

Title: Fife Educational Psychology Service

Closing the numeracy attainment gap through the application of metacognitive strategies in primary education.

What did we ask?

- What is the most effective method of observing metacognitive strategies in use within the classroom?
- What do we consider are the pre-requisites for the development of metacognitive practice within the classroom to support numeracy development and attainment of those children living in poverty?

What is the evidence base?

Current national priorities have highlighted the underlying principle of developing learners who are able to approach learning as an active participant. Although not a new concept, metacognition has been used as a framework from which to explore children's understanding of their own learning processes thereby promoting more effective learning and positive attainment.

Metacognition and learning

Metacognition, as it was defined by John Flavell, can be understood as "cognition about cognitive phenomena" (1979). Within the field of cognitive psychology, metacognition is described as an executive cognitive function that supports us to think about and to regulate our cognitive processes. Metacognition is distinct from cognitive ability and as such can be utilised across learning domains. It is a useful tool when trying to close the poverty related attainment gap.

It can be argued that such a skill does not exist in isolation and to be metacognitive we must have cognitive knowledge (Veenman, 2006). Veenman describes this as metacognition "drawing on cognition."

If this is the case, then by developing metacognitive knowledge and regulation skills, a metacognitive approach will support pupils' abilities to think about their own learning

processes. This will help them to shape their thought processes so that learning is more effective. By applying metacognitive strategies learners are more efficient in planning, monitoring and evaluating their own learning outcomes (Brown et al, 1983).

The Education Endowment Foundation (EEF) identified that metacognitive approaches have an extensive evidence base. EEF research indicated that from seven meta-analyses from 1998 to 2015 metacognitive approaches have a weighted mean effect size of 0.62. This has been reiterated by a recent SPICe report (Marcus, 2016) which identified learning and teaching approaches that support pupils to plan, monitor and evaluate their learning are most effective in terms of increasing attainment. For children who are at risk of low achievement, the application of practical metacognitive approaches in the classroom may be an effective and practical tool. The following metacognitive approaches in school have been found to be most effective:

- When pupils are taught in collaborative groups with the opportunity to ‘think aloud’ about their thinking skills (Schraw et al, 2006).
- When approaches are implemented by trained teachers or staff with interest in the area (EEF, 2016)
- There is explicit instruction for children on how to use metacognitive strategies, when to use such strategies and the benefits of these (Schraw et al, 2006).
- Teachers and adults model metacognitive and self-regulation strategies in the classroom, with a particular focus on how to support pupils to plan, monitor and evaluate their own learning.
- There is a shared language about thinking skills and metacognitive strategies between peers and teachers (Pintrich, 2002).

Metacognition and numeracy development

Recent OECD PISA results (Programme for International School Assessment, 2015) indicated that Scotland’s ranking in numeracy had fallen from ‘above average to average’ within their comparative scale.

Although, arguably, reliant on a comparative standardised measure and not indicative of contextual factors, it was highly publicised and indicated a real need to look more in depth at

'what works' in terms of numeracy development and attainment. Research has highlighted the role of metacognitive skills and positive attainment in mathematics (Cornoldi et al, 2015). This has focused largely on problem solving abilities, given that problem solving relies heavily on monitoring and evaluating progress against a goal. Given the research evidence surrounding metacognitive knowledge, academic achievement with a particular focus within problem solving and numeracy achievement, the challenge is how best to make such skills and research explicit. From this to then develop an accessible and practical metacognitive methodology for children to learn and achieve within numeracy, in particular those children who are most disadvantaged in terms of the poverty attainment gap.

What did we do?

Identifying an initial area of focus: needs analysis

- Identified a school with a clear focus on numeracy attainment and the poverty attainment gap detailed on their School Improvement Plan.
- An initial needs analysis agreed a focus on Primary Four and Primary Five classes.
- Consent and ethical aspects of research agreed, including use of video recordings and parental consent gained.
- Links developed between the EPS and the University of Stirling to share research information and current findings.

Method

Research Question 1

What is the most effective method of observing metacognitive strategies in use within the classroom?

- Pre intervention data was gathered in order to gather base line information regarding the extent of metacognitive approaches currently being used in class. Video and observation protocols were used to collate data regarding pupil and teacher approaches to numeracy tasks.
- Two assessment tools were developed. Both assessment tools aimed to provide a framework to support observation of metacognitive skills in practice: one tool to support the observation of teacher practice, the other to observe

pupil interactions and their use of metacognitive skills. Video recording was also used to triangulate data.

Research Question 2

What do we consider are the pre-requisites for the development of metacognitive practice within the classroom to support numeracy development and attainment of those children living in poverty?

- The focus of study was narrowed to the identification of prerequisites to best enable the development of metacognitive practice with a more specific focus on how children understand their use of metacognitive skills within conceptual numeracy activities.
- A pupil 'self-evaluation' tool was drafted to explore pupils' understanding and use of metacognitive skills before, during and after a numeracy activity. This tool was used over a 6 week period during two numeracy activities a week. It was agreed that this would be trialed in the classrooms where most counts of metacognitive skill in practice were observed.

What have we found so far?

Research Question 1

Analysis of class teacher questionnaires

- Teachers felt they applied the principles of metacognitive approaches but were not hugely confident in their understanding of theory underlying these approaches. Teaching staff did not feel that children regularly understood and used metacognitive language within the classroom.

Analysis of observation of metacognitive skills within the classroom (class teacher observation and video analysis)

- There was evidence of increased metacognitive approaches being used by class teachers within the early planning stages of learning tasks. This was again evident within the modelling of 'monitoring' of task progress skills however less evident within the evaluation or feedback stages of a lesson.
- Class teachers who were identified as the 'intervention' group who had knowledge

and interest in metacognition showed more incidences of modelling metacognitive strategies across the planning, monitoring and evaluation stages of a lesson.

- Video recordings provided a useful record of effective metacognitive strategies
- Video recorded data was found to be the most sensitive method of identifying metacognitive approaches in practice, as it reduced potential observer bias.
- There were within practitioner differences across all stages with regards differences in planning, monitoring and evaluation skills.
- Overall metacognitive skills in monitoring were much more evident through video analysis.
- Planning skills more evident through data gathered using the observation framework.
- In the evaluation of task progression, metacognitive skills were least observable across all methods.

Analysis of pupil observation and video data

- There were less incidences of metacognitive skills observed during pupil observation and video recorded data.
- Pupils displayed more use of metacognitive skills during monitoring progression of their learning of conceptual numeracy activities; this was predominantly observed during collaborative work.

Class teacher and pupil observation data - key comparisons

Using both tools there was little correlation between teacher modelling of metacognitive skills and pupils observable use of metacognitive skills. This was true across observed metacognitive behaviour displayed across planning, monitoring and evaluation skills. There was however, indication that metacognitive monitoring of task progress was more evident across all data gathered for pupils and class teachers. Video was more effective in allowing analysis of the use of metacognitive strategies in practice for both children and class teachers.

Research Question 2

Pupil Self Evaluation Tool-Summary of Results

Primary Five Report (13 SIMD ½ population)

- Primary five pupils reported that they were confident in using metacognitive strategies. This was particularly evident for the use of metacognitive strategies to support planning or the 'before' stages of the task.

Primary Four Report (All pupils)

- Primary four pupils also reported that they were confident in using metacognitive strategies. The highest percentage of children (across stages) self-reported confidence in using metacognitive strategies to support their learning, however when observed in the classroom, there was scant evidence to support these self-reports.

What do we plan to do next?

- Replicate pupil self-monitoring regarding the use of metacognitive strategies as sample sizes were different for each class. Further consider the use of direct consultation with pupil groups.
- Explore in further depth the disconnect between pupil self-confidence regarding the use of metacognitive strategies and actual demonstrable metacognitive behavior
- Develop education staff CPD activities involving the practical application of metacognitive approaches with a specific focus on planning, monitoring, and evaluation of learning activities.
- Explore the use of feedback methodologies in relation to the usage of metacognitive strategies
- The observation tools and pupil self report questionnaires can be used to explore further class teacher coaching workshops.
- The above activities to be used as a means of developing a shared 'metacognitive' language or script between pupils and class teachers which would serve as a practical teaching approach.

References

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