ECMG submission to DFE Curriculum and Assessment Review: call for evidence

2.General Views

10. What aspects of the current a) curriculum, b) assessment system and c) qualification pathways are *working well* to support and recognise educational progress for children and young people?

a) Curriculum:

The aims of NC maths are sound, and should be retained, but are not exemplified by the rest of the curriculum and current guidance, resources and practice. The current reference to 'fluency' in the NC aims is helpful to teachers if this is clearly defined as flexibility and efficiency rather than speed, and emphasises that this includes fluency in the application of knowledge (e.g., within problem solving). The KS1 programme of study includes a broad range of mathematics, number, measurement, geometry and statistics, all of which is important. Some of the KS1 mathematics content for number is appropriately sequenced, but some is inappropriate for the age group and unsupported by research.

b) **Assessment:**

While it cannot be said that KS1 assessment is currently working well, the removal of the statutory requirement for KS1 SATs has the potential to encourage more informative teacher assessment.

11. What aspects of the current a) curriculum, b) assessment system and c) qualification pathways should be *targeted for improvements* to better support and recognise educational progress for children and young people?

a) Curriculum

Content reduction: The KS1 mathematics curriculum needs to be significantly reduced, especially in Year 1, in order to give all children, particularly the summer born and disadvantaged, more time to develop a secure understanding of foundational concepts in mathematics, and to avoid the widening gap in attainment. Cahoon et al. (2021, p.13) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The EIF (2018, p.10) recommended that 'the ages of three to five are considered an ideal time to rectify income-related gaps in children's understanding of numbers'. This suggests that the Year 1 curriculum should be focused on all children establishing key understandings. The research evidence for 5 to 7 year-olds indicates that y1 number content could be reduced, rather than introducing abstract ideas like equations, which children will learn more readily in y2. For example, the current curriculum requires y1 children to solve equations like 7=?-9. Dowker, et al. (2005) found that less than half of six year olds understood 'number sentences' like 6-2=4, and Clements and Sarama (2021, p285) report that 6 and 7 year olds found it difficult to recognise equations like 8=12–4. Similarly the curriculum requires Y1 children to use number bonds within 20: this is not an evidence-based expectation for this age group (Clements and Sarama, 2021, p147). We need to ensure a more effective and evidence-based transition from reception, in terms of both content and pedagogy, allowing Y1 teachers more time and flexibility to ensure the learning and progress of all children, including the summer born and those experiencing socio-economic disadvantage (NFER, 2022; Sutton Trust, 2024).This opportunity for consolidation in the first year of the national curriculum would also be more in line with international practice.

Cahoon, A., Gilmore, C. & Simms, V. (2021). Developmental pathways of early numerical skills during the preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).

Clements, D. & Sarama, J. (2021). *Learning and teaching early math: The learning trajectories approach*. Routledge.

Dowker, A. (2005). *Individual differences in arithmetic: Implications for psychology, neuroscience and education.* Psychology Press. https://doi.org/10.4324/9780203324899

Early intervention Foundation (2018) *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

NFER (2022). Assessment in the early years: summer born children https://www.nfer.ac.uk/assessment

Sutton Trust (2024). General Election Policy Briefing: Closing the Attainment Gap
https://www.suttontrust.com/wp-content/uploads/2024/02/Closing-the-attainment-gap.pdf

Content balance: It is essential that the KS1 mathematics curriculum content is amended to include more pattern and spatial reasoning, which research tells us are crucial to develop at this age in order to support success in mathematics in later schooling and STEAM careers. For instance, Rittle Johnson et al. (2019, p.176) conclude that 'Both theories of early math development and early math standards should be expanded to incorporate a role for repeating patterning and spatial skills'; Gilligan et al.'s research (2017, p.120) highlighted the 'longitudinal roles of spatial skills for general mathematics achievement'. The Royal Society's 'Mathematical Futures' report's recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (RS, 2024, p.82). Number learning in Y1 should be set in problem-solving contexts which allow children to make sense of the mathematics. This approach helps young children to establish not only key mathematical understandings, but also mathematical behaviours, like reasoning, and positive attitudes, which are essential for future mathematics progression and participation. The current focus on assessment goals means that the curriculum is skewed towards pencil and paper evidence using symbolic notation. A range of practical activity and graphical representations would provide the depth of understanding for children to build a solid grasp of symbolic notation.

Gilligan, K.A., Flouri,E. & Farran, E.K. (2017) .The contribution of spatial ability to mathematics achievement in middle childhood. *Journal of Experimental Child Psychology*, 163, 107–125.
http://dx.doi.org/10.1016/j.jecp.2017.04.016)
Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, 46, 166–178.
https://doi.org/10.1016/j.ecresq.2018.03.006
The Royal Society (2024). *A new approach to mathematical and data education.*
https://royalsociety.org/news-resources/projects/mathematical-futures/

Evidence-based pedagogy: Curriculum statements need to make playful pedagogy explicit so that it is not overlooked (e.g. 'add, subtract and share in meaningful contexts, including number games and story contexts' and 'compose and decompose numbers to 10 in a range of play contexts'). Research indicates that guided play is the most effective pedagogy for mathematics with children under 8 (Skene et al., 2022) and is in line with much international practice. This should include teaching through playful interactions and activities children enjoy, e.g. games, stories and construction. Play is important for developing mathematical exploration, thinking and language; playful problem-solving helps to develop executive function and metacognition, which are important for attainment, according to Education Endowment Foundation (2021), Hodgen et al. (2020) and Scerif et al. (2023).

Education Endowment Foundation (2021). *Teaching and Learning Toolkit*
https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. & Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. London: Education Endowment Foundation.
https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf
Scerif G., Cragg, L., & Gilmore, C. (2023). Executive function: what early years teachers need to know. TES
https://www.tes.com/magazine/teaching-learning/early-years/executive-functions-what-early-years-teachers-need-know
Skene, K., O'Farrelly, C.M., Byrne, E.M., Kirby, N., Stevens, E.C., & Ramchandani, P.G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Development,* 93, 1162–1180. https://doi.org/10.1111/cdev.13730

Problem solving and mathematical reasoning: Problem solving and reasoning are currently significantly underrepresented in the KS1 mathematics curriculum. The Education Endowment Foundation (2021, p.8) state that foundational learning requires 'a culture that supports children's curiosity, thinking and problem-solving'. This needs to be a separate strand in the mathematics curriculum and also embedded throughout all content, examples and guidance. This would also support depth of mathematical understanding. There should be opportunities for children's question-raising and investigation within contextualised and practical maths, rather than a focus on

problems in mathematics, thinking about mathematical relationships, manipulating the mathematics flexibly and sense-checking ideas and solutions. This would provide continuity with the EYFS Characteristics of Effective Learning, including creating and thinking critically.

EEF (2020). *Improving mathematics in the early years and key stage 1:Guidance report.*https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths

Mathematical language: Curriculum content for KS1 mathematics should include mathematical oracy, in order to support effective communication of mathematical ideas. This builds on the requirements of the EYFS educational programme for 'a rich range of vocabulary and language structures (p.9). For young children, research emphasises the importance of teacher 'maths talk' for acquiring mathematical language, which is 'important to the acquisition of mathematical concepts and to the application of these concepts in problem solving' (Klibanoff et al., 2006,p.68). Mathematical oracy involves more than mathematics vocabulary, and includes reasoning, listening and discussion.

Duncan, R.J., Anderson, K.L., King, Y.A., Finders, J.K., Schmitt, S.A., & Purpura, D.J. (2023) Predictors of preschool language environments and their relations to children's vocabulary *Infant and Child Development,* 32(1), e2381. https://onlinelibrary.wiley.com/doi/10.1002/icd.2381
Klibanoff, R. S., Levine,S.C., Huttenlocher,J., Vasilyeva, M. & Hedges, L.V.(2006) Preschool children's mathematical knowledge: The effect of teacher "math talk". *Developmental Psychology,* 42(1), 59-69. https://doi.org/10.1037/0012-1649.42.1.59

Positive attitudes: It is crucial for children to develop a positive disposition towards mathematics, including mathematical habits of mind. It is particularly important that they perceive themselves as successful learners of mathematics, according to Dowker et al. (2019); otherwise, they are less likely to be engaged by mathematical learning and to make progress. According to Obersteiner (2019), young children need to experience less abstract maths which they can make sense of, including links with real-world applications of maths and the local community. The curriculum could include a mathematics equivalent to reading for pleasure in English, focussing on positive attitudes and enjoyment (for instance by increasing puzzles, problem solving and pattern content).

Dowker, A., Cheriton, O., Horton, R. & Mark, W. (2019). Relationships between attitudes and performance in young children's mathematics. *Educational Studies in Mathematics*, 100, 211–230. https://doi.org/10.1007/s10649-019-9880-5
Obersteiner, A. (2019) Multiple pathways between affect and mathematical competence in young children-commentary on the studies in the special issue. *Educational Studies in Mathematics*, 100, 317–323, https://doi.org/10.1007/s10649-018-9853-0)

Assessment

Removal of the optional KS1 SATs for mathematics: The removal of the statutory requirement for KS1 SATs potentially supports more effective teacher assessment which provides evidence about key mathematical concepts and thereby supports progress. However, the continued publication and administration of KS1 SATs test papers creates pressure on teachers to accelerate through KS1 content (as reported by Ofsted, 2024) and to use test-based pedagogies. These include paper-based tasks, with reduced access to manipulatives (which is not aligned with research evidence, according to Hodgen et al., 2020). This may be due to school leaders' reliance on SATs-type data or because there is a need for support and guidance for teacher assessment using other approaches including practical tasks, e.g. ATM/MA (2024).

ATM/MA (2024). *Key Stage 1 assessment tasks*. https://atm.org.uk/ks1-assessment-tasks.
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. & Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf
Ofsted, (2024) *Strong foundations in the first years of school*. https://www.gov.uk/government/publications/strong-foundations-in-the-first-years-of-school/strong-foundations-in-the-first-years-of-school

Removal of the Reception Baseline Assessment (RBA) as a progress measure for primary:

validity and utility for this purpose (BERA, 2018), it could be removed at a cost saving. (This would also free reception teachers to better understand and meet children's mathematical needs).

BERA (2018). A baseline without basis: The validity and utility of the proposed reception baseline assessment in England. https://www.bera.ac.uk/project/mtas#:~:text=A%20baseline%20without%20basis%3A%20The,progress%20that%20those%20pupils

3.Social Justice and Inclusion

12. In the current curriculum, assessment system and qualification pathways, are there any barriers to improving attainment, progress, access or participation (class ceilings) for learners experiencing socioeconomic disadvantage?

Content reduction: The KS1 mathematics curriculum needs to be significantly reduced, especially in Year 1, in order to give children experiencing socioeconomic disadvantage time to develop a secure understanding of foundational concepts in mathematics, which will ensure future progress and close the attainment gap early in their school careers. The start of school is the optimal time to make a difference for those children who would otherwise fail to progress. Cahoon et al. (2021, p.13) found that children lacking key number skills at the start of school, including younger children, 'have a lower rate of growth'. The EIF (2018, p.10) recommended that 'the ages of three to five are considered an ideal time to rectify income-related gaps in children's understanding of numbers'. This suggests that the Year 1 curriculum should be focused on all children establishing key understandings, rather than introducing abstract ideas like equations, which children will learn more readily in y2. It is particularly important for children at risk of low attainment that KS1 number content should avoid moving to abstraction too soon. For example, y1 children are expected to solve equations like 7 = ? -9. Dowker et al. (2005) found that less than half of six year olds understood simple equations like 6 - 2 = 4. Clement and Sarama (2021, p285) report that 6 and 7 year olds found it difficult to even recognise equations like 8 = 12 – 4. Similarly, the curriculum requires Y1 children to use number bonds within 20, which is not an evidence-based expectation for 5 and 6 year olds (Clements and Sarama, 2021, p147). We need to ensure a more effective and evidence-based transition from reception, in terms of both content and pedagogy, particularly for children experiencing socioeconomic disadvantage. A reduced curriculum would allow Y1 teachers more time and flexibility to ensure the learning and progress of these children. It would also avoid the need for segregated interventions, where children experiencing socioeconomic disadvantage are overrepresented and taken away from class activities for additional mathematics instruction. This disadvantages these children by negatively labelling their mathematics potential and prevents them learning from more experienced, higher attaining peers. Labelling can lead to a loss of confidence and lower expectations, becoming a self-fulfilling prophecy (Campbell, 2021).

Cahoon, A., Gilmore, C. & Simms, V. (2021). Developmental pathways of early numerical skills during the preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).
Campbell, T. (2021). In-class 'ability'-grouping, teacher judgements and children's mathematics self-concept: evidence from primary-aged girls and boys in the UK Millennium Cohort Study. *Cambridge Journal of Education*, 51(5), 563–587. https://doi.org/10.1080/0305764X.2021.1877619 https://www.tandfonline.com/doi/full/10.1080/0305764X.2021.1877619#abstract
Clements, D. & Sarama, J. (2021). *Learning and teaching early math: The learning trajectories approach*. Routledge.
Dowker, A. (2005). *Individual differences in arithmetic: Implications for psychology, neuroscience and education*. Psychology Press. https://doi.org/10.4324/9780203324899
Early intervention Foundation (2018). *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

Content balance: For children experiencing socioeconomic disadvantage, it is essential that the KS1 mathematics curriculum is amended to include more pattern and spatial reasoning, as these are crucial to support success in mathematics in later schooling. Rittle Johnson et al. (2019, p.176) concluded that 'theories of early math development and early math standards should be expanded

that patterning was an important predictor of mathematics achievement for young children from low-income families. Gilligan et al.'s research (2017, p.120) highlighted the 'longitudinal roles of spatial skills for general mathematics achievement'. Verdine et al. (2017,p.104) concluded that, for children of low SES backgrounds, an early curriculum which 'includes spatial experiences may be the most fruitful way to construct a stronger foundation for future learning'. The Royal Society's 'Mathematical Futures' recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (The Royal Society, 2024, p.82). In Y1 number learning should be set in meaningful problem solving contexts which allow children to make sense of the mathematics. This approach helps young children to establish not only key mathematical understandings, but also mathematical behaviours, like reasoning, and positive attitudes, which are essential for future mathematics progression and participation. Focusing on assessment goals means that the curriculum is currently skewed towards pen and paper evidence using symbolic notation. A range of practical activity and graphical representations would provide the depth of understanding for children to build a solid grasp of symbolic notation.

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Rittle-Johnson, B., Fyfe, E.R., Hofer, K.G. & Farran, D.C. (2017). Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11. *Child Development*, 88, 1727-1742. https://doi.org/10.1111/cdev.12662
Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006
The Royal Society (2024). *A new approach to mathematical and data education.* https://royalsociety.org/news-resources/projects/mathematical-futures/
Verdine, B.N., Golinkoff, R.M., Hirsh-Pasek, K., & Newcombe, N.S. (2017). Links between Spatial and Mathematical Skills across the Preschool Years. *Monographs of the Society for Research in Child Development*, 82(1), 1–150. https://srcd.onlinelibrary.wiley.com/toc/15405834/2017/82/1

Mathematical language: For children experiencing socioeconomic disadvantage, it is paramount that KS1 mathematics includes mathematical oracy, in order to support effective communication of mathematical ideas. This builds on the requirements of the EYFS educational programme for 'a rich range of vocabulary and language structures (p.9). For young children, research emphasises the importance of teacher 'maths talk' for acquiring mathematical language, which is 'important to the acquisition of mathematical concepts and to the application of these concepts in problem solving' (Klibanoff et al., 2006,p.68). Mathematical oracy involves more than mathematics vocabulary, and includes reasoning, listening and discussion.

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Klibanoff, R. S., Levine,S.C., Huttenlocher,J., Vasilyeva, M. & Hedges, L.V.(2006). Preschool children's mathematical knowledge: The effect of teacher "math talk". *Developmental Psychology,* 42(1), 59-69. https://doi.org/10.1037/0012-1649.42.1.59

Positive attitudes: It is crucial for children experiencing socioeconomic disadvantage to develop a positive disposition towards mathematics, including mathematical habits of mind. It is particularly important that they perceive themselves as successful learners of mathematics, according to Dowker et al. (2019); otherwise, they are less likely to be engaged by mathematical learning and to make progress. According to Obersteiner (2019), young children need to experience less abstract maths they can make sense of, including links with real-world applications of maths and with the local community. The curriculum could include a mathematics equivalent to reading for pleasure in English, focussing on positive attitudes and enjoyment (for instance by increasing puzzles, problem solving and pattern content).

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commentary on the studies in the Special Issue. Educational Studies in Mathematics, 100, 317–323. https://doi.org/10.1007/s10649-018-9853-0)

13 ditto …which may disproportionately impact pupils based on other protected characteristics **(e.g. gender, ethnicity)?**

Content balance: For girls in particular, it is essential that the KS1 mathematics curriculum content is amended to include more spatial reasoning, which research tells us is crucial to develop in order to support success in mathematics in later schooling and in STEAM careers (Newcombe, 2020). The Royal Society's 'Mathematical Futures' recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (The Royal Society, 2024, p.82). Many girls have fewer experiences in spatial reasoning compared to their peers so these need to be embedded in the curriculum.

Newcombe, N.S. (2020), The Puzzle of Spatial Sex Differences: Current Status and Prerequisites to Solutions. *Child Development Perspectives,* 14, 251-257. https://doi.org/10.1111/cdep.12389
The Royal Society (2024). *A new approach to mathematical and data education*. https://royalsociety.org/-/media/policy/projects/maths-futures/mathematical-and-data-education-policy-report.pdf

14. ditto …learners with SEND?

Content reduction and balance: For children with SEND, the number aspect of the KS1 mathematics curriculum needs to be significantly reduced, especially in Year 1, in order to give teachers of these children more time to assess and support them in developing a secure understanding of foundational concepts. Cahoon et al. (2021,p.5) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The opportunity for consolidation of key aspects of number in Y1 would be particularly important for children with SEND. A greater emphasis on spatial learning, pattern recognition and meaningful problem solving is also likely to benefit children with SEND who may learn in less verbal and more multimodal ways. We need to ensure a more effective and evidence-based transition from reception, particularly for children with SEND, in terms of both content and pedagogy.

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Early intervention Foundation (2018). *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

15. …are there any ***enablers*** that support attainment, progress, access or participation for the groups listed above?

Content reduction: The start of school is the optimal time to make a difference for those children who would otherwise fail to progress. We need to ensure a more effective transition from reception for those children, in terms of both content and pedagogy. Cahoon et al (2021) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The EIF recommended that 'the ages of three to five are considered ideal to remedy income-related disadvantage'. This suggests that the Year 1 curriculum should be focused on all children establishing a secure understanding of foundational concepts in mathematics, which will ensure future progress and close the attainment gap early in their school careers. It is particularly important for children with socioeconomic disadvantage and SEND, that unrealistic expectations are removed from KS1 number content. For example, y1 children are expected to use number bonds within 20 and solve equations like 7 = ? – 9: these expectations are not supported by research for typically achieving 5 and 6 year olds (Dowker et al., 2005; Clements and Sarama, 2021, pp147 & 285). Reducing number content would allow Y1 teachers more time and flexibility to ensure the learning and progress of all children. This would also avoid segregated interventions, where children may be negatively labelled in terms of their mathematics potential and taken away from class activities (where they might learn from more experienced, higher attaining peers). Labelling can lead to a loss of confidence and lower expectations, becoming a self-fulfilling prophecy (Campbell, 2021).

preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).
Early intervention Foundation (2018) *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).
Campbell, T. (2021). In-class 'ability'-grouping, teacher judgements and children's mathematics self-concept: evidence from primary-aged girls and boys in the UK Millennium Cohort Study. *Cambridge Journal of Education*, *51*(5), 563–587. https://doi.org/10.1080/0305764X.2021.1877619 https://www.tandfonline.com/doi/full/10.1080/0305764X.2021.1877619#abstract
Clements, D. & Sarama, J. (2021). Learning and teaching early math: The learning trajectories approach. Abingdon: Routledge.
Dowker, A. (2005). Individual Differences in Arithmetic: Implications for Psychology, Neuroscience and Education (1st ed.). Psychology Press. https://doi.org/10.4324/9780203324899
Early intervention Foundation (2018) *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

Content balance:
A broadening of the KS1 mathematics curriculum is likely to engage and advantage many children in the groups listed above. A greater emphasis on spatial learning, pattern recognition and meaningful problem solving is likely to benefit children who may learn in less verbal and more multimodal ways. Many children in these groups have fewer experiences in pattern and spatial reasoning, which presents a threat to their future attainment in maths. Researchers recommend a broadening of the early maths curriculum: e.g. Rittle Johnson et al. (2019, p.176) conclude that, 'both theories of early math development and early math standards should be expanded to incorporate a role for repeating patterning and spatial skills'. The Royal Society's 'Mathematical Futures' recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (R.S., 2024, p.82). For children experiencing socioeconomic disadvantage, it is essential that the KS1 includes pattern as well as spatial reasoning, in order to support later success in mathematics. Rittle-Johnson et al. (2017) found that patterning was an important predictor of mathematics achievement for young children from low-income families. For girls in particular, it is essential that the KS1 mathematics curriculum content is amended to include more spatial reasoning. Many girls have fewer experiences in spatial reasoning compared to their peers (Newcombe, 2020) so these need to be embedded in the curriculum.
In Y1 number learning should be set in less abstract, meaningful problem-solving contexts which allow children to make sense of the mathematics. This approach helps young children to establish not only key mathematical understandings, but also mathematical behaviours, like reasoning, and positive attitudes, which are essential for future mathematics progression and participation. A range of practical activity and graphical representations would provide the depth of understanding for children to build a solid grasp of symbolic notation.

Newcombe, N.S. (2020), The Puzzle of Spatial Sex Differences: Current Status and Prerequisites to Solutions. Child Dev Perspect, 14: 251-257. https://doi.org/10.1111/cdep.12389
Rittle-Johnson, B., Fyfe, E.R., Hofer, K.G. and Farran, D.C. (2017), Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11. Child Development, 88: 1727-1742. https://doi.org/10.1111/cdev.12662
Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006
The Royal Society (2024). *A new approach to mathematical and data education.* https://royalsociety.org/news-resources/projects/mathematical-futures/

Mathematical language: For children experiencing socioeconomic disadvantage, it is paramount that KS1 mathematics includes mathematical oracy, in order to support effective communication of mathematical ideas. This builds on the requirements of the EYFS educational programme for 'a rich range of vocabulary and language structures (p.9). For young children, research emphasises the importance of teacher 'maths talk' for acquiring mathematical language, which is 'important to the acquisition of mathematical concepts and to the application of these concepts in problem solving' (Klibanoff et al., 2006,p.68). Mathematical oracy involves more than mathematics

Duncan, R.J., Anderson, K.L., King, Y.A., Finders, J.K., Schmitt, S.A., & Purpura, D.J. (2023). Predictors of preschool language environments and their relations to children's vocabulary *Infant and Child Development,* 32(1), e2381. https://onlinelibrary.wiley.com/doi/10.1002/icd.2381
Klibanoff, R. S., Levine,S.C., Huttenlocher,J., Vasilyeva, M. & Hedges, L.V.(2006). Preschool children's mathematical knowledge: The effect of teacher "math talk". *Developmental Psychology,* 42(1), 59-69. https://doi.org/10.1037/0012-1649.42.1.59

Positive attitudes: It is crucial for children in these groups to develop a positive disposition towards mathematics, including mathematical habits of mind. It is particularly important that they perceive themselves as successful learners of mathematics, according to Dowker et al. (2019); otherwise, they are less likely to be engaged by mathematical learning and to make progress. According to Obersteiner (2019), young children need to experience less abstract maths that they can make sense of, including links with real-world applications of maths and the local community. The curriculum could include a mathematics equivalent to reading for pleasure in English, focussing on positive attitudes and enjoyment (for instance by increasing puzzles, problem solving and pattern content).

Obersteiner, A. (2019). Multiple pathways between affect and mathematical competence in young children—commentary on the studies in the Special Issue. Educational Studies in Mathematics, 100:317–323 https://doi.org/10.1007/s10649-018-9853-0)
Dowker, A., Cheriton, O., Horton, R. & Mark, W. (2019). Relationships between attitudes and performance in young children's mathematics. Educational Studies in Mathematics 100, 211–230 (2019). https://doi.org/10.1007/s10649-019-9880-5

Better alignment of the Y1 mathematics curriculum with the EYFS educational programme would provide time for teachers to ensure that foundational concepts in mathematics are secure and to fully assess the mathematical needs of all children, including the summer born, children experiencing socioeconomic disadvantage and those with SEND. The start of school is the optimal time to make a difference for those children who risk failing to progress and to prevent a widening gap in attainment. To enable this, the KS1 mathematics curriculum needs to be significantly reduced and rebalanced, especially in Year 1. We need to ensure a more effective transition from reception for all children, in terms of both content and pedagogy.

Removal of the optional KS1 SATs for mathematics: The removal of the statutory requirement for KS1 SATs potentially supports more effective teacher assessment, which would provide evidence about the key mathematical concepts which support progress. However, the continued publication and administration of KS1 SATs test papers creates pressure to accelerate through KS1 content and to use test-based pedagogies, These include paper-based tasks, with reduced access to manipulatives (which is not aligned with research evidence, according to Hodgen et al., 2020). This may be due to school leaders' reliance on SATs-type data or because there is a need for support and guidance for teacher assessment using other approaches including practical tasks. e.g. ATM/MA (2024).

ATM/MA (2024). *Key Stage 1 assessment tasks.* https://atm.org.uk/ks1-assessment-tasks.
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. and Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. London: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf

Professional development is key to curriculum and assessment impact, potentially supporting children's attainment, progress, access and participation. It raises teacher confidence and the quality of overall mathematics teaching, reducing the need for interventions. Teachers need to know about mathematics itself, children's mathematical development, and effective mathematical pedagogy for the age group (Education Endowment Foundation, 2020). Professional development must be sustained to ensure changes in behaviour: it needs to involve regular contact with trusted leaders and gap tasks between sessions (EEF 2021). Mathematics professional development, including for senior managers, is arguably more important for maths, because of anxiety and negative attitudes.

*report.*https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths
EEF (2021) *What are the characteristics of effective professional development? A systematic review and meta- analysis.* https://d2tic4wvo1iusb.cloudfront.net/production/documents/pages/Teacher-professional-development.pdf?v=1728655965

4. Ensuring an excellent foundation in maths and English

16. To what extent does the content of the **national curriculum** at *primary* level (key stages 1 and 2) enable pupils to **gain an excellent foundation in** a) English and **b) maths?**
Are there ways in which the content could **change to better support this aim?**

The national curriculum introduction states: *A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.* This would seem to be a useful definition for an excellent foundation in mathematics, however, the programmes of study for KS1 do not exemplify understanding the world, reasoning mathematically, mathematical beauty and power nor foster enjoyment and curiosity.

Reducing content would give teachers time to develop children's positive attitudes and appreciation of maths. The KS1 mathematics curriculum needs to be significantly reduced, especially in Year 1, in order to give all children, particularly the summer born and disadvantaged, more time to develop a secure understanding of foundational concepts in mathematics, and to avoid the widening gap in attainment. Cahoon et al. (2021, p.13) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The EIF (2018, p.10) recommended that 'the ages of three to five are considered an ideal time to rectify income-related gaps in children's understanding of numbers'. This suggests that the Year 1 curriculum should be focused on all children establishing these key understandings. The research evidence for 5 to 7 year-olds indicates that Y1 number content could be reduced rather than introducing abstract ideas like equations, which children will learn more readily in y2. For example, the current curriculum requires y1 children to solve equations like 7=?-9. Dowker et al. (2005) found that less than half of six year olds understood 'number sentences' like 6-2=4, and Clements and Sarama (2021, p285) report that 6 and 7 year olds found it difficult to recognise equations like 8=12–4. Similarly, the curriculum requires Y1 children to use number bonds within 20, which is not an evidence-based expectation for 5 and 6 year olds (Clements and Sarama, 2021, p147). We need to ensure a more evidence-based and effective transition from reception, in terms of both content and pedagogy, allowing Y1 teachers more time and flexibility to ensure the learning and progress of all children. This opportunity for consolidation of early learning in the first year of the national curriculum would also be more in line with international practice.

Cahoon, A., Gilmore, C. & Simms, V. (2021). Developmental pathways of early numerical skills during the preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).
Clements, D. & Sarama, J. (2021). Learning and teaching early math: The learning trajectories approach. Abingdon: Routledge.
Dowker, A. (2005). Individual Differences in Arithmetic: Implications for Psychology, Neuroscience and Education (1st ed.). Psychology Press. https://doi.org/10.4324/9780203324899
Early intervention Foundation (2018) *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

More spatial reasoning and **pattern spotting in KS1** would encourage children to appreciate the beauty and power of mathematics, and experience enjoyment and curiosity. Research tells us these are also crucial to develop at this age in order to support success in mathematics in later schooling and STEAM careers. For instance, Rittle Johnson et al. (2019, p.176) conclude that 'Both theories of early math development and early math standards should be expanded to incorporate a role for repeating patterning and spatial skills'; The Royal Society's 'Mathematical Futures' recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (R.S., 2024, p.82). The curriculum could include a mathematics equivalent to reading for pleasure in English, focussing on positive attitudes and enjoyment, for instance by increasing puzzles, problem solving and pattern

Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006
The Royal Society (2024). *A new approach to mathematical and data education.* https://royalsociety.org/news-resources/projects/mathematical-futures/

More problem solving and mathematical thinking, which are currently significantly underrepresented. The Education Endowment Foundation (2020, p.8) state that foundational learning requires 'a culture that supports children's curiosity, thinking and problem-solving'. This needs to be a separate strand in the mathematics curriculum and also embedded throughout all content, examples and guidance. This would also support depth of mathematical understanding. There should be opportunities for children's question-raising and investigation within contextualised and practical maths, rather than a focus on correct/incorrect answers. Over the key stage children should develop confidence in approaching problems in mathematics, thinking about mathematical relationships, manipulating the mathematics flexibly and sense-checking ideas and solutions. This would provide continuity with the EYFS Characteristics of Effective Learning, including creating and thinking critically.

EEF (2020). *Improving mathematics in the early years and key stage 1:Guidance report.*https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths

Pedagogy in KS1 should be evidence-based and developmentally appropriate for the age of children, in order to be effective (EEF, 2020). Therefore it should include guided play (Skene et al., 2022), in line with much international practice. Curriculum statements need to make playful pedagogy explicit so that it is not overlooked (e.g. 'add, subtract and share in meaningful contexts, including number games and story contexts' and 'compose and decompose numbers to 10 in a range of play contexts'). Examples should include teaching through playful interactions and activities children enjoy, e.g. games, stories and construction. Play is important for developing mathematical exploration, thinking and language; playful problem-solving helps to develop executive function and metacognition, which are important for attainment, according to Education Endowment Foundation (2021), Hodgen et al. (2020) and Scerif et al. (2023). Number learning in Y1 should be less abstract and set in problem-solving contexts which allow children to make sense of the mathematics. According to Obersteiner (2019), abstract mathematics contributes to young children's anxiety, while real-life contexts and using visualizations makes mathematics more accessible and motivating for young children. Pedagogy should be less focused on seated, written work: the current focus on assessment goals means that the curriculum is skewed towards pencil and paper evidence using symbolic notation. A range of practical activity and graphical representations would provide the depth of understanding for children to build a solid grasp of symbolic notation. The classroom culture needs to enable all children to perceive themselves as successful learners of mathematics, according to Dowker et al. (2019); otherwise, they are less likely to be engaged by mathematical learning and to make progress.

Dowker, A., Cheriton, O., Horton, R. & Mark, W. (2019). Relationships between attitudes and performance in young children's mathematics. Educational Studies in Mathematics 100, 211–230 (2019). https://doi.org/10.1007/s10649-019-9880-5
EEF (2020). *Improving mathematics in the early years and key stage 1:Guidance report.*https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths
EEF (2021). *Teaching and Learning Toolkit* https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. & Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. London: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf) .
Obersteiner, A. (2019) Multiple pathways between affect and mathematical competence in young children—commentary on the studies in the Special Issue. Educational Studies in Mathematics, 100:317–323 https://doi.org/10.1007/s10649-018-9853-0)
Scerif G., Cragg, L., & Gilmore, C. (2023) Executive function: what early years teachers need to know. TES https://www.tes.com/magazine/teaching-learning/early-years/executive-functions-what-early-years-teachers-need-know

Skene, K., O'Farrelly, C.M., Byrne, E.M., Kirby, N., Stevens, E.C., & Ramchandani, P.G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Development,* 93, 1162–1180. https://doi.org/10.1111/cdev.13730

Mathematical language: Curriculum content for KS1 mathematics should include mathematical oracy, in order to support effective communication of mathematical ideas. This builds on the requirements of the EYFS educational programme for 'a rich range of vocabulary and language structures (p.9). For young children, research emphasises the importance of teacher 'maths talk' for acquiring mathematical language, which is 'important to the acquisition of mathematical concepts and to the application of these concepts in problem solving' (Klibanoff et al., 2006,p.68). Mathematical oracy involves more than mathematics vocabulary, and includes reasoning, listening and discussion.

Duncan, R.J., Anderson, K.L., King, Y.A., Finders, J.K., Schmitt, S.A., & Purpura, D.J. (2023) Predictors of preschool language environments and their relations to children's vocabulary *Infant and Child Development,* 32(1), e2381. https://onlinelibrary.wiley.com/doi/10.1002/icd.2381
Klibanoff, R. S., Levine,S.C., Huttenlocher,J., Vasilyeva, M. & Hedges, L.V.(2006) Preschool children's mathematical knowledge: The effect of teacher "math talk". *Developmental Psychology,* 42(1), 59-69. https://doi.org/10.1037/0012-1649.42.1.59

Professional development is key to curriculum and assessment impact, potentially supporting children's attainment, progress, access and participation. It raises teacher confidence and the quality of overall mathematics teaching in KS1, reducing the need for interventions. Teachers need to know about mathematics itself, children's mathematical development, and effective mathematical pedagogy for the age group (EEF, 2020). Professional development must be sustained to ensure changes in behaviour: it needs to involve regular contact with trusted leaders and gap tasks to work on between sessions (EEF 2021). Mathematics professional development, including for senior managers, is arguably more important for maths, because of anxiety and negative attitudes.

EEF (2020). *Improving mathematics in the early years and key stage 1:Guidance report.*https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths
EEF (2021) ,*What are the characteristics of effective professional development? A systematic review and meta- analysis.* https://d2tic4wvo1iusb.cloudfront.net/production/documents/pages/Teacher-professional-development.pdf?v=1728655965

17. To what extent do **the English and maths *primary* assessments** support pupils to gain an excellent foundation in these key subjects?
Are there any changes you would suggest that would support this aim?

Removal of the optional KS1 SATs for mathematics: The removal of the statutory requirement for KS1 SATs potentially supports more effective teacher assessment, which would provide evidence about children's understanding of the key mathematical concepts which support progress. However, the continued publication and administration of KS1 SATs test papers creates pressure to accelerate through KS1 content and to use test-based pedagogies. These include paper-based tasks, with reduced access to manipulatives (which is not aligned with research evidence, according to Hodgen et al., 2020). This may be due to school leaders' reliance on SATs-type data or because there is a need for support and guidance for teacher assessment using other approaches including practical tasks. e.g. ATM/MA (2024). Endorsing and supplementing such guidance for teacher assessment, supported by professional development, including moderation, would improve planning based on assessment.

ATM/MA (2024). *Key Stage 1 assessment tasks*. https://atm.org.uk/ks1-assessment-tasks
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. & Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. London: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf

21. Are there any particular challenges with regard to the English and maths a) curricula and b) assessment for learners in need of additional support (e.g. learners with SEND, socioeconomic disadvantage, English as an additional language (EAL))? Are there any changes you would suggest to overcome these challenges?

Content reduction: The start of school is the optimal time to make a difference for those children who would otherwise fail to progress. We need to ensure a more effective transition from reception for those children, in terms of both content and pedagogy. Cahoon et al (2021) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The EIF recommended that 'the ages of three to five are considered ideal to remedy income-related disadvantage'. This suggests that the Year 1 curriculum should be focused on all children establishing a secure understanding of foundational concepts in mathematics, which will ensure future progress and close the attainment gap early in their school careers. It is particularly important for children with socioeconomic disadvantage and SEND, that unrealistic expectations are removed from KS1 number content. For example, y1 children are expected to use number bonds within 20 and solve equations like 7 = ? – 9: these expectations are not supported by research for typically achieving 5 and 6 year olds (Dowker et al., 2005; Clements and Sarama, 2021, pp147 & 285). Reducing number content would allow Y1 teachers more time and flexibility to ensure the learning and progress of all children. This would also avoid segregated interventions, where children may be negatively labelled in terms of their mathematics potential and taken away from class activities (where they might learn from more experienced, higher attaining peers). Labelling can lead to a loss of confidence and lower expectations, becoming a self-fulfilling prophecy (Campbell, 2021).

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Early intervention Foundation (2018) Key competencies in early cognitive development: Things, people, numbers and words. Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

Campbell, T. (2021). In-class 'ability'-grouping, teacher judgements and children's mathematics self-concept: evidence from primary-aged girls and boys in the UK Millennium Cohort Study. Cambridge Journal of Education, 51(5), 563–587. https://doi.org/10.1080/0305764X.2021.1877619

https://www.tandfonline.com/doi/full/10.1080/0305764X.2021.1877619#abstract

Clements, D. & Sarama, J. (2021). Learning and teaching early math: The learning trajectories approach. Abingdon: Routledge.

Dowker, A. (2005). Individual Differences in Arithmetic: Implications for Psychology, Neuroscience and Education (1st ed.). Psychology Press. https://doi.org/10.4324/9780203324899

Early intervention Foundation (2018) Key competencies in early cognitive development: Things, people, numbers and words. Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

Content balance: A broadening of the KS1 mathematics curriculum is likely to engage and advantage many children in the groups listed above. A greater emphasis on spatial learning, pattern recognition and meaningful problem solving is likely to benefit children who may learn in less verbal and more multimodal ways. Many children in these groups have fewer experiences in pattern and spatial reasoning, which presents a threat to their future attainment in maths. Researchers recommend a broadening of the early maths curriculum: e.g. Rittle Johnson et al. (2019, p.176) conclude that, 'both theories of early math development and early math standards should be expanded to incorporate a role for repeating patterning and spatial skills'. The Royal

(R.S., 2024, p.82). For children experiencing socioeconomic disadvantage, it is essential that the KS1 includes pattern as well as spatial reasoning, in order to support later success in mathematics. Rittle-Johnson et al. (2017) found that patterning was an important predictor of mathematics achievement for young children from low-income families. For girls in particular, it is essential that the KS1 mathematics curriculum content is amended to include more spatial reasoning. Many girls have fewer experiences in spatial reasoning compared to their peers (Newcombe, 2020) so these need to be embedded in the curriculum.

In Y1 number learning should be set in less abstract, meaningful problem-solving contexts which allow children to make sense of the mathematics. This approach helps young children to establish not only key mathematical understandings, but also mathematical behaviours, like reasoning, and positive attitudes, which are essential for future mathematics progression and participation. A range of practical activity and graphical representations would provide the depth of understanding for children to build a solid grasp of symbolic notation.

Newcombe, N.S. (2020), The Puzzle of Spatial Sex Differences: Current Status and Prerequisites to Solutions. Child Dev Perspect, 14: 251-257. https://doi.org/10.1111/cdep.12389

Rittle-Johnson, B., Fyfe, E.R., Hofer, K.G. and Farran, D.C. (2017), Early math trajectories: Low-income children's mathematics knowledge from ages 4 to 11. Child Development, 88: 1727-1742. https://doi.org/10.1111/cdev.12662

Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. Early Childhood Research Quarterly, 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006

The Royal Society (2024). A new approach to mathematical and data education. https://royalsociety.org/news-resources/projects/mathematical-futures/

Mathematical language: For children experiencing socioeconomic disadvantage, it is paramount that KS1 mathematics includes mathematical oracy, in order to support effective communication of mathematical ideas. This builds on the requirements of the EYFS educational programme for ‘a rich range of vocabulary and language structures (p.9). For young children, research emphasises the importance of teacher ‘maths talk’ for acquiring mathematical language, which is ‘important to the acquisition of mathematical concepts and to the application of these concepts in problem solving’ (Klibanoff et al., 2006,p.68). Mathematical oracy involves more than mathematics vocabulary, and includes reasoning, listening and discussion.

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Klibanoff, R. S., Levine,S.C., Huttenlocher,J., Vasilyeva, M. & Hedges, L.V.(2006). Preschool children’s mathematical knowledge: The effect of teacher “math talk”. Developmental Psychology, 42(1), 59-69. https://doi.org/10.1037/0012-1649.42.1.59

Positive attitudes: It is crucial for children in these groups to develop a positive disposition towards mathematics, including mathematical habits of mind. It is particularly important that they perceive themselves as successful learners of mathematics, according to Dowker et al. (2019); otherwise, they are less likely to be engaged by mathematical learning and to make progress. According to Obersteiner (2019), young children need to experience less abstract maths that they can make sense of, including links with real-world applications of maths and the local community. The curriculum could include a mathematics equivalent to reading for pleasure in English, focussing on positive attitudes and enjoyment (for instance by increasing puzzles, problem solving and pattern

Obersteiner, A. (2019). Multiple pathways between affect and mathematical competence in young children—commentary on the studies in the Special Issue. Educational Studies in Mathematics, 100:317–323 https://doi.org/10.1007/s10649-018-9853-0)

Dowker, A., Cheriton, O., Horton, R. & Mark, W. (2019). Relationships between attitudes and performance in young children's mathematics. Educational Studies in Mathematics 100, 211–230 (2019). https://doi.org/10.1007/s10649-019-9880-5

Better alignment of the Y1 mathematics curriculum with the EYFS educational programme would provide time for teachers to ensure that foundational concepts in mathematics are secure and to fully assess the mathematical needs of all children, including the summer born, children experiencing socioeconomic disadvantage and those with SEND. The start of school is the optimal time to make a difference for those children who risk failing to progress and to prevent a widening gap in attainment. To enable this, the KS1 mathematics curriculum needs to be significantly reduced and rebalanced, especially in Year 1. We need to ensure a more effective transition from reception for all children, in terms of both content and pedagogy.

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ATM/MA (2024). Key Stage 1 assessment tasks. https://atm.org.uk/ks1-assessment-tasks.

Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. and Simms, V. (2020). Early Years and Key Stage 1 Mathematics Teaching: Evidence Review. London: Education Endowment Foundation.

https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf

Professional development is key to curriculum and assessment impact, potentially supporting children's attainment, progress, access and participation. It raises teacher confidence and the quality of overall mathematics teaching, reducing the need for interventions. Teachers need to know about mathematics itself, children's mathematical development, and effective mathematical pedagogy for the age group (Education Endowment Foundation, 2020). Professional development must be sustained to ensure changes in behaviour: it needs to involve regular contact with trusted leaders and gap tasks between sessions (EEF 2021). Mathematics professional development, including for senior managers, is arguably more important for maths, because of anxiety and negative attitudes.

EEF (2020). Improving mathematics in the early years and key stage 1:Guidance report.https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths

EEF (2021) What are the characteristics of effective professional development? A systematic review and meta- analysis. https://d2tic4wvo1iusb.cloudfront.net/production/documents/pages/Teacher-professional-

5.Curriculum and qualification content

22. Are there particular curriculum .. subjects where:

a. there is too much content; not enough content, or content is missing;

Too much content: There needs to be less advanced number in KS1 e.g. less abstract number and calculation, including fractions. The KS1 mathematics curriculum needs to be significantly reduced, especially in Year 1, in order to give all children, particularly the summer born and disadvantaged, more time to develop a secure understanding of foundational concepts in mathematics, and to avoid the widening gap in attainment. Cahoon et al. (2021, p.13) found that children lacking key number skills at the start of school 'have a lower rate of growth'. The EIF (2018, p.10) recommended that 'the ages of three to five are considered an ideal time to rectify income-related gaps in children's understanding of numbers'. This suggests that the Year 1 curriculum should be focused on all children establishing key understandings. The research evidence for 5 to 7 year-olds indicates that KS1 number content could be reduced rather than introducing abstract ideas like equations, which children will learn more readily in y2. For example, the current curriculum requires y1 children to solve equations like 7=?-9. Dowker, et al. (2005) found that less than half of six year olds understood 'number sentences' like 6-2=4, and Clements and Sarama (2021, p285) report that 6 and 7 year olds found it difficult to recognise equations like 8=12–4. Similarly, the curriculum requires Y1 children to use number bonds within 20, which is not an evidence-based expectation for 5 and 6 year olds (Clements and Sarama, 2021, p147). We need to ensure a more evidence-based and effective transition from reception, in terms of both content and pedagogy, allowing Y1 teachers more time and flexibility to ensure the learning and progress of all children. This opportunity for consolidation of early learning in the first year of the national curriculum would also be in line with most international practice.

Cahoon, A., Gilmore, C. & Simms, V. (2021). Developmental pathways of early numerical skills during the preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).
Clements, D. & Sarama, J. (2021*). Learning and teaching early math: The learning trajectories approach*. Routledge.
Dowker, A. (2005). *Individual differences in arithmetic: Implications for psychology, neuroscience and education.* Psychology Press. https://doi.org/10.4324/9780203324899
Early intervention Foundation (2018). *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words).

Not enough or missing content: There needs to be more about pattern, spatial reasoning, problem solving and mathematical thinking and also more about attitudes and mathematical habits of mind. It is essential that the KS1 mathematics curriculum content is amended to include more pattern and spatial reasoning, which research tells us are crucial to develop at this age, in order to support success in mathematics in later schooling and STEAM careers. For instance, Rittle Johnson et al. (2019, p.176) conclude that 'Both theories of early math development and early math standards should be expanded to incorporate a role for repeating patterning and spatial skills'; Gilligan et al.'s research (2017, p.120) highlighted the 'longitudinal roles of spatial skills for general mathematics achievement'. The Royal Society's 'Mathematical Futures' report's recommendations include: 'Review the early years and primary curriculum to provide strong foundations, strengthening key areas such as spatial reasoning' (The Royal Society, 2024, p.82). It should be noted that spatial reasoning is broader than the current geometry curriculum and involves visualizing in order to solve spatial problems.
Problem solving and reasoning are currently significantly underrepresented. The Education Endowment Foundation (2020, p.8) state that foundational learning requires 'a culture that supports children's curiosity, thinking and problem-solving'. This needs to be a separate strand in the mathematics curriculum and also embedded throughout all content, examples and guidance. This would also support depth of mathematical understanding. There should be opportunities for children's question-raising and investigation within contextualised and practical maths, rather than

problems in mathematics, thinking about mathematical relationships, manipulating the mathematics flexibly and sense-checking ideas and solutions. This would provide continuity with the EYFS Characteristics of Effective Learning, including creating and thinking critically.

Education Endowment Foundation (EEF, 2020). *Improving mathematics in the early years and key stage 1:Guidance report*.https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-maths
Gilligan, K.A., Flouri,E. & Farran, E.K. (2017) .The contribution of spatial ability to mathematics achievement in middle childhood. *Journal of Experimental Child Psychology*, 163 107–125. http://dx.doi.org/10.1016/j.jecp.2017.04.016)
Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly,* 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006
The Royal Society (2024). *A new approach to mathematical and data education.* https://royalsociety.org/-/media/policy/projects/maths-futures/mathematical-and-data-education-policy-report.pdf

b. the content is out-of-date;

Geometry content in KS1 does not take account of current research on spatial reasoning, especially the importance of visualising (Gilligan et al., 2017). Pattern in the national curriculum (and EYFS Early Learning Goals) does not reflect current research on repeating patterns or the centrality of pattern- spotting to mathematics (Di Lonardo Burr et al., 2022; Rittle-Johnson et al, 2019).

Di Lonardo Burr, S. M., Xu, C., Douglas, H., LeFevre, J. A., & Susperreguy, M. I. (2022). Walking another pathway: the inclusion of patterning in the pathways to mathematics model. *Journal of Experimental. Child Psychology,* 222, 105478. https://doi.org/10.1016/j.jecp.2022.105478
Gilligan, K.A., Flouri,E. & Farran, E.K. (2017) .The contribution of spatial ability to mathematics achievement in middle childhood. *Journal of Experimental Child Psychology*, 163 107–125. http://dx.doi.org/10.1016/j.jecp.2017.04.016)
Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly,* 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006

c. the content is unhelpfully sequenced (for example to support good curriculum design or pedagogy);

Pattern is particularly incoherent in the national curriculum for mathematics. In KS1 it appears in Y1 Number non-statutory guidance: 'They *recognise and create repeating patterns with objects and with shapes'* and '*They make connections between arrays, number patterns, and counting in twos, fives and tens'*, then in the Y2 Geometry programme: 'order and arrange combinations of mathematical objects in patterns and sequences'. There is no mention of the key concept of identifying the 'unit of repeat', which is essential grounding for later learning (Rittle-Johnson et al., 2019). Although pattern recognition is an early form of algebraic thinking, there is no thread to algebra in KS2 (for instance by identifying the rule in growing patterns).

Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, 46, 166–178. https://doi.org/10.1016/j.ecresq.2018.03.006

d. there is a need for greater flexibility (for example to provide the space for teachers to develop and adapt content)? *Please provide detail on specific key stages where appropriate.*

Reducing mathematics curriculum content in KS1 would free teachers to spend more time on mathematical reasoning in a range of contexts. There needs to be less advanced number in KS1 e.g. less abstract number and calculation, including fractions. Reduction of number content, especially in Year 1, would give all children, particularly the summer born and disadvantaged, more time to develop a secure understanding of foundational concepts in mathematics, and to avoid the widening gap in attainment. Cahoon et al. (2021, p.13) found that children lacking key

gaps in children's understanding of numbers'. This suggests that the Year 1 curriculum should be focused on all children establishing key understandings. The research evidence for 5 to 7 year-olds indicates reducing abstract ideas like equations in Y1, which children will learn more readily in y2. For example, the current curriculum requires y1 children to solve equations like 7=?-9. Dowker, et al. (2005) found that less than half of six year olds understood 'number sentences' like 6-2=4, and Clements and Sarama (2021, p285) report that 6 and 7 year olds found it difficult to recognise equations like 8=12–4. Similarly the curriculum requires Y1 children to use number bonds within 20: this is not an evidence-based expectation for this age group (Clements and Sarama, 2021, p147). We need to ensure a more effective and evidence-based transition from reception, in terms of both content and pedagogy, allowing Y1 teachers more time and flexibility to ensure the learning and progress of all children. This opportunity for consolidation in the first year of the national curriculum would also be more in line with international practice.

Cahoon, A., Gilmore, C. & Simms, V. (2021). Developmental pathways of early numerical skills during the preschool to school transition. *Learning and Instruction,* 75, 101484. https://doi.org/10.1016/j.leaininstruc.2021.101484).
Clements, D. & Sarama, J. (2021). *Learning and teaching early math: The learning trajectories approach*. Routledge.
Dowker, A. (2005). *Individual differences in arithmetic: Implications for psychology, neuroscience and education*. Psychology Press. https://doi.org/10.4324/9780203324899
Early intervention Foundation (2018). *Key competencies in early cognitive development: Things, people, numbers and words.* Public Health England https://www.eif.org.uk/report/key-competencies-in-early-cognitive-development-things-people-numbers-and-words.

23. Are there particular **changes** that could be made to ensure the curriculum (including qualification content) is **more diverse and representative of society?**

24. To what extent does the current curriculum (including qualification content) support students to **positively engage with, be knowledgeable about and respect others?** Are there elements that could be improved?

A greater emphasis on children playing games, and a collaborative culture in classrooms, with children working and discussing together, and without ability grouping, would support students to positively engage with, be knowledgeable about and respect others. Linking mathematics to real world contexts and engagement with the community in KS1 would also support this.

25. In which ways does the current *primary* curriculum support pupils to have the skills and knowledge they need for life and further study and what could we change to better support this?

A greater emphasis on children playing games, and a collaborative culture in classrooms, of children working and discussing together, without ability grouping, would support children in developing social, communicative and thinking skills for life and further study. A continued focus on the EYFS Characteristics of Effective learning, including 'creating and thinking critically' would also support this. According to the OECD (2016), '*More than ever before, living and working in the 21st century requires the "four Cs" – creativity, critical thinking, communication and collaboration'.*

OECD (2016). *How teachers teach and students learn: successful strategies for school OECD Education Working Paper No. 130.* https://www.oecd-ilibrary.org/education/how-teachers-teach-and-students-learn_5jm29kpt0xxx-en

6. A broad and balanced curriculum

28. To what extent does the current *primary* curriculum support pupils to study **a broad and balanced curriculum?** Should anything change to better support this?

The curriculum could identify more cross-curricular links between maths and other subjects, for instance linking spatial reasoning with geography and design & technology.

31. To what extent do the current curriculum (at primary *and* secondary) .. ensure that pupils and learners are able to develop creative skills and have access to creative subjects?

Mathematics is a creative subject (as described in the current curriculum purpose and aims: '*Mathematics is a creative and highly inter-connected discipline'.* Current curriculum content in KS1 for mathematics does not enact these aims. Problem solving, with children recording in their own way

7. Assessment and accountability

35. Is the volume of statutory assessment at key stages 1 and 2 right for the purposes - to:

- measure whether pupils have reached expected standards.., with a focus on the end of key stage 2.
- enable a range of stakeholders (including Ofsted, governing bodies and parents) to hold primary schools to account.
- help monitor performance regionally and nationally and
- support schools and parents in understanding whether children need more support in the subjects being assessed.

Also

- how effectively the current assessment system captures young people's knowledge and abilities .
- how the overall volume of assessments impacts wellbeing

Please note, we invite views specifically on transitions between key stages in section 9.

Currently, KS1 assessment is not effective in measuring whether children have reached the expected standards. This is partly due to the continued publication and administration of KS1 SATs paper and pencil tests, which encourage schools to continue conducting them and therefore using the pencil and paper pedagogy which aligns with them. This reduces the use of manipulatives in KS1 mathematics teaching. Teacher assessment, supported by resources and professional development including moderation, would more accurately identify children's need for further support and allow stakeholders to hold schools to account.

36. Are there any changes that could be made to **improve efficacy** without having a negative impact on pupils' learning or the wider education system?

The removal of the statutory requirement for KS1 SATs potentially supports more effective teacher assessment which provides evidence about key mathematical concepts and thereby supports progress. However, the continued publication and administration of KS1 SATs test papers creates pressure on teachers to accelerate through KS1 content and to use test-based pedagogies. These include paper-based tasks, with reduced access to manipulatives (which is not aligned with research evidence, according to Hodgen et al., 2020). This may be due to school leaders' reliance on SATs-type data or because there is a need for support and guidance for teacher assessment using other approaches including practical tasks, e.g. ATM/MA (2024). Such resources and guidance need to be supported by professional development, including moderation.

ATM/MA (2024). *KS1 assessment tasks*. https://atm.org.uk/ks1-assessment-tasks
Hodgen, J., Barclay, N., Foster, C., Gilmore, C., Marks, R. and Simms, V. (2020). *Early Years and Key Stage 1 Mathematics Teaching: Evidence Review*. London: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/public/files/Early_Years_and_Key_Stage_1_Mathematics_Teaching_Evidence_Review.pdf

Removal of the Reception Baseline Assessment (RBA) as a progress measure for primary:
The RBA was designed to provide a baseline measure for KS2 SATs, but since it has questionable validity and utility for this purpose (BERA, 2018) it could be removed at a cost saving. (This would also free reception teachers to better understand and meet children's mathematical needs and support transition to KS1).

BERA (2018). *A baseline without basis: The validity and utility of the proposed reception baseline assessment in England.* https://www.bera.ac.uk/project/mtas#:~:text=A%20baseline%20without%20basis%3A%20The,progress%20that%20those%20pupils

37. Are there other changes to the statutory assessment system at key stages 1 and 2 that could be made to improve pupils' experience of assessment, without having a negative impact on either pupils' learning or the wider education system?

38. What can we do to ensure the assessment system at key stages 1 and 2 works well for all learners, including learners in need of additional support in their education (for example SEND, disadvantage, EAL)?

development, for instance in using non-verbal and non-written forms of evidence, such as practical tasks with manipulatives.

ATM/MA (2024). *KS1 assessment tasks.* https://atm.org.uk/ks1-assessment-tasks.

Accountability

44. To what extent, and in what ways, does the accountability system influence curriculum and assessment decisions in schools and colleges?

High stakes assessments produce downward pressure from senior management on teachers of younger children to accelerate the curriculum with content and pedagogy which is not appropriate and actually counterproductive for 5- to 7-year-olds. Accountability needs to support teachers and leaders in ensuring deep, honest and rigorous self-evaluation. Expectations need to match child development and focus on the understanding which predicts future success, according to our strongest research evidence. There needs to be more professional development for senior leaders in primary schools about young children's mathematical development and effective pedagogy, in order to reduce counterproductive pressure on KS1 teachers to teach content and use pedagogy that is more appropriate in upper KS2 and secondary. Leaders need to be aware that their school mathematics curriculum needs revising to have evidence-based, age-related expectations: e.g. not expecting 5 and 6 year olds to solve equations like 7=?-9, or to know number bonds to 20 (Clements & Sarama, 2021).

The accountability regime is so high-stakes that it shapes almost all aspects of teachers' professional lives, as teachers and leaders try to anticipate what Ofsted inspectors want. Unfortunately, most inspectors do not have sufficient knowledge of mathematical development and effective mathematics pedagogy for KS1 children. This puts teachers under pressure to teach in ways that inspectors can easily recognise and gain evidence of. (This leads to abstract written mathematics work, rather than effective mathematics pedagogy using manipulatives, including practical activities rooted in play and children's informal recording.) Inspectors should have appropriate experience, and at least be trained in mathematics education for the phases they are inspecting, so there is greater consistency between inspections. It would then be more beneficial if the inspection role included giving supportive advice, including encouragement for professional development, rather than looking for particular answers from teachers.

Clements, D. & Sarama, J. (2021). *Learning and teaching early math: The learning trajectories approach.* Routledge.

45. How well does the current accountability system support and recognise progress for all pupils and learners? What works well and what could be improved?

The current accountability system creates a high-stakes, performative environment where teachers and school leaders feel undue pressure to prioritise whatever is assessed. This distorts pedagogy and narrows content, in order to 'teach to the test' and to succeed within a shallow notion of school effectiveness. National assessments should be used formatively for schools to check understanding and to shape teaching in the key 'big ideas' in mathematics and in the positive attitudes which will help children to succeed in future schooling, qualifications and adult lives. Ofsted's remit needs reforming so that they focus on school effectiveness in terms of management, safeguarding and self-improvement and not their version of curriculum and pedagogy or performance in national assessments. Rather than focusing on 'doing what Ofsted want', schools should be empowered to determine what is right for their pupils and communities. In addition, inspectors should have appropriate experience, and at least be trained in mathematics education for the phases they are inspecting.

46. Should there be any changes to the current accountability system in order to better support progress and incentivise inclusion for young people with SEND and/or from socioeconomically disadvantaged backgrounds? If so, what should those changes be?

9. Other issues on which we would welcome views

Transitions

52. How can the curriculum, assessment and wraparound support better enable transitions

The KS1 content needs to extend the reception curriculum, providing more time to consolidate key foundational understandings and skills. It needs to be based on research evidence about feasible expectations for all 5- to 7-year-olds (e.g. Clements & Sarama, 2021) and the key concepts that research indicates are predictive of future success. Especially in y1, pedagogy should be based on evidence of effectiveness for this age group (e.g. Skene et al., 2022). The EYFS educational programme needs to continue into KS1, as it is more up to date and research-based for this age group (see Ofsted, 2024). However, current Early Learning Goals do not assess the EYFS mathematics educational programme and so distorts the implemented reception curriculum, with knock-on effects in Y1.

The Reception Baseline Assessment (RBA) has questionable validity (BERA, 2018) and also skews the reception curriculum, diverting teachers' time from more productive teaching. Removal of the RBA would free reception teachers to better understand and meet children's mathematical needs, thereby aiding transition.

BERA (2018). A baseline without basis: The validity and utility of the proposed reception baseline assessment in England. https://www.bera.ac.uk/project/mtas#:~:text=A%20baseline%20without%20basis%3A%20The,progress%20that%20those%20pupils...

Ofsted (2024). *Best start in life part 3: the 4 specific areas of learning.* https://www.gov.uk/government/publications/best-start-in-life-a-research-review-for-early-years/best-start-in-life-part-3-the-4-specific-areas-of-learning

Skene, K., O'Farrelly, C.M., Byrne, E.M., Kirby, N., Stevens, E.C., & Ramchandani, P.G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Development,* 93, 1162–1180. https://doi.org/10.1111/cdev.13730

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