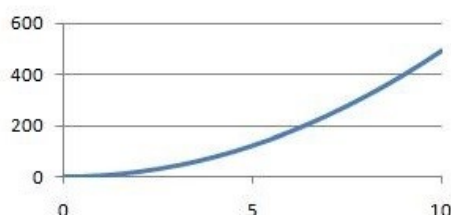


Project title	Critical analysis of the languages of functional and graphical change in secondary mathematics classrooms
Principal supervisor	Cathy Smith
Second supervisor	Sue Forsythe
Discipline	Mathematics Education
Research area/keywords	classroom language, functions, discourse
Suitable for	Full time or part time applicants

Project background and description

Describing the mathematical behaviour of graphs in progressively more sophisticated classroom language is a challenging skill for teachers of secondary school mathematics (Smith and Bretscher, 2018). How does a teacher respond to student descriptions such as:



“The graph grows bigger”

“The slope goes up”

“It increases more up to 400”?

Terms such as ‘increase’ and ‘growth’ have different meanings in the mathematical and everyday language registers. When teachers and students construct short phrases to describe types of growth, the words and grammar they use may lead to different foci: on endpoints, on overall impression, on comparing incremental changes or on the relationship between variables (Thompson, 1994; Watson and Harel, 2013). They may also use gestures to direct attention to local perceptual features or to indicate deictically a feature that they do not yet have words for (e.g. Hähkiöniemi, 2007).

This project examines the ways that language and gestures are used by teachers and students to shift attention to relevant features of a functional relationship. Whereas recent research (e.g. Şahin-Gür and Prediger, 2018) has focused on calculus, this project will compare two stages of the mathematics curriculum: precalculus and early calculus. In English and Welsh classrooms, these two stages manifest as A-level and GCSE courses of study. For A-level mathematics, teachers introduce early calculus concepts of increasing and decreasing functions and of gradient as a number, a variable and a function. The new GCSE mathematics curriculum includes pre-calculus concepts of slope and growth including recognition of linear, quadratic, exponential and hyperbolic graphs. This project will examine the similarities and the progression in the language used by students and teachers in these two phases, using case studies and linguistic

methods of studying classroom discourse (see for example Ingram, 2014).

This project is suitable for a candidate with prior experience of teaching mathematics at upper secondary level. A good level of written academic English is required to engage with mathematics education literature and linguistic analysis. The candidate will need to negotiate access to case study classrooms and so must be eligible for an appropriate DBS certificate to work with children.

Background reading/references

- Häikiöniemi, M. (2007) 'How the derivative becomes visible: the case of Daniel', *Teaching Mathematics and Computer Science*, 5(1), pp. 81–97.
- Ingram, J. (2014) 'Shifting Attention', *For the Learning of Mathematics*, 34(3), pp. 19–24.
- Şahin-Gür, D. and Prediger, S. (2018) "Growth goes down, but of what?" A case study on language demands in qualitative calculus', In Bergqvist, E., Österholm, M., Granberg, C., and Sumpter, L. (eds.), *Proceedings Of the 42nd Conference of the International Group for the Psychology of Mathematics Education (Vol 4)* Umeå, Sweden., pp. 99–107.
- Smith, C. and Bretscher, N. (2018) 'Designing teacher education for pre-university mathematics: articulating and operationalizing pedagogic messages', *Teaching Mathematics and its Applications: An International Journal of the IMA*, 37(2), pp. 84–97.
- Thompson, P. (1994) 'Images of Rate and Operational Understanding of the Fundamental Theorem of Calculus', *ESM*, 26(2–3), pp. 229–274.
- Watson, A. and Harel, G. (2013) 'The Role of Teachers' Knowledge of Functions in Their Teaching: A Conceptual Approach With Illustrations From Two Cases', *Canadian Journal of Science, Mathematics and Technology Education*, 13(2), pp. 154–168.

How to apply for this project

1. Read the [Guide for applicants](#) to check eligibility, especially entry and English language requirements.
2. Informal enquiries can be directed to the [Director of Research](#).
3. Complete an [application form](#), and send to the [Director of Research](#) by 8th March 2019.