50 years of Computing at Birkbeck

Intelligent Support for Mathematical Generalisation

Project Leader(s)
Richard Noss (IOE)
Alex Poulovassilis
Celia Hoyles (IOE)
George Magoulas
Niall Winters (IOE)
Project Staff
Eirini Geraniou (IOE)
Sergio Gutiérrez
Ken Kahn (IOE)
Manolis Mavrikis (IOE)
Darren Pearce
Mihaela Cocea
Teachers/Teacher Educators
Paul Clifford
Peter Tang
Dietmar Kuchemann
Teresa Smart

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Project Aims

The MiGen project is tackling a thorny problem that confronts all teachers of mathematics:
What is algebra for?

- How is it useful for expressing generalisations?
- What does it mean to generalise in mathematics?

We are building a pedagogical and technical environment to support 11–14 year-old students' learning of mathematical generalisations. The system comprises a **microworld**, *the eXpresser* and two intelligent tools, *the eGeneraliser* and *the eCollaborator*. When students are tackling generalisation tasks, the eGeneraliser will be **providing personalised feedback** adapted to the learning trajectories of each student. Through the eCollaborator, students will be able to view each others' constructions and **compare, critique and discuss** them. Both intelligent tools will send information to teachers to help them provide appropriate guidance.

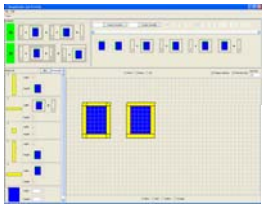
Our research team of social, educational and computer scientists, together with teachers and teacher educators are co-designing the system and iteratively testing it with students.

The ShapeBuilder Mockup

We have developed a mockup tool (ShapeBuilder) to allow us to explore with teachers and students the functionalities that we expect to implement as part of the eXpresser.

Currently, we are using ShapeBuilder to tackle a generalisation task typically known in the National Curriculum as "**pond-tiling**" (see Figure 1). ShapeBuilder aims to encourage structured algebraic reasoning by providing tools for the learner to build general shapes using expressions. A critical feature of the software allows users to *define expressions using shapes* which are **represented iconically** (see Figure 1b). Three representations, (iconic, symbolic and numeric) are available to the students.

(a)



(b)

Someone wants to know the number of square tiles needed to surround a rectangular swimming pool with one layer of tiles. You don't know the size of their swimming pool, so you need to tell them *a rule* for coming up with *the number of tiles* they need to surround it.

Figure 1: The Pond-tiling Task

The pond-tiling task, which is just one of many activities that our system will support, is surprisingly rich in that it lends itself to a variety of different solutions. Different learners can produce multiple but valid solutions leading them to discuss the equivalence of different representations. We intend that these sorts of scenarios will provide an incentive for students to develop together some basic rules of algebra.