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TI-AIE

Hands-on learning and embodiment: constructions in geometry

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Contents

What this unit is about

When you look around, there are angles to be noticed everywhere. Life without angles does not seem possible. There are angles in objects, in buildings, in hills, in trees, in the waves of the sea – even in people, in the movement of our arms and legs (Figure 1).

Figure 1 Angles are everywhere.

In this unit you will learn how hands-on learning and embodiment can be used when working on constructions in geometry with your students. The unit contains suggestions on using the outdoors as a mathematical arena. Working in this way can help your students become independent learners, able to think through the ideas they have studied in the classroom and apply them outside. To help your students further with this, the unit also discusses ways to help them become ‘unstuck’ in their learning of mathematics.

What you can learn in this unit

- How to use embodiment and make large-scale constructions to promote learning and enjoyment in doing mathematics.
- Some ideas to help your students deal with being stuck by themselves, so that they develop personal strategies for moving forward with their learning.
- Some ideas on how to use hands-on approaches to teach constructions in geometry.

This unit links to the teaching requirements of the NCF (2005) and NCFTE (2009) outlined in Resource 1.

1 Constructing angles by folding paper

Angles play an important role in life. Yet somehow, students often do not see these angles around them or associate them with the angles that they work with in the mathematics classroom. When students think of angles, they often restrict their thoughts to intersecting lines drawn on paper that can only be measured and constructed by using a protractor and a pair of compasses.

Activity 1 aims to introduce students to how they can 'construct' angles through paper-folding using nothing but a rectangular piece of paper. This hands-on experience of manipulating angles can help students to explore the meanings behind the symbols, representations and concepts relating to angles. This is intended as a quick revision of angles that they will have studied in elementary school.

Before attempting to use the activities in this unit with your students, it would be a good idea to complete all (or at least part) of the activities yourself. It would be even better if you could try them out with a colleague, as that will help you when you reflect on the experience. Trying the activities yourself will mean that you get insights into learners' experiences that can in turn influence your teaching and your experiences as a teacher. When you are ready, use the activities with your students. After the lesson, think about the way that the activity went and the learning that happened. This will help you to develop a more learner-focused teaching environment.

Activity 1: Constructing angles by folding paper

Tell your students that any straight edge represents a straight angle of 180°. When you fold an angle so that the initial ray falls on the terminal ray, this results in what is termed bisecting an angle.

Using this knowledge, ask your students to try to construct angles that measure 180°, 90°, 77.5°, 50°, 45°, 30°, 22.5° and 11.25°.

Then they should answer these questions:

- Which ones were easy to fold?
- Which were difficult or impossible to fold?
- Why are these angles all less than 180°? Is it possible to bisect angles beyond that value?

Case Study 1: Mr Rawool reflects on using Activity 1

This is the account of a teacher who tried Activity 1 with his secondary students.

The students had never done a paper-folding exercise before (or at least not for a long time) and seemed to be a little confused at the start. Somehow they seemed to find the concept that you can halve angles unusual. I asked questions to explore what they were thinking and it turned out they saw angles as something static, something fixed, and not as a description of movement or turning. So I first asked them to stand up, hold both arms up forward, and turn clockwise/anti-clockwise through 180°, 360°, 720°, 90°, 45°, half of 360°, double 45°, half of 360°, followed by 45°, etc., trying to hold one arm in place and move the

other to indicate the size of the angle so that they began to see measuring an angle as measuring a turn or rotation.

After this they were happy to do the paper-folding. What they noticed was that getting the angles accurate became a major problem, especially when trying to fold the smaller angles.

Reflecting on your teaching practice

When you do such an activity with your class, reflect afterwards on what went well and what went less well. Consider the questions that led to the students being interested and being able to get on and those where you needed to clarify. Such reflection always helps with finding a ‘script’ that helps you engage the students to find mathematics interesting and enjoyable. If they do not understand and cannot do something, they are less likely to become involved. Use this reflective exercise every time you undertake the activities, noting, as Mr Rawool did, some quite small things that made a difference.