately improving our sector's understanding of how cognitive science teaching strategies can be best implemented across ages, settings and phases.

To support this process, the Chartered College of Teaching will:

- share the 15 research priorities with funders to ensure that they can be incorporated into new funding rounds
- disseminate the priorities among researchers and other stakeholders in education so that new research projects can investigate them
- support researchers to disseminate their findings among the teaching profession
- encourage teachers to conduct their own research into some of these questions and share it with the education community via our publishing opportunities
- facilitate collaborations between teachers and researchers to jointly investigate some of these questions
- incorporate the priorities into upcoming calls for papers for *Impact*, the Chartered College's peer-reviewed practitioner journal, to encourage submissions around the highlighted topics
- highlight existing resources that answer some of these questions to support members whilst further research is being conducted.

How to get involved

As teachers, practitioners and school leaders:

- share this report with your network
- discuss the report and how it relates to your own practice in one of your staff meetings
- use the top 15 priorities to guide practitioner research projects in your schools.

As researchers:

- conduct research into the top 15 priorities or any of the questions from the longlist
- let us know if you are conducting research on any of the priorities and how we can support the dissemination of your findings
- form research partnerships from the start of your projects to ensure any new research in this field is academically rigorous and practically relevant.

As research funders:

- reserve funding for projects looking into any of the questions presented here.

For everyone:

- strike up a conversation on social media using **#CogSciResearchPriorities** and tagging **@CharteredColl.**

Longlist of research priorities

Based on the coding framework developed by the two authors of this report, the 424 questions submitted by teachers to our survey were collated into overarching questions which are presented below. These questions are more detailed than the final 15 research priorities and can help to guide discussions around research on specific cognitive science strategies.

Retrieval practice

01 What are the most effective approaches to retrieval practice across different contexts?

02 How can retrieval practice support the recall and development of complex information and skills?

03 What is the ideal frequency with which retrieval practice should be implemented within and across subjects for ideal outcomes?

04 What is the ideal timing for retrieval practice in a learning sequence?

05 How can retrieval practice be implemented effectively across subjects and phases?

06 How effective is retrieval practice for students with a range of different SENDs and those with lower prior attainment?

Working with schemas

07 How are knowledge organisers used most effectively across different subjects and age groups?

08 Should the use of knowledge organisers be differentiated?

09 Where in the learning sequence should knowledge organisers best be used?

10 What is the appropriate size of schemas to support student learning at different levels?

Interleaving

11 What is the most effective approach to interleaving at the micro (i.e. task) and macro (i.e. curriculum/scheme of work) level?

12 How is interleaving applied across subjects and phases, especially with younger students?

13 Does interleaving risk to confuse students if they do not have the necessary prior knowledge?

Cognitive Load Theory (CLT)

14 How can scaffolding be adapted most effectively to suit students' learning needs?

15 What are the implications of CLT for younger students ?

16 What are the implications of CLT for the teaching of practical subjects and those using complex texts and reasoning skills?

17 What are the implications for CLT for different student groups, especially those with different SENDs and lower attaining students?

18 How can students be supported to deal with higher cognitive load?

Dual coding

19 How can dual coding be implemented most effectively across different subjects?

20 Does dual coding necessarily require the use of images?

21 Is the use of images/videos as effective as using processed written explanations?

22 Where can teachers access high-quality images for dual coding?

23 How can workload associated with dual coding be minimised?

24 How often/long does dual coding need to be implemented to achieve maximum effectiveness?

25 When in the learning sequence should dual coding best be used?

26 Is dual coding effective for all student groups, including those with different SENDs?

Spacing

27 How much time should ideally lapse between spaced practice sessions for maximum outcomes?

28 How can spaced practice be integrated most effectively into learning sequences?

29 How should spaced practice be implemented across subjects?

30 How effective is spaced practice for younger students?

Embodiment

31 What is embodiment and how is it different from kinaesthetic learning?

32 How can embodied practice be integrated across ages, especially older students (from KS3)?

33 How is embodiment best implemented across subjects (especially music)?

Metacognition

34 How can students be taught to use metacognitive strategies in their independent learning, not only when directed?

35 Are metacognitive strategies appropriate for all age groups, including the early years?

36 How can metacognitive strategies be used effectively across all subjects?

Interactions

37 How are different cognitive science strategies best combined and incorporated at the curriculum level?

38 How are different cognitive science strategies best combined and incorporated across subjects and at the school level?

39 What do we know about the interaction between different cognitive science strategies at the curriculum and school-level and how these interactions impact learning?

40 How can cognitive science teaching strategies best be combined with other evidence-informed teaching approaches to improve outcomes?

41 How does the use of cognitive science strategies interact with students' motivation?

42 How does students' understanding of cognitive science impact their learning approaches and outcomes?

Context-specificity

43 How effective is the use of different cognitive science teaching strategies for different student groups, especially those with different SENDs such as autism, dyslexia, ADHD and attachment disorders as well as persistent absentees?

44 How effective are cognitive science approaches across different subjects, especially for the acquisition of higher-order thinking and practical skills?

45 To what extent are findings from the cognitive sciences applicable across ages, especially to younger students?

Prioritisation and curriculum constraints

46 What is the right balance between teaching new content and retrieving past knowledge?

47 How should the different strategies be sequenced and combined for best outcomes?

Measuring impact

48 How can teachers best measure the impact of specific cognitive science teaching approaches on students' learning within complex classroom environments ?

49 How long does it typically take for different cognitive science teaching strategies to show an effect on students' learning?

Fidelity

50 How can teachers know if they are implementing strategies 'correctly'?

51 How important is it for implementation to resemble research designs as closely as possible?

52 What are the risks of implementing research-informed strategies simplistically?

Teachers

53 Where can teachers access training relating to the use of findings from the cognitive sciences in their classrooms, including specific examples of how strategies are used in practice?

54 To what extent do these strategies differ from current practice?

55 What approaches are most effective in developing teachers' understanding of cognitive sciences and initiating a change from current practice?

56 How can teachers'/leaders' negative attitudes towards the cognitive sciences be improved?

General validity of cognitive science

57 How applicable are research findings from the cognitive sciences to real-life classrooms?

58 How can we be sure that cognitive science is not just another gimmick?

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