

## Title

PSYCHOLOGICAL FACTORS IN PROMOTING NUMERACY

## What did we ask? (Research Questions)

The key research questions are:

1. What psychological factors are present in the development of mathematics?
2. Which of these factors are important for implementing improvements?

## What is the evidence base?

Psychological factors impact on attainment in all areas, but it would appear that they may have a particularly strong influence within numeracy development for several reasons. Early relationships are important for the development of maths skills as young children typically develop these skills informally in interaction with their surroundings and mediated by their relationship with their main caregivers. Learning in maths differs from other subjects in its requirements to shift between abstract constructs and infinite possible interactions. The language used within mathematics is both familiar and unfamiliar as known words have new meanings, as described. Factors such as learners' motivation and ability to use metacognitive skills will be particularly important for a subject that is perceived as more difficult than others to learn. Action research, as used by teachers, has an important contribution in how improvement in numeracy and these psychological factors can be implemented.

This report considers four distinct studies aimed at improving numeracy attainment and the links to the poverty related attainment gap by each of the four Educational Psychology Services in the Forth Valley and West Lothian Regional Collaborative. The first four chapters are a report of each individual project.

1. *Attachment and Numeracy: A Literature Review, Clackmannanshire Council*. This study involved a literature review of research into development of early years numeracy and its links with childhood development and particularly Attachment theory.
2. *Bridging the Gaps: Long Term Outcomes of an Action Research Programme to Improve Numeracy, Falkirk Council*. This project focused on a longitudinal analysis of pupil outcome data from an action research skills project, involving the Coach Consult method of professional learning, undertaken with teachers and managers from 12 schools, in 4 discrete projects during 2016/17.

3. *Metacognition and Numeracy: A Literature Review, Stirling Council.* This study involved a literature review of meta-cognitive aspects of numeracy development, which in turn is being used to contribute to a professional learning programme for teachers in early primary in Stirling Schools, using an appreciative inquiry approach.
4. *Pupil Voice: Views of National 5 Pupils in Relation to their Experiences of Numeracy Skill Development, West Lothian Council.* This piece of research involved focus groups with 56 participants from 8 high schools. All were studying for National 5 Maths and in S4.

We undertook an analysis of common psychological factors identified within these projects, in what we have termed a Meta-Study. Each Study has considered the relationship between their key questions, the effect of poverty and the evidence base in their individual subject area. To our knowledge this is the first attempt at identifying key psychological factors affecting numeracy development across diverse studies in a Meta-study.

## What did we do?

The four individual studies were analysed using a two-stage process:

1. Initial coding of psychological factors identified in the study
2. Thematic coding of the identified factors through an iterative process.

The definition of a Psychological factor used in the initial coding stage was:

*The factors that talk about the psychology of an individual that drive his or her actions.*

The factors were then grouped into meaningful clusters and levels of psychological influence.

## What have we found?

### **Key factors**

The meta-study identified 94 discrete psychological factors and grouped them into 20 cluster factors across 3 categories of psychological development. See Table 1.

**TABLE 1 – CLUSTER FACTORS BY TYPE OF PSYCHOLOGICAL INFLUENCE**

<b>Individual</b>	<b>Intersubjective</b>	<b>Contextual</b>
Enjoyment and motivation Early skills and knowledge Prior Learning Emotional development and self-regulation Maths specific skills knowledge and learning Attitudes and beliefs Purpose and relevance Learning approach Cross-cutting - developmental stage and age	Prior relationship Teacher relationship Learning Activity Pedagogy fit Teacher led culture Quantity/resource Teacher practice Peer dynamics	Poverty Leadership and culture Continuity and sustainability

Our findings are that the psychological factors important for the development of numeracy need to be considered in the context of an ecological model of understanding child development and learning (Bronfenbrenner, 1998) and the National Practice Model of Getting it Right for Every Child (Scottish Government, 2018). This includes a correlation between poverty and insecure attachment styles, which if there is a causal link suggests we might address maths attainment through interventions that promote secure attachment. This may form the start of the cycle for the growing gap in attainment as the children impacted in this way are more likely have lower levels of ‘prior learning’ and ‘emotional development and self-regulation’.

**TABLE 2 – VALIDITY ANALYSIS**

<b>Study</b>	<b>Ecological system</b>	<b>GIRFEC My World Triangle</b>
Individual development	microsystem	Within child factors - “how children grow and develop”
Intersubjective Effective pedagogy and peer dynamics	mesosystem	Immediate relationship factors - “what I need from those that look after me”
Contextual	exo, macro and chronosystems	Wider societal factors - “my wider world”

**DIAGRAM 1 - INDIVIDUAL FACTORS**



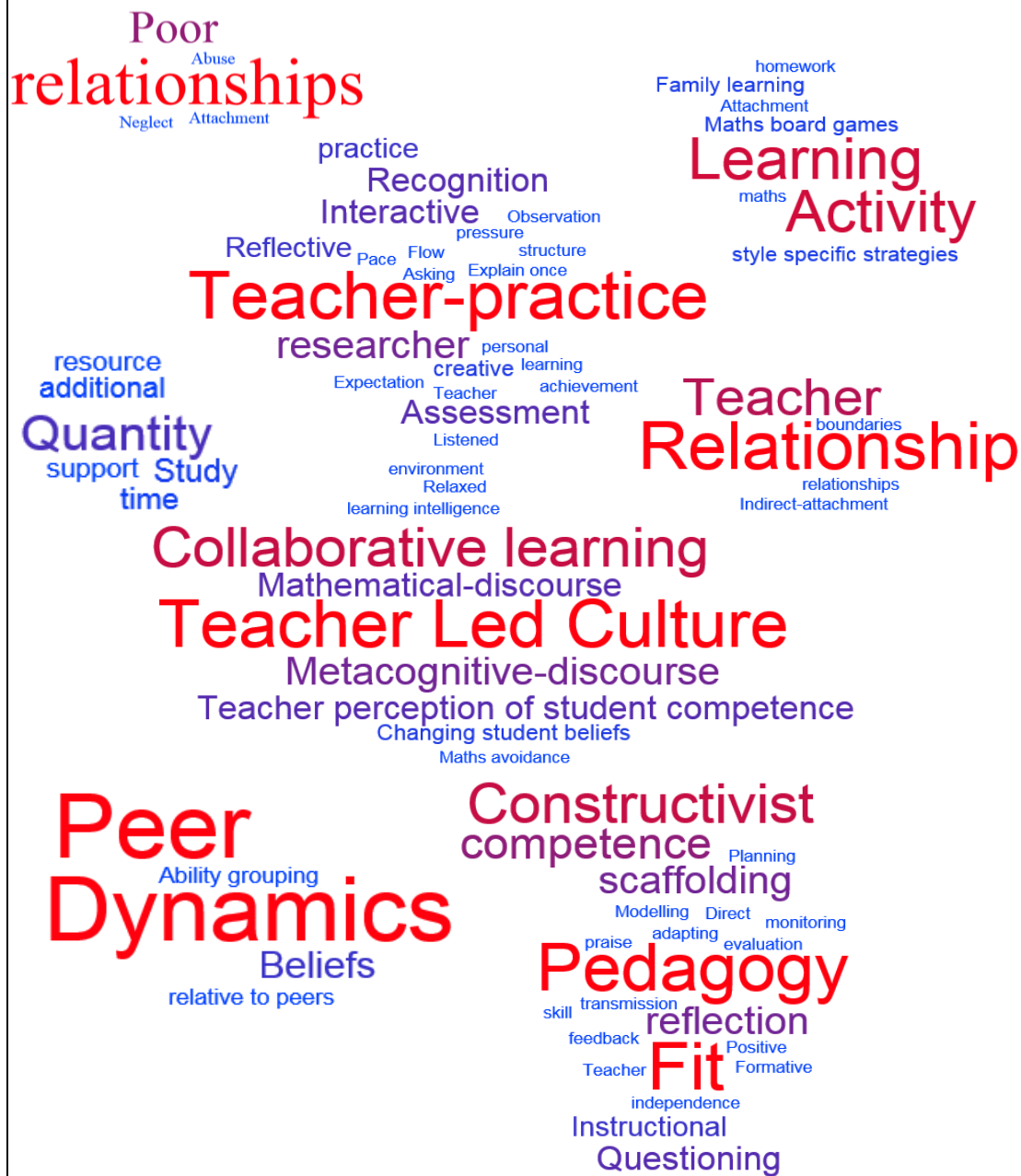
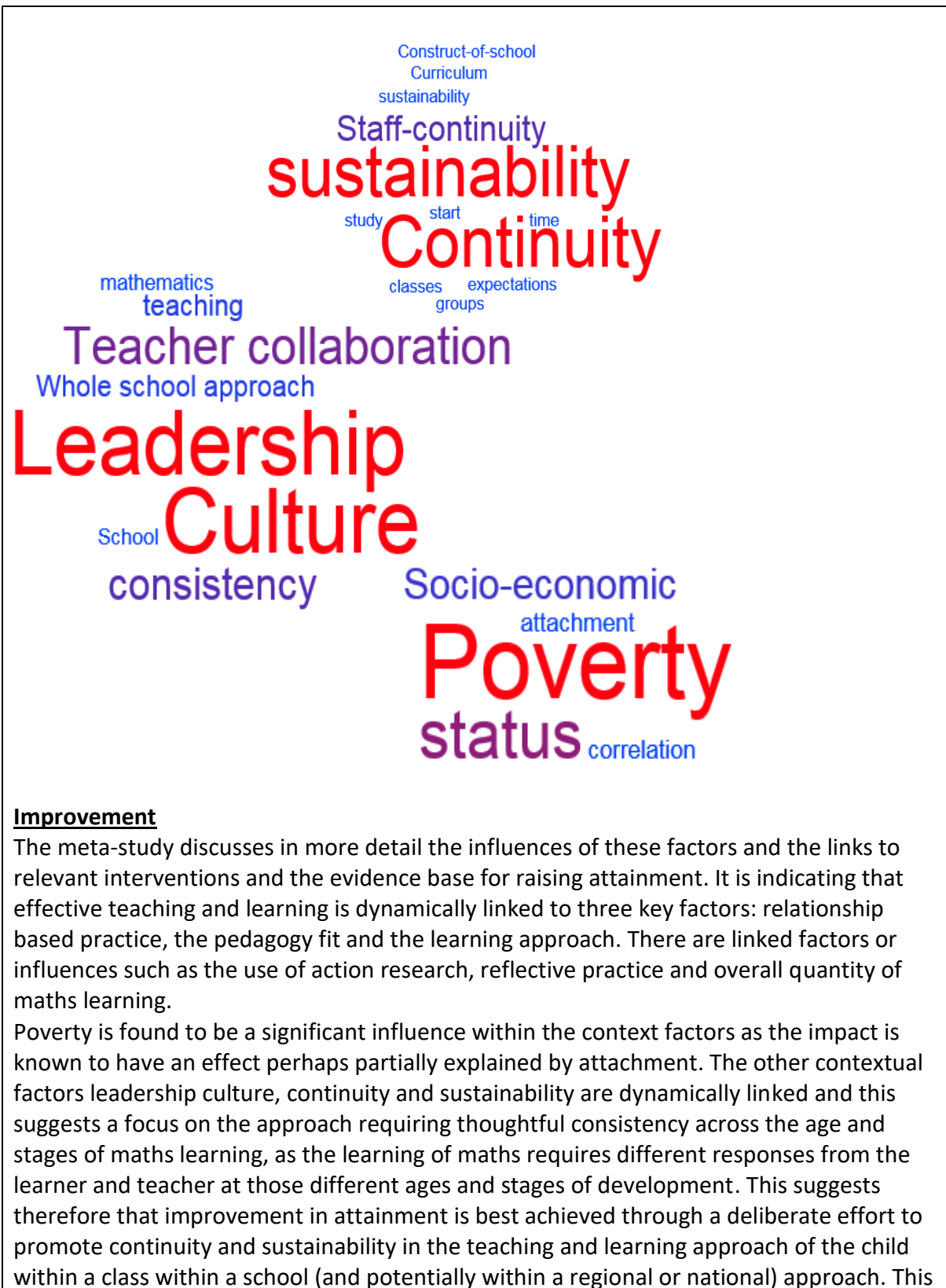


DIAGRAM 3 – CONTEXTUAL FACTORS



can only be achieved with teachers knowing their part in a wider vision for learning mathematics and feeling empowered and enabled to realise that vision.

#### RECOMMENDATIONS

Given the complexity and multitude of factors that influence numeracy development and mathematical attainment, Councils, the Regional Collaborative and Scottish Government need to find ways of:

1. promoting long term duration of teacher pupil relationships,
2. promoting whole school consistency and beyond in the teaching of mathematics
3. consider the impact that relationships and attachment style may have on pupils' numeracy development
4. ensure that teacher led innovations occur in a culture of learning, knowledge and research and with reference to the existing evidence base on effective interventions
5. Encouraging parents to become more involved in contributing to the development of concepts skills and knowledge which are fundamental to math but not necessarily maths specific such as risk-taking behaviour, metacognition, self-regulation and beliefs about intelligence and mastery.
6. Actively encourage collective teacher efficacy in a context that promotes sustainability of improvement in evidence based ways.

### What do we plan to do next?

We plan to highlight the need for a cultural change with regard to numeracy education to include funding, employment and training arrangements that promote the long term relationship with staff and pupils in schools, effective mathematics teaching, and recognise the impact of relationships and attachment style on pupils' numeracy development. Implementing improvement needs sustainability and implementation of improvement to be considered as important as the specific mathematic concepts and knowledge in encouraging children to learn maths.

The four studies and the meta-study will be used to inform debate about practice and improvement at a strategic and practice level within the Regional Collaborative and the four education authorities.

### References

The full report is published on the local authority Educational Psychology Service websites

<https://blogs.glowscotland.org.uk/fa/epservice/how-we-work/research/> and the regional improvement collaborative blog: <https://blogs.glowscotland.org.uk/glowblogs/fwvlric/>

This study analysed the results of 4 studies published within the Regional Collaborative from each Educational Psychology Service. These studies are also published on the Improvement Hub.

Bronfenbrenner, U; Morris, P. A. (1998). W. Damon & R. M. Lerner, ed. The ecology of developmental processes in Handbook of child psychology, Vol. 1: Theoretical models of human development (5th ed.). New York: John Wiley and Sons, Inc. pp. 993–1023.

Scottish Government [online at 10/12/2018,  
<https://www2.gov.scot/Topics/People/Young-People/gettingitright/national-practice-model/my-world-triangle> ]

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<https://blogs.glowscotland.org.uk/fa/epservice/how-we-work/research/>

<https://blogs.glowscotland.org.uk/glowblogs/fwvlric/psychology-and-numeracy-research-2019/>