Unit Overview: Linear Functions

Summary of learning goals

As part of the Special Topic **Bringing the Real World into Algebra** this unit looks at linking real world, algebraic, numeric and graphical representations of linear functions. Special emphasis is given to considering the gradient of each linear function.

All units in the Special Topic: Bringing the Real World in to Algebra are guided by the principles of Realistic Mathematics Education (RME). As a consequence, this unit:

- Uses realistic situations to develop mathematics.
- Places less emphasis on memorising and more on describing patterns and creating function rules.
- Places more emphasis on sense making.
- Uses "guided reinvention".

Students will have the opportunity to consider real world objects that can be described using linear functions. Through technology assisted exploration these examples will become models for understanding the gradient, position and orientation of lines. Students will learn to identify, and where appropriate interpret gradient from the graph and from the function rule.

Australian Curriculum: Mathematics (Year 9)

ACMNA215: Determining linear rules from suitable diagrams, tables of values and graphs and describing them using both words and algebra.

Summary of lessons

Who is this unit for?

Year 9: enhancing a standard approach to teaching linear functions or for revision. The challenge of finding the rule for a line that matches an object in the real world can engage students and the examples may create strong, memorable images that students can look back on when they need to remember and make sense of linear functions in the future. The technology is used in different ways in each lesson in order to maintain students' interest and to draw attention in different ways to the links between algebraic, graphic and numeric representations of linear functions.

Lesson 1: Linking Graphs and Rules

The link between the position, gradient and orientation of linear function graphs and the corresponding algebraic representation will be explored with the help of GeoGebra. In the first activity, focus is given to the change in each parameter in the function rule as the line is manipulated. In the second activity, students use the y=mx+b form of the function rule and systematically vary the parameters "m" and "b" in order to find a line that is a good fit to a feature on a digital image.

Lesson 2: Gradient, Ramps and Slides

These two tasks explore the real contexts of access ramps and playground slides using linear functions and linking the visual, graphical, symbolic and numeric representations. Students take their own photos of ramps and slides in their school or nearby and fit linear functions to them using GeoGebra. The focus is on gradient shown by the coefficient of x in $y=mx+b$, and also by rise over run. In the first task, students decide if the ramps match the Australian Standards. The second task uses slides with varying gradient to introduce average gradient. Students also learn to use sliders in GeoGebra to easily vary the line and approximate the steepest and shallowest gradients of the slides.

Reflection on this sequence

Rationale

In teaching or revising linear functions by starting in the real world we aim to link visual, graphical, symbolic and numerical representations of functions in a way that will help students build strong and memorable conceptual schema. Using digital images to link to the real world can engage students, especially if they have some ownership of the photos. Then, with the aid of technology, the tasks of exploring links between the parameters in a function rule and of a graph can be made accessible to students across a wide range of mathematical ability. The focus on the gradient (slope) in the real world has direct application to linear functions but also builds schema that may be applied to more complicated mathematical models in the future.

If we can help our students understand and engage with the algebra and graphs of linear functions through even a few real examples then it is a small step to help them see that the same mathematical principles might be applied to use algebra to model far more complicated real world shapes and paths.

reSolve Mathematics is Purposeful

These tasks are aimed to be memorable and with some real world application. With the aid of technology students can explore the gradients of ramps and slides in a novel way that makes use of simple mathematics to check this key feature of the built environment in which children move and play.

While some aspect of the tasks are artificial, experience has shown that students enjoy the challenge of line fitting and so are motivated to pay attention to the impact of varying each parameter of the linear function rule.

reSolve Tasks are Challenging Yet Accessible

reSolve contests a view that some students can “do” mathematics and others cannot. By working with appropriate software all students are able to participate in the activities of line fitting and learn through the experience of guided experimentation. Activities can be scaffolded to different degrees for different students.

Accessibility to the concepts encapsulated by linear functions arises from the use of the real world situation to develop a firm mental model. Transition from relying fully on the real world situation, to using the somewhat more abstract graphs, then algebra occurs at a pace set by the student. The use of several real world situations throughout the sequence provides an opportunity to reinforce the new ideas, as well as extend them.

reSolve Classrooms Have a Knowledge Building Culture

This unit builds knowledge through active exploration of different representations of linear functions and in particular requires students to work to achieve the best models they can by varying the parameters of the linear function rule. The process of working through the process of strategic trial and error requires students to keep trying and to reflect, at each stage, on the impact each change they make to the algebraic rule has on the graphic representation and, in some examples, the real world interpretation of that result. The use of software means that errors may be quickly corrected or even erased. There need be no embarrassment!

Further Reading

Read more about RME: http://e-library.math4teaching.com/what-is-realistic-mathematics-education

Acknowledgements

Sections of this unit draw on examples from the RITEMATHS project. These lessons can still be accessed from: https://extranet.education.unimelb.edu.au/DSME/RITEMATHS/