Written evidence submitted by Dr Laura Outhwaite

I am Principal Research Fellow based in UCL's Centre for Education Policy and Equalising Opportunities. Our research centre aims to provide new evidence on barriers to equality across the life course and explore approaches to reducing or eliminating those barriers.

My work most closely related to this inquiry explores the impact of educational technologies, including software applications (apps) on the early mathematical learning and development outcomes of young children, as well as the various individual and contextual factors that influence these outcomes.

Summary of key points made in this submission:

- When considering children's learning and development in the context of screens and mobile devices, it is important to focus on the quality of the learning experience, rather than the quantity of screen time.
- Overall, evidence shows high-quality educational apps can support children's learning.
- When deciding if technology-based experiences are suitable for specific children, it is important to consider their age, stage of language development, and ability to engage with the content presented.
- Technology on its own will not effectively support children's learning and development. It is also important to consider how the educational apps are designed and how the devices are being used within children's early learning environments to maximise outcomes.
- Parents/ caregivers and teachers need evidence-based support to identify high-quality resources, including educational apps, for their children, particularly in early maths (e.g., similar to existing recommendations for literacy).
- We recommend a national campaign to support early maths skills, which includes an expert panel to accredit high-quality educational maths apps and other learning resources to encourage well-balanced learning environments for young children.

What is the current understanding of how screen time can support and impact children's development and educational outcomes, including the effect on concentration and behaviour?

1. When considering the evidence surrounding children's use of screens and mobile devices and the impacts on learning, development, and behaviour, it is important to focus on the content and context of these experiences, rather than just the 'amount of time' spent on devices.

2. A range of systematic reviews and meta-analyses have synthesised the current evidence on the efficacy of educational apps for supporting children's maths and literacy outcomes. Within these studies, primary-aged children used the educational apps for an average total of 10 hours, across approximately 2-3 months (e.g., 20 minutes per session for 30 sessions). For typically developing children there is an overall reported effect size of +0.31. This is approximately equivalent to 4 months additional progress. Furthermore, it is consistent with the size of reported effects for traditional one-to-one tutoring and small-group instruction, implemented over a longer 4-10-month period.

3. For primary-aged children identified as 'struggling learners' and in need of additional, individualised support, reported effect sizes ranged from an average of +0.37 for literacy (approximately 5 months additional progress) and +0.54 for maths (approximately 7 months additional progress). Within these studies, children used the maths apps for an average total of 11-12 hours, across approximately 2 months (e.g., 30 minutes per session for 23 sessions). Sufficient data were not available to calculate time on task for the literacy apps.

4. However, there is mixed evidence as to whether these benefits are constrained to the specific skills taught in the educational apps (e.g., number recognition skills), or whether these benefits also generalise to more complex skill areas (e.g., addition skills) and/or novel contexts (e.g., outside of the app).

5. A systematic review and meta-analysis of 42 studies also showed that quality screen time (in this case, television or screen exposure), defined as educational programmes and co-viewing with caregivers, was positively associated with learning outcomes for children aged 12 years and under, rather than simply 'screen time'.

6. The age and language skills of the child also needs to be considered. Evidence shows children aged 4-5 years typically benefit more from educational apps, compared to their older peers and those younger than 4 years. Very young children may face barriers when accessing educational app software based on their limited language skills (e.g., vocabulary), particularly if the apps are designed for independent use.

7. Our research shows children with stronger language skills were more likely to understand the app content and instructions, and progress further through the educational app, than children with weaker language skills. This is likely due to the limited range of language (e.g., vocabulary

used to explain task instructions) included in many apps. If children are unable to comprehend the app instructions, they are unable to effectively engage with the technology.

8. For these younger children, and/or those with weaker language skills, other types of apps may be more beneficial. In particular, parent-based apps are designed to be used by a caregiver to give them ideas for how to integrate play-based activities with their children. The child does not use the technology. Evidence shows these types of apps can support children's learning and development across a broad range of outcomes.

9. For children with special educational needs and disabilities, there is experimental evidence to show that children can access and learn with screen-based technologies, including high-quality educational maths apps and computerised board games. However, these children also faced challenges in the implementation of these forms of app-based instruction, such as sometimes becoming distracted or unfocused in their behaviour.

10. The importance of considering how technology is implemented in children's early learning environments was also emphasised in our research. We found that 47% of the variance in children's learning outcomes was explained by how well the educational app was implemented as part of an 'established routine'. This included consistent timing, a dedicated staff member and classroom space, with organised equipment and a seating plan.

11. The impact of mobile device use and screentime on other areas of child development is also a nuanced picture. For example, active engagement with mobile devices (e.g., scrolling and tapping motions) has been shown to be associated with early fine motor skill development, but not gross motor or language development. Experimental evidence also shows improvements in attentional skills following engagement with a high-quality educational maths app, compared to a non-educational app or standard classroom practice in a low-resourced context.

How can schools and parents be better supported to manage children's screen usage, for example, through age-related guidance? Could the Department for Education be doing more in this area?

12. There are over half a million apps that claim to be educational within the leading app stores (Google Play and Apple App Store). This makes determining which apps will provide a high-quality learning experience a significant challenge.

13. Our recent research analysed the mathematical content of the Top 25 most popular commercial educational apps available on the Apple and Google Play Stores with the search term 'maths' for children aged 5 years. Of these 25 apps, only one maths app has been empirically evaluated with positive impacts on children's maths outcomes, particularly for children identified as in need of additional support with their learning.

14. However, more concerningly, six of these Top 25 apps did not include any mathematical content. This is likely because there are no quality standards for educational content or design features that apps must align with to be included in the app stores or the educational category. App developers can simply upload their apps with their chosen descriptions and key words.

15. Over half of these apps also did not adequately include app design features, which our research shows maximise children's outcomes when learning with apps. These best-practice app design features include feedback that explains to children why their answer is right or wrong and a sequence of learning activities, which is personalised to individual children, based on their initial ability and/or how well they are progressing through the app activities.

16. This evidence demonstrates the limited options for identifying high-quality maths apps currently available for parents/caregivers and teachers. By contrast, there are existing Department for Education (DfE) recommendations for apps targeting young children's literacy and language skills.

17. As part of the UCL's Centre for Education Policy and Equalising Opportunities evidence-based policy priorities, we recommend the launch of a new campaign with similar recommendations to support children's early maths skills. Strong early maths skills are essential foundations for later education and employment outcomes. Furthermore, attainment in maths has fallen since the Covid-19 pandemic, particularly for those from disadvantaged backgrounds, while there has been no similar decline in reading.

18. We recommend that this new initiative for early maths should include a panel of early mathematical development and learning researchers and experts to accredit high-quality educational maths apps and other learning resources. This will help parents/caregivers and teachers to make informed decisions about the use of technology (and alternative options) to create positive and well-balanced learning environments with their children.

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