Policy briefing

The importance of maths

Evidence from the CLS cohort studies

Among the similarities between the education policies espoused by prospective incoming Conservative and Labour governments is an agreement on the importance of developing maths skills – but a disagreement on the best way to achieve them.

While the Conservatives' focus is on continuing maths training until at least age 18, Labour are more focused on early intervention, with the idea of putting in place the building blocks for later development.

To date, the parties have not provided much underpinning evidence to support their policy positions. Four British cohort studies by the Centre for Longitudinal Studies (CLS) (see box on page two) have collected information about young people's maths skills at different ages in childhood and their outcomes across the life course, making them valuable sources of evidence for informing polices designed to improve these skills.

In this briefing note, we review some key evidence from the CLS cohort studies to discuss:

1. how much maths skills matter for later outcomes
2. whether maths skills appear to be more important than other skills
3. when it might make sense to intervene to support the development of maths skills
4. what types of policy actions could usefully boost the development of maths skills.

Key findings

- Stronger maths skills in childhood are associated with earning a wage premium in adulthood, highlighting the value of maths skills in the workplace.
- Early maths skills are important predictors of later educational attainment, and the links between early and later skills are stronger for maths than for other types of skills.
- Maths skills assessed in primary school are independently associated with adult outcomes, over and above later educational attainment, supporting the value of early intervention.
- Increasing family resources, reducing the practice of ability-setting, and focusing on a 'phonics' equivalent for maths could all support the development of early maths skills.

"Maths skills measured at a variety of ages in childhood are strongly associated with later life outcomes, and in many cases, more strongly associated than other skills."

Do maths skills predict later life outcomes?

Research from the British cohort studies shows that maths skills measured at a variety of ages in childhood are strongly associated with later life outcomes, and in many cases, more strongly associated than other skills. For example, a study using a number of different data sources including the 1970 birth cohort, found that both early reading and maths skills were significant predictors of later educational attainment, but that the effect was more than 50% larger for maths.[1]

Of all the skills and family background measures considered, early maths skills were the strongest predictors of later maths and reading attainment.

Maths skills also have lasting effects on adult outcomes. Compared to the benefit of attaining a 'good pass' (a C rather than a D) in English at GCSE, attaining a 'good pass' in maths at GCSE was associated with a higher probability of gaining a university degree (6.2% vs. 5.4%) and a lower likelihood of being 'Not in Education, Employment or Training' (NEET) at age 26, in a study using the Next Steps cohort, born in 1989-90.[2]

Similarly, among those who stayed on after the end of compulsory schooling to study A-levels, those who studied a maths or a computing subject earned around 10% more in their early thirties compared to those who did not, while no other A-level subject was associated with a wage premium, according to studies based on the 1958 and 1970 cohorts.[3, 4]

Based on the same cohorts, higher numeracy skills in adulthood were also associated with a significant wage premium,[5] and better health outcomes.[6]

"Early intervention may be particularly important for developing strong maths skills later on."

The British cohort studies

These studies are nationally representative samples of the population born in a particular period who are followed from birth (or age 14 in Next Steps) and collect rich information about their development and family background during childhood and about their lives in multiple domains as adults.

Millennium Cohort Study (MCS) is a nationally-representative UK birth cohort born at the turn of the century (2000-01) – original sample size 18,818 – latest data from 2018 at age 17.

Next Steps is a nationally-representative cohort of secondary school students in England born in 1989-90 – original sample size 15,770 – latest data from 2015 at age 25.

1970 British Cohort Study (BCS70) is a nationally representative UK birth cohort born in a single week in April 1970 – original sample size 16,568 – latest data from 2016 at age 46.

1958 National Child Development Study (NCDS) is a nationally representative UK birth cohort born in a single week in March 1958 – original sample size 17,415 – latest data from 2013 at age 55.

When is the best time for maths skills intervention?

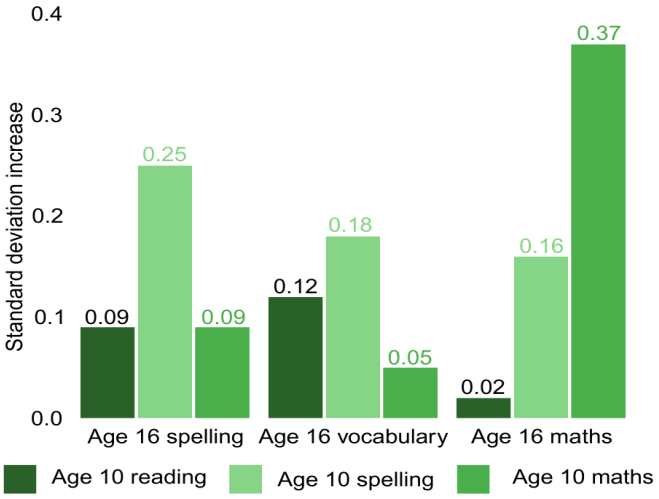
As highlighted above, evidence from the British cohort studies provides ample justification for a policy focus on maths skills. But when does it make most sense to intervene to develop them?

To help answer this question we can consider how important early skills are for predicting later outcomes. If they are not very predictive, then it may make more sense to support the development of maths skills later in school or adulthood. But if they are found to be important, then it suggests that 'skills beget skills' and hence it may be more effective to intervene early, to give children a strong foundation on which to build.

Evidence from the cohort studies suggests that early intervention may be more productive. One study compared the predictive power of skills measured at age 10 on skills measured at age 16 using the 1970 birth cohort. Comparing results for spelling, vocabulary, and maths, maths skills at age 10 were

found to be much more predictive of maths skills at age 16 than was the case for either spelling or vocabulary,[7] as shown in the figure below. In other words, those who do well in maths at age 10 are highly likely to go on to do well in maths at age 16, and the association between early and later maths skills is stronger than for spelling or vocabulary. This highlights that early intervention may be particularly important for developing strong maths skills later on.

Figure 1: Early skills predicting future skills performance



Note: Test scores were measured on different scales and were thus standardised to aid comparability. For example, a one standard deviation increase in age 10 maths predicted 0.37 of a standard deviation increase in age 16 maths, which corresponded to scoring about 4 points higher on the age 16 maths test where the average score was 37 points.[7]

There is also some evidence to suggest that early maths skills matter for later outcomes even after accounting for later educational attainment. In other words, improving early maths skills may not just have benefits for later educational attainment, as the study above suggests, but may also matter for outcomes observed later in life. For example, studies based on the cohorts born in 1958 and 1970 found that maths test scores at ages 7 and 10 respectively remained significantly associated with measures of socio-economic status in adulthood, including income, occupation, housing tenure, and wages, when individuals were in their 30s and 40s, even after accounting for their highest level of education.[8, 9]

In summary, evidence suggests that investing in the earlier development of maths skills may be a more efficient substitute for - or complement to - later maths investment.

How could policymakers support the development of maths skills?

Research from the cohort studies forms part of a wide literature on the links between family background and educational attainment, which shows that children from families with lower resources (such as lower income or education) tend to have lower maths skills than those from higher resource families.[10, 11, 12, 13]

This suggests that reducing inequality in family resources could help to reduce inequalities in maths attainment and later outcomes.

Other research from the cohort studies may also be useful for policymakers when considering how best to develop early maths skills.

The practice of 'ability grouping' is designed to teach children at the appropriate level and speed for their ability. However, a large body of research from the MCS cohort (born in 2000-01) has highlighted some issues related to ability grouping, particularly in young children. For example, one study found that teachers (who assign children into ability groups in primary school) were more likely to underestimate the maths ability of girls, children from low-income families, and Black Caribbean children, when compared to their study-administered cognitive test scores at age 7.[14] Other studies have highlighted the negative consequences of being placed in bottom ability sets on children's confidence with and enjoyment of subjects at later ages, particularly for maths.[15] One author concluded that "reforming the use of in-class 'ability' grouping for maths in early primary school could help boost maths progression and contribute to closing gender gaps".[16]

There is also evidence of a 'maths-reading attainment gap' in the same cohort following the start of formal schooling.[17] Study-administered cognitive tests at age 3 found that numerical skills exceeded alphabetical skills.

However, by age 7, after the start of formal schooling, reading skills had surpassed overall maths skills. The authors attributed this to the greater focus of early teaching on reading, and on the greater practise of reading compared to maths activities at home. They suggest that policymakers should focus on developing the maths equivalent to 'phonics', which has been successful in raising literacy standards and reading attainment in primary school – an idea adopted explicitly in the Labour Party's 2024 manifesto.

Considerations for policymaking

Maths skills are strongly associated with the achievement of higher educational qualifications and higher wages. As such they have the power to influence not only individuals' careers, but potentially also to boost productivity. The Conservative and Labour parties have both recognised the value of maths skills but propose different approaches to boosting them.

Evidence from the British cohort studies suggests that intervening early may be the most effective approach to improving maths skills: early maths skills are strongly predictive of later maths skills, and they also retain predictive power over later measures of educational attainment. This suggests that improving maths in the early years or in primary school is likely to have lasting benefits.

Evidence from the same cohort studies also points towards some potentially successful approaches to improving early maths skills, including boosting family resources, helping to ensure that children are not 'pigeon-holed' early in ability-based groups, which may hold back children in lower sets, as well as a greater emphasis in the early years and primary curriculum on maths, bringing it into line with the heavy focus on teaching children to read.

"Reducing inequality in family resources could help to reduce inequalities in maths attainment and later outcomes."

Published in June 2024

References

1. Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., & Brooks-Gunn, J. (2007). School readiness and later achievement.
2. Jerrim, J. (2023). The benefits of meeting key grade thresholds in high-stakes examinations. New evidence from England. British Journal of Educational Studies, 71(1), 5-28.
3. Adkins, M., & Noyes, A. (2016). Reassessing the economic value of advanced level mathematics. British Educational Research Journal, 42(1), 93-116.
4. Dolton, P. J., & Vignoles, A. (2002). The return on post–compulsory school mathematics study. Economica, 69(273), 113-142.
5. Vignoles, A., De Coulon, A., & Marcenaro-Gutierrez, O. (2010). The value of basic skills in the British labour market. Oxford Economic Papers, 63(1), 27-48.
6. Sabates, R., & Parsons, S. (2012). The contribution of basic skills to health related outcomes during adulthood: evidence from the BCS70. Department for Business, Innovation & Skills.
7. Sullivan, A., & Brown, M. (2013). Social inequalities in cognitive scores at age 16: the role of reading. CLS Working Paper 2013/10.
8. Crawford, C., & Cribb, J. (2013). Reading and maths skills at age 10 and earnings in later life: a brief analysis using the British Cohort Study. CAYT report.
9. Ritchie, S. J., & Bates, T. C. (2013). Enduring Links From Childhood Mathematics and Reading Achievement to Adult Socioeconomic Status. Psychological Science, 24(7), 1301-1308.
10. Hartas, D. (2015). Parenting for social mobility? Home learning, parental warmth, class and educational outcomes. Journal of Education Policy, 30(1), 21-38.
11. Major, L. E., & Parsons, S. (2022). The forgotten fifth: examining the early education trajectories of teenagers who fall below the expected standards in GCSE English language and maths exams. CLS Working Paper 2022/06.
12. Mensah, F. K., & Kiernan, K. E. (2010). Gender differences in educational attainment: Influences of the family environment. British Educational Research Journal, 36(2), 239-260.
13. Michael, R. T. (2008). Children's reading and maths skills: the influence of family caring. CLS Working Paper 2008/2.
14. Campbell, T. (2015). Stereotyped at seven? Biases in teacher judgement of pupils' ability and attainment. Journal of Social Policy, 44(3), 517-547.
15. Boliver, V., & Capsada-Munsech, Q. (2021). Does ability grouping affect UK primary school pupils' enjoyment of Maths and English? Research in Social Stratification and Mobility, 76, 100629.
16. Campbell, T. (2021). Little fish, big streams: How do early inclass maths 'ability'-groups and early teacher judgements relate to primary school children's later maths self-concept? CASE brief.
17. Outhwaite, L., Anders, J., & Van Herwegen, J. (2022). Mathematics Attainment Falls Behind Reading in the Early Primary School Years. Centre for Education Policy and Equalising Opportunities, UCL.

Contact the research team

Dr Charlotte Booth
charlotte.booth@ucl.ac.uk

Dr Claire Crawford
claire.crawford@ucl.ac.uk

Dr Vanessa Moulton
vanessa.moulton@ucl.ac.uk