Learning and doing geometry (ME321) focuses on geometry and how people learn and develop geometric thinking. Geometry is an important part of mathematics because it builds on our intuitive sense of space developed through our experience of the physical world. In geometry learners develop their reasoning skills starting with forming simple conjectures, developing ways to justify their reasoning before moving on to formal proof.

This module aims to teach you about how learners think and reason in geometry. You will consider the way in which geometry is taught in school, from upper primary to secondary school. You will work on geometry tasks and reflect on your approach using pedagogical ideas from the module. You will become familiar with using GeoGebra, which is a freely accessible version of Dynamic Geometry Software and learn how to use it to construct figures in geometry. You will consider the differences between static (paper and pencil) and dynamic geometry.

Most of your studies will be online through the VLE. This includes materials such as readings, interactive activities, videos and screencasts. There will be forums for students to post messages and observations and to ask questions. A schedule of tutorials will provide support in aspects of the course and with preparation for the assessments. There will be a printed resource in the form of the task booklet, which will contain geometric tasks for you to work on each week, with some marked as suitable for use with learners.

An example of a geometry activity

Some useful geometric terms:

- Convex quadrilateral – a four sided shape whose interior angles are all smaller than 180 degrees
- Congruent shapes- shapes which are exactly the same as each other. You could place one over another and it would fit exactly.
- Alternate angles are formed within a set of parallel sides with one transversal line cutting across them. We often think of them as being inside a Z-shape.

The congruent triangles task

Every convex quadrilateral has two diagonals which divide it into 4 triangles. An example is figure 1 below which shows a quadrilateral that appears to have no special properties. None of the four triangles appear to be congruent to any other.

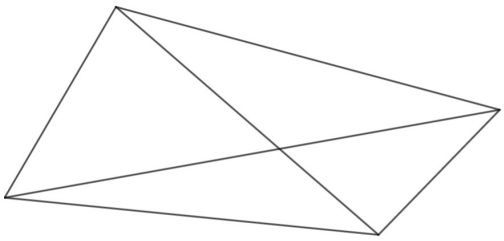

Figure 1

There are classes of quadrilaterals, which we give names to, which have special properties such as equal sides, equal angles, parallel sides, diagonals which bisector each other, reflection symmetry or rotation symmetry.

a) For each class of quadrilaterals below, draw an example and then draw in its diagonals:

   Square, rectangle, parallelogram, rhombus, kite trapezium.

b) For each example of a quadrilateral identify any triangles which are congruent. You might do this by shading those triangles which are congruent to each other.
   Give reasons why these triangles are congruent. You will need to refer to the properties of the quadrilateral in your argument.

An example solution

Figure 2 is an example from the class of parallelograms. It appears that there are two pairs of congruent triangles: the shaded pair and the unshaded pair.

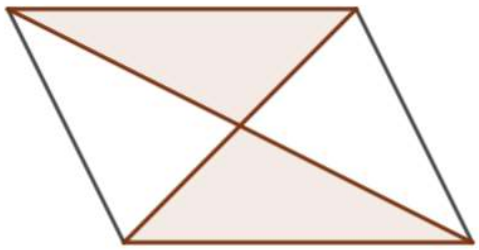

Figure 2

Parallelograms have two pairs of equal length parallel sides. This means that the base of the lower triangle is equal in length to the top side of the upper triangle. It also implies that alternate angles are equal. This information is shown in figure 3.

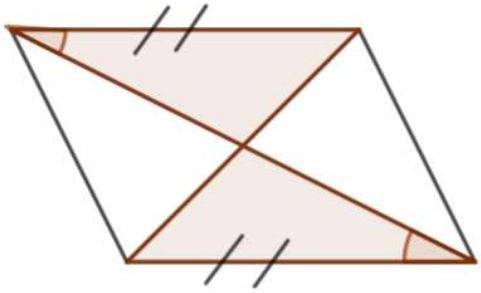

Figure 3

There is another pair of alternate angles as shown in figure 4.

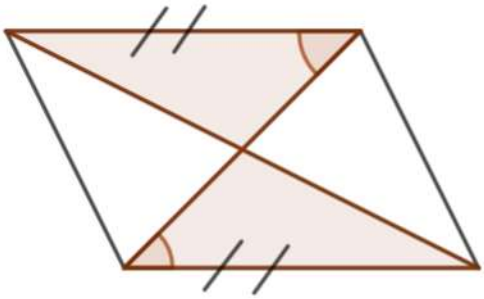

Figure 4

The two shaded triangles both have the angle, included side, angle property which provides a justification that they are congruent.

The same argument can be applied to the unshaded triangles to show that they are congruent to each other.

Discussion

You used **perceptual reasoning** (this is linked to seeing and visualising and making intuitive judgements based on this) when you looked at the parallelogram to identify possible congruent triangles. However, this did not provide a reason for why those triangles were congruent. You needed to construct a reasoned argument, using the properties of the parallelogram. In this you were using **discursive reasoning**, which describes reasoning based on articulating an argument based on the logic of the geometric figure. Perceptual and discursive reasoning are two important ME321 module ideas which help to explain how we think and learn about geometry.

Tutorials and assessment

Students on ME321 have regular contact with their tutors, usually by phone, email or skype. In addition, online tutorials are held regularly where module ideas are discussed, and students can ask for advice on the assessments. There are three tutor marked assessments plus one final assessment. These are typically based on activities which you undertook during your studies. For example, an assessment based on the congruent triangles task might look like this:

Question 1 (1200 words)

This question is about you as a learner. Explain your own work on the congruent triangles task. You need to include the following:

(a) An account of what you did, how you did it and why you did it that way.

(b) An explanation with evidence of how you used the module ideas of perceptual and discursive reasoning and at least one other idea from the module.

(c) Your personal reflection on your role as a learner making use of any ME321 module ideas This section of the assessment gives you the opportunity to reflect on how your engagement with the tasks affected/enhanced your learning and to comment on any learning issues that arose.

Question 2 (1200 words)

This question is about you as the teacher.

(a) Adapt the congruent triangles tasks you worked on in Question 1 to use with your learner(s). Explain how, and where, you expect your learner(s) to make use of generalisation when they are working on the task.

(b) Try the task with your learner(s). Explain what actually happened, including how they used the module ideas perceptual and discursive reasoning and possibly other module ideas from the module as they engaged with the task. Include examples of their work as supporting evidence. These should be annotated with ME321 module ideas, in particular references to discursive reasoning.