



The Science of Learning in the Classroom - Impact Report

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Programme Overview

Starting in September 2021, a project headed by Exceed Institute and funded by Bradford Opportunity Area was launched, intended to upskill teachers with an array of evidence-based pedagogical approaches that are underpinned by current cognitive science theory. This provided an opportunity for participating schools to reflect on current practice and ensure that teaching and learning is evidence informed.

The programme was targeted at teachers with a responsibility for teaching and learning or curriculum development. Nine schools and eleven teachers enrolled on the programme; all participants engaged fully with the programme.

The overarching aims of the programme were as follows:

- Understand core pedagogical principles that secure long-term learning into memory
- Understand the interconnectedness of cognitive theory-based pedagogy and effective curriculum implementation
- Develop key pedagogical approaches for the development of meta-cognitive learners

Programme Design and Delivery Model:

A flexible and supportive approach was taken to accommodate for challenges related to COVID-19 (staffing issues, isolations). This was reflected in the delivery model which took on a blended approach, with face-to-face sessions; a mixture of live and recorded webinars; in person school visits; lesson observations and participant interviews.

Webinar evaluations, gap task data, lesson observations and participant interviews were analysed after each session and used to identify key issues and strengths. These then informed the design and content of future webinars and gap tasks.

All participants engaged fully with the programme and attended or watched each training sessions.

An overview of the programme's rationale, evidence based and intended outcomes can be found here: <https://www.teachingschoolhub.co.uk/site/data/files/documents/emma/5B0F971FCD3DC8643E8E12162727DF59.docx>

Delivery of the Programme

Much of the programme was delivered as a mix of webinars shared as PowerPoints with video recordings on each slide or live webinars which were recorded then uploaded to YouTube. 81% of participants said that they found this format of CPD useful as it allowed them to watch it in their own time and make notes at their own pace. 63% of participants said they had been able to re-watch the videos on the slides when planning future lessons. *"I could go home and work in my office. This meant I could pause, rewind and revisit concepts I found challenge or ones I really wanted to try out in my lessons."* Finally, 55% of participants shared webinar recordings or the slides with colleagues in their schools. The impact of this was seen during school visits when lessons were observed and resources from teachers were shared. These included resources used with hinge-point questions, knowledge organisers and an observation of live modelling.

Overview and Impact of Webinars

Webinars were delivered by Christabel Shepherd, Executive Headteacher and National Leader of Education, Exceed Academies Trust.

Live Webinar 1: 16th of November 2021 - The Importance of Cognitive Load Theory Driving School Improvement

This webinar gave participants a clear overview of cognitive load theory and its importance in teaching and learning. Participants were able to develop an understanding how cognitive load can be effectively reduced by learning about working memory and long-term memory in the context of Sweller's cognitive load theory. Participants learnt about the different types of cognitive load (intrinsic, extraneous, and germane) and how to apply this knowledge to reduce cognitive load for pupils. The webinar challenged teachers to consider changes to their own and school-wide practice, to improve the quality of teaching and learning.

Teacher's feedback evidenced:

Webinar 1	% Rated Excellent	% Rated good	% Rated satisfactory	% Rated Unsatisfactory	% Good or better
Overall rating of training in meeting its intended aims and outcomes	60	40	0	0	100
Rating of facilitator's subject knowledge and ability to meet your needs	60	40	0	0	100
Rating of links between the content and concepts of the webinar and improved pupil outcomes	60	40	0	0	100

Follow up lesson observations and teacher interviews that focussed on cognitive load and application of suggested strategies evidenced the following:

- 100% of participants used their new knowledge of cognitive load theory to make changes to their day-to-day pedagogy. *"Now I always consider how everything I do relates to the learning objective for that lesson. Before I would spend time making sure my slides were engaging and had interesting pictures. On reflection these things did not always contribute towards children learning. I still use pictures on my slides, but only when they serve a purpose. For example, during a science lesson I will use pictures of apparatus as a scaffold for those children who do not know the name of the equipment."*
- 77% of participants said that they have changed their curriculum design and medium-term planning based on their learning from this session. *"We used to spend one lesson looking at fronted adverbials in Year 3, now we deliver this content across several lessons and break the concept down further over time. This has allowed us to scaffold the learning of pupils and break it down into more manageable steps. There are now far more assessment opportunities for us to notice those struggling and identify misconceptions."*

Following this webinar, participants completed a gap task, analysing the planning of a lesson or series of lessons. Participants were challenged to identify where cognitive overload might be taking place and where the teacher had been able to reduce or manage the cognitive load of students. Teachers were also asked to consider how teaching episodes could be adapted considering cognitive load theory. Through analysis of this gap task, participants evidenced:

- 100% of participants confidently identified where cognitive overload was present in lesson plans. *"I prevented the cognitive overload by carefully selecting only the key principles for that lesson. I broke down the skill of understanding how fossils provide information about animals and plants millions of years ago and decided to break this down over 3 lessons instead of one."*

- 66% of participants were able to identify potential extraneous load and adapt lesson resources to reduce this. *"In light of learning about extraneous load, I now use a black background on all of my slides, the text/images used are minimal and all serve a purpose linked directly to the learning goal."*
- 55% of participants referred to curriculum design and considered what children had learnt in previous year groups when assessing the level of cognitive load in a lesson. *"I decided to break these concepts down into multiple lessons (previously done in year 3 but very limited long-term memory of this as the Germane Cognitive Load wasn't as strong as needed to be because children didn't recall the 'schema'). This was difficult and needed to be broken down into steps so children had an opportunity for better retrieval and then would have some prior learning to rely upon."*
- The quality of the gap tasks was generally extremely high with some excellent examples of how the understanding of cognitive load theory had changed pedagogy. In some cases, participants were at risk of reducing the level of challenge in lessons whilst managing cognitive load. All participants received feedback on their gap tasks.

Live Webinar 2: 12th January 2022 - The Importance of Retrieval practice as a Pedagogical Approach

This webinar gave participants an understanding of the key principals of retrieval practice and its links to cognitive load theory. This session also focused on how retrieval practice could contribute to curriculum design and support long-term learning. Additionally, participants were shown a range of strategies for how retrieval practice could be implemented in the classroom which included a case study from Bradford Research School.

Teacher's feedback evidenced:

Webinar 2	% Rated Excellent	% Rated good	% Rated satisfactory	% Rated Unsatisfactory	% Good or better
Overall rating of training in meeting its intended aims and outcomes	60	40	0	0	100
Rating of facilitator's subject knowledge and ability to meet your needs	60	40	0	0	100
Rating of links between the content and concepts of the webinar and improved pupil outcomes	60	40	0	0	100

In addition, observations and interviews demonstrated how teachers have implemented retrieval practice into their lessons:

- Observations of Year 6 pupils using knowledge organisers to retrieve prior learning about Ancient Greece was carried out. Pupils were able to use this resource to support them to answer a short quiz which included a mixture of simple questions and more challenging inferential questions. This showcased a good example of children being challenged using retrieval practice and having to think more deeply about their answers. The use of knowledge organisers served as a scaffold in enabling this.
- A further lesson observation focused on Year 6 pupils filling in missing sections of a knowledge organiser. This activity was designed from an example which was shared in the case-study during the live webinar. Pupils were challenged to recall facts from World War 2 and complete definitions of words they had previously learnt. This was effective as the level of challenge meant pupils had to think hard about their

previous learning to complete the task. The focus of the retrieval practice was carefully designed to support pupils to achieve intended learning by activating prior knowledge. This demonstrated an excellent understanding of the link between retrieval practice and cognitive load theory.

- Several teachers changed how they use knowledge organisers following this session. One example being, *"I have simplified the information on my knowledge organisers to reduce the extraneous load and present children the key information they need. This has meant they are quicker for me to make, and children are now using them more effectively within a topic to recall key information."*

Recorded Webinar 3: 2nd March 2022 - Developing Highly Effective Questioning and Modelling

This webinar explored the importance of effective questioning with regards to curriculum design, challenge for all and assessment for learning. Teachers were given a range of strategies to develop questioning in the classroom. The second part of this webinar highlighted the importance of modelling and the ways that scaffolding can be gradually withdrawn to promote pupil independence and proficiency. Participants were shown three modelling strategies which could be used in their classrooms.

After this webinar, participants were asked to complete a gap task. This challenged them to observe a peer or reflect on their own practice with a focus on modelling and questioning. They were asked to identify how the modelling or questioning was effective and how the strategies they had learnt affected teaching pupil outcomes and behaviours for learning. Additionally, teachers were asked to reflect on how recommended strategies could be shared more widely across their school.

Analysis of this gap task, participants evidenced:

- 89% of participants had implemented at least one strategy for questioning and modelling in their classroom.
- 66% of participants reported evidence of improved behaviour for learning following the use of these strategies: *"[Using pose, pause, pounce, bounce questioning] This challenged pupils into thinking deeper and to think about what their peers have said rather than only listening to the teacher's input and thoughts. It promoted interaction and collaborative work between one another which deepened learning through considering different points of view as well as having to justify their own ideas. This enabled me to assess pupils learning further and catch any misconceptions/errors."*
- 44% of participants planned to disseminate strategies to all teachers in their schools through staff meetings:
"We used the questioning section of the PowerPoint in a staff meeting two weeks ago as a reminder and way to reinforce the importance of cold calling, pause pounce bounce and the consideration of use of Hinge Point Questions as an assessment tool – at the beginning of a unit or work, during a lesson to address misconceptions and as tool for formative assessment."
- The quality of the gap tasks was generally extremely high with some excellent examples of how these strategies have been implemented across schools. In some cases, the modelling sections were less well answered, however the follow up interviews with teachers helped address barriers and how these strategies could be implemented across any setting of education.

All participants were given written feedback on their gap tasks to allow further reflection and learning.

Observations and interviews also demonstrated that teachers have implemented a number of these strategies in class:

- Nursery pupils were observed as a teacher used backward fading to model how to play a range of instruments in time. The use of a partially worked example allowed the teacher to see which pupils were confident with this skill and which needed more structured practice during provision time.

Live Webinar 4: 26th April 2022 - The Importance of Metacognition for Effective Learning

This webinar provided participants with an overview of what metacognition is and how it is relevant to the learners in their schools. Teachers were introduced to a cycle of learners planning, monitoring, and evaluating

learning and how this process can help regulate cognitive activities. Participants were given strategies to develop metacognition in their classrooms which included a case study of how this works at Copthorne Primary School.

Webinar 4	% <i>Rated Excellent</i>	% <i>Rated good</i>	% <i>Rated satisfactory</i>	% <i>Rated Unsatisfactory</i>	% <i>Good or better</i>
Overall rating of training in meeting its intended aims and outcomes	91	9	0	0	100
Rating of facilitators subject knowledge and ability to meet your needs	91	9	0	0	100
Rating of links between the content and concepts of the webinar and improved pupil outcomes	54	36	9	0	91

Observations and interviews evidenced how teachers have implemented metacognition into their lessons:

- During an observation of 'live modelling' the teacher modelled aloud their thought process of how to use a checklist to effectively monitor how writing was progressing. By making their thinking explicit, pupils were able to more effectively self-assess during their writing task to improve work they had already completed and use the checklist to plan for the next part of their writing. The teacher reflected that, previously, they had only given the children an opportunity to develop these metacognitive skills after completing their writing. The teacher identified that children had been missing an opportunity to 'monitor' their work and make changes and revisions *during* their task.
- During a Year 1 English lesson children were shown how to use their books and the working wall as resources for planning their writing by referring to previous work. Pupils were encouraged to look at the marking they had received on previous work to make sure they learnt from prior errors and look at their work on adjectives. This allowed pupils to use these resources effectively during their writing to successfully write sentences which included adjectives to improve their descriptions.
- During an interview, a teacher explained that she had introduced metacognitive strategies to her EYFS team, consequently there is now a focus on 'commentating' metacognitive strategies as they play and interact with children. *"We commentate our thinking aloud to children and now focus much more on the processes. For example, if I was building a tower and it fell, I would start again and talk out loud about noticing why the last tower fell and how I would adapt my design based on the faults of my previous tower."*

Baseline Diagnostics

Before the programme began in September 2021, senior leaders from all schools were asked to complete a baseline diagnostic which reflected current practice around aspects of cognitive science. Schools graded themselves against each statement on a scale of 1-5, the value being as follows:

1 = This is central to schools' work and is embedded in practice.

2 = This is embedded with minor points for development.

3 = This has some areas for development that have been identified by leaders but not yet remedied

4 = This has major areas for development

5 = This aspect is absent in our practice

The process was repeated in June 2022 to identify any improvements in practice. The table below shows the percentage of schools that demonstrated areas of practice as being graded at a **1 or 2** at the beginning of the programme compared to the end.

Statements	September 2021 Assessed 1/2	June 2022 Assessed 1/2
Teachers engage with research and an evidence-based approach to inform their classroom practice	33%	55%
Teachers have a secure understanding of cognitive theory	33%	55%
Teachers are current and up to date in their pedagogical approaches to improve pupil outcomes	44%	66%
Teachers are confident in the use of retrieval practice to secure pupils' long-term learning	33%	55%
Teachers use a wide range of techniques through questioning/ feedback & modelling to secure deep learning	77%	77%
Teachers have a clear understanding of cognitive load theory	33%	44%
Teachers actively encourage pupils to use metacognitive talk to problem solve and articulate learning	22%	55%
Teachers have a good understanding of metacognition that supports strong pupil progress	22%	44%

The data from September 2021 demonstrates that, in many cases, schools were already developing various aspects of cognitive science as part of their pedagogy. However most senior leaders reported that there were still significant improvement and developments that need to be made. Furthermore, 89% of school leaders said that at least one of these aspects of teaching was one their school development plan for this academic year. This ensured that school leaders endorsed the evidence base of the approaches being shared on the course. It also supported the aim that this would impact positively on the culture of learning in their settings.

The exit data from June 2022 show improvements in each area, aside from questioning and modelling, which remained at 77%. This pedagogy was already well implemented in schools prior to the start of the program, however, evidence from observations and teacher interviews shows that a much wider range of strategies are now being used across the schools with regards to modelling and questioning.

In addition to this data, school leaders also said in June 2022:

- *“The design of the course - a mixture of recorded and live sessions - has enabled it to fit into what has been a hectic year in schools. We have used the pre-recorded as staff training which has been extremely useful.”*
- *“[The course] ... really helped add consistency across the whole school.”*

- “[Our participant] has thoroughly enjoyed the CPD and it has been extremely beneficial to her teaching. She is sharing her knowledge with colleagues and will be delivering a staff meeting after the half term.”

Participants Professional Skills and Knowledge

Before the course began, and over the duration of the programme participants were asked to rate their existing knowledge and skills in the various aspects of pedagogy the course would focus on. These self-assessments were on a Likert scale of **1-7**, with **1** being the ‘worst it can be’ and **7** being the ‘best it can be’

The baseline data from the 9th of November 2021 demonstrates a clear need and desire for experienced teachers to develop their pedagogy around areas of cognitive science, particularly in relation to modelling, questioning, metacognition, and instructional coaching. It also confirms that there is a need for experienced teachers to understand and incorporate evidence-based practice from cognitive science into their everyday classroom practice.

The table below shows the percentage of participants self-assessing themselves at 5 or above, as the course progressed.

	November 9 th 2021	January 12 th 2022	April 26 th 2022
Understand the interconnectedness of cognitive theory-based pedagogy and effective curriculum implementation	10%	27%	64%
Practice pedagogy which closely considers Cognitive Load Theory principles	10%	36%	82%
Understanding the key principles of retrieval practice and its links to Cognitive Load Theory	20%	29%	82%
Implement recommended concepts and strategies into classroom practice	10%	27%	100%
Develop a whole school approach to effective questioning and modelling.	0%	29%	73%
Understand what instructional models are and their importance in school	10%	43%	64%
Practice pedagogical approaches that support meta-cognitive learners	10%	29%	82%

This shows a clear trend of improvement as the course progressed, teachers were able to implement and monitor the impact of teaching and learning through gap tasks, lesson observations and interviews.

Feedback

100% of participants recommended this programme to other schools and colleagues. Here are some of the reasons they gave for this during teacher interviews:

- “The programme gave me the space and safety to implement strategies that I had learnt and the confidence to give them a go in my classroom.”
- “The programme has challenged me to reflect on my day-to-day classroom practice and challenge the habits I had got into around the way I questioned pupils. For example, accepting the first answer given to me and not always asking for this to be explained or bounced to other pupils.”
- “The chance to reflect on practice with other colleagues in the Trust has been useful, especially having felt like we were working in isolation for the last two years with COVID.”

- *"I feel like this has updated my knowledge of classroom practice. Previously, when speak to RQTs or even ECTs, I felt like their knowledge of pedagogy was in some ways, more current than mine. This programme has helped me feel much more confident discussing teaching and learning with newer colleagues whilst sharing what I have learnt with more experienced teachers."*
- *"I really liked having the slides and recordings of the webinars. I have looked back at them several times when planning parts of my lessons. I used the live modelling part to plan my model and include the 'messy thinking' that Christabel talked about."*
- *"The gap tasks make it easier to try out things in my class and really think about how this was changing my teaching and how this impacted on my pupils. They helped me think about what was working well and what to do when things didn't work so well."*
- *"It has fitted really well with our school development plan and CPD calendar for staff. We really wanted to develop modelling and questioning this year, so staff have been watching the webinars and PowerPoint slides and now we see them using live modelling, basketball questioning and hinge-point questioning in class. We used IRIS to video a live modelling lesson and shared it with all the teachers and had some great professional dialogue about how it impacted on pupils and how best to use this strategy in our lessons."*
- *"The lesson visit and interview were really useful, and it gave me confidence to try something new in a lesson that I would not normally do during a normal, appraisal observation. We could talk about how the lesson was planned and really think about how pupils responded to what was asked of them. It has helped me make improvements for the next time I deliver that with pupils."*

All participants were asked how we could improve this programme. Here is some of the feedback we received:

- 1-2 additional face-to-face sessions to provide more time to discuss learning with colleagues. Whilst this was able to take place in breakout rooms during Zoom sessions, they felt that this was still not as valuable as doing it face to face.
- More focus on secondary school and early years settings, especially when showing how strategies could be delivered to children in these age groups.
- Additional opportunities to work like this across the trust, particularly with school visits and lesson observations.

Conclusions

Analysis of qualitative and quantitative data gathered exemplifies the aim of this programme, to upskill teachers with evidence-based pedagogical approaches linked to current cognitive science theory, has been met. Overall, feedback and impact of the project is extremely positive, with robust evidence of schools and participants reviewing their approaches and making changes to their pedagogy. Many participants have taken a collaborative whole school approach to implementing recommended strategies and have included these within their school improvement plan.