Transcript for CoffeePod, based on Espresso 26

Welcome!

This is an audio recording of Espresso 26, which was published in December 2019 and written by Dominika Majewska.

Espressos are 2-page filtered research documents from Cambridge Mathematics. Each one focuses on selecting and summarising research on a given area of mathematics education, called a Talking Point. They are published as free pdf documents on the Cambridge Mathematics website www.cambridgemaths.org.

This CoffeePod is 22 minutes and 19 seconds long in total. It comprises the following sections: a talking point; quotes; a summary; the main text of the Espresso; the infographic; and an optional reference section which is also available as a separate document linked in the video notes.

You will hear the following sound to indicate a reference [tone], followed by the reference number to help you identify it.

The chapter timings for the different sections, and a link to the original published Espresso, can also be found in the video notes.

You can give us feedback or ask questions in the comments section under this video – we'd love to hear from you!

Talking point:

What does research tell us about supporting those students for whom English is an additional language (EAL students) in mathematics classrooms?

Here are two quotes from the research that you might find interesting to think about:

"Despite widespread agreement that language is crucial to mathematical achievement, mathematics textbooks and curricula do not make the language demands of their tasks evident to mathematics teachers"

This was written by Lucero in 2012, and it was cited by Adoniou and Qing in their article titled 'Language, mathematics and English language learners', which was published in 2014 on pages 3 to 13 of volume 70, issue 3 of the journal 'Australian Mathematics Teacher'.[6]

In the same article, we found this undated quotation from Galvan Carlan:

"Fluency in interpersonal conversation does not equate to fluency in concepts and the discipline-specific language of mathematics"

In summary:

We found seven main implications for teachers in the research. We have numbered them here for ease of listening, but they are not intended to be hierarchical (that is, no one implication is more important than any of the others). The seven implications are:

1. Institutions recognising that EAL learners are diverse and varied should understand that their needs are similarly diverse and varied
2. Language development in mathematics may take several years to develop compared to proficiency in conversational English
3. EAL students may have difficulties with word problems at text, sentence and word level, with symbols representing multiple concepts, and with mathematical terms which have meanings that are different from their everyday use
4. Measuring and assessing EAL students' mathematical ability may be confounded by their ability to speak, read and understand the language in which the mathematics is presented
5. Assessments that avoid culture-specific language and minimise complex details that are irrelevant to the questions, will be more effective for testing knowledge of mathematics
6. EAL students in mathematics may benefit from: glossaries and diagrams; consistent vocabulary when introducing new concepts; focusing on their mathematical practices rather than inaccuracies in words
7. It is suggested that teachers consider students' home and informal language as assets in moving towards more formal mathematical language

Here is more detail about the research which fed into the summary implications, organised into four paragraphs which each have a set of implications for teachers at the end.

Paragraph one:

Students can be considered as having English as an additional language (EAL) if they speak a language other than English at home. This includes British citizens who speak another language at home, migrants and refugees.[1] The proportion of EAL students in England has steadily increased over the last decade.[2] EAL students are extremely heterogeneous, having different language proficiency, first language, life and/or educational experiences.[1] We discuss this in the infographic section. Research suggests that mathematical language proficiency may not develop until later school years[3] and that even when EAL learners appear to have mastered conversational English, they may need several more years to achieve native-like proficiency in mathematical English.[4]

There are two implications of paragraph one:

First implication: Teachers and school leaders who recognise the differences between EAL students will understand what effects these might have on learners' needs

Second implication: EAL students may appear to have mastered the use of English before they achieve native-like use of mathematical language; teachers should be mindful of the difference between conversational and subject-specific language proficiency

Paragraph two:

Mathematical word problems can pose a range of difficulties for EAL students.[5] At text level, they are often placed in real-life contexts which may be a distraction for students who may therefore have issues in drawing out mathematical information. At sentence level, the meaning is often embedded within symbols, which can represent several complex words:[6] for example, the greater than or equal to symbol (≥) simultaneously communicates the idea of relative numerical value and equality.[6] Mathematical words can be context-specific: for example, 'positive' and 'negative' may refer to integers, but in science they can refer to electrical charges and in history refer to attitudes.[6] They may also hold meanings that differ from everyday use; for example, 'odd number' may be assumed to be a synonym for unusual or incorrect.[6] EAL learners may find it challenging to learn the English language and mathematical language simultaneously and to move between informal and formal language.[7]

There are four implications of paragraph two:

First implication: EAL learners may find the shift from conversational to mathematical language more difficult than native speakers and may require more time to develop mathematical language proficiency compared to their peers

Second implication: EAL students may have difficulties with word problems at text, sentence and word level, with symbols representing multiple concepts and with mathematical terms which have meanings that are different from their everyday uses

Paragraph three:

Measuring students' mathematical knowledge is difficult when confounded by their ability to speak, read and understand the language in which the mathematics is presented.[7] Word problems present EAL students with additional cognitive demands as they spend time processing the syntax, semantics and vocabulary, as well as context, to get to the mathematics.[7,8] Research has found that EAL students perform worse on mathematics word problems written with dense, complex sentences compared with those written in simpler sentences.[9]

There are three implications of paragraph three:

First implication: Measuring and assessing EAL students' mathematical 'ability' may be confounded by their ability to speak, read and understand the language in which the mathematics is presented

Second implication: Complex sentences and contexts may impair students' ability to unpick and comprehend assessment items irrespective of their mathematical 'ability'

Third implication: Assessments that aim only to test students' knowledge of mathematics should avoid culture-specific language and minimise complex details that are irrelevant to questions

Paragraph four:

Teachers who focus on EAL students' mathematical practices such as reasoning or justifying, rather than focusing on inaccuracies in vocabulary, notice when students make connections; they encourage learners to explain their reasoning and allow them to use different resources such as symbols, languages and/or level of formality to show mathematical thinking.[10] Probing students' thinking and developing formal language is more effective when teachers know the extent of students' informal language use[10] and see home language and everyday language as resources when explaining mathematical concepts.[11] It may be useful to keep language

simple and consistent during early learning of new concepts, and to build a class glossary of definitions with accompanying diagrams.[5] Alternatively, students could be encouraged to keep bilingual glossaries with mathematical phrases.[12] Creating diagrams to represent word problems has been shown to support EAL students in problem solving.[8] Collaboration with other EAL students and learners with good language skills and mathematical knowledge can help EAL students clarify and share their own ideas, deepen reasoning and consider alternative ways of thinking and problem solving.[10]

There are four implications of paragraph four:

First implication: EAL students may benefit from bilingual glossaries of key terms and definitions accompanied by student-drawn diagrams

Second implication: EAL students may benefit from bilingual glossaries of key terms and definitions accompanied by student-drawn diagrams

Third implication: It is important to view students' home and everyday languages as assets in building their language skills in the mathematics classroom

Fourth implication: It is beneficial to encourage EAL learners to express their own ideas and deepen their own reasoning by collaborating with other learners with a range of language proficiency skills

The Espresso also has an infographic

The title of the infographic is 'Proportion of students in state-funded schools in England exposed to a language other than English over time, and what the most frequent of those languages were in 2012'.

The infographic is very detailed, so the next section will also be very detailed, but we offer you the chance to listen slowly and imagine this in the way that makes the most sense to you.

The infographic is a line graph with an x-axis running left to right at the bottom of the graph and a y-axis running up and down at the left side of the graph. The line on the graph shows a gentle slope upwards. On the x-axis is time, marked in years from 2006 to 2016. On the y-axis is percentage, from 0% to 100%. The line begins, in 2006, at 13.8% and slopes upwards until, by 2016, it reaches 19.3%. This shows the rise in percentage of EAL students across the intervening ten years. The area under the line is shaded in turquoise to create a wedge shape, and in this space are the names of some of the first languages that EAL pupils in the UK spoke in 2012, shown from most frequent (in largest type) to least frequent (in smallest type). The top five most frequent languages shown are 1. Urdu, 2. Panjabi, 3. Bengali, 4. Polish and 5. Portuguese.

These data came from the 'Explore education statistics' section of the gov.uk website, and are shared under the Open Government Licence version 3.0.

Thanks for sampling this new product.

We loved you joining us.

The details of the references are coming next, so feel free to listen or stop here – whichever you prefer. If you enjoyed this CoffeePod, there are others available, and more recordings in progress.

We'd love to hear your thoughts about this CoffeePod. Please email us at admin@cambridgemaths.org. And you can also read the original Espresso by going to www.cambridgemaths.org.

The Espresso has a reference list of 12 entries written using APA 7 notation.

The references can either be accessed as a separate document or in the published Espresso via links in the video information box. Alternatively, you can continue to listen to them here.

Reference 1: Hutchinson, J. (2018). *Educational outcomes of children with English as an additional language* (Research Report).

Reference 2: Department for Education. (2018). *Schools, pupils and their characteristics*.

Reference 3: Cummins, J. (1981). The role of primary language development in promoting educational success for language minority students. In California State Department of Education (Ed.), *Schooling and language minority students: A theoretical framework* (pp. 3–49). California State University.

Reference 4: Pimm, D. (1987). *Speaking mathematically: Communication in the mathematics classroom*. Routledge.

Reference 5: Barwell, R. (2005). Working on arithmetic word problems when English is an additional language. *British Educational Research Journal, 31*(3), 329–348.

Reference 6: Adoniou, M., & Qing, Y. (2014). Language, mathematics and English language learners. *Australian Mathematics Teacher, 70*(3), 3–13.

Reference 7: Daro, P., Cheuk, T., & Daro, V. (2018). The language of mathematics and summative assessment: Interactions that matter for English learners. In A. L. Bailey, C. A. Maher & L. C. Wilkinson (Eds.), *Language, literacy and learning in the STEM disciplines: How language counts for English learners*. Routledge.

Reference 8: Avalos, M. A., Medina, E., & Secada, W. G. (2018). Reading mathematics problems: Exploring how language counts for middle-school students with varying mathematics proficiency. In A. L. Bailey, C. A. Maher & L. C. Wilkinson (Eds.), *Language, literacy and learning in the STEM disciplines: How language counts for English learners*. Routledge.

Reference 9: Barbu, O., & Beal, C. R. (2010). Effects of linguistic complexity and math difficulty on word problem solving by English learners. *International Journal of Education, 2*(2), 1–19.

Reference 10: Department for Education. (2002). *Access and engagement in mathematics: Teaching pupils for whom English is an additional language*.

Reference 11: Moschkovich, J. (2018). Talking to learn mathematics with understanding: Supporting academic literacy in mathematics for English learners. In A. L. Bailey, C. A. Maher & L. C. Wilkinson (Eds.), *Language, literacy and learning in the STEM disciplines: How language counts for English learners*. Routledge.

Reference 12: The Bell Foundation. (2017). *Teaching EAL learners in maths*.