

DEVELOPING CONTOUR LINE SKILLS

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In a survey of Geography teachers carried out in 1992 (Gillmor and Waddington, 1993), the three map work skills which were considered to be most difficult to achieve were: -

- (1) Calculate gradient
- (2) Recognise landforms from contour patterns
- (3) Understanding cross-sectional diagrams

It is observed that all of these skills depended on understanding of contours and their interpretation. The following is an outline of a course designed to improve student skills in these aspects of map work. It is based on suggestions made by colleagues and a large number of written sources read over a long period and adapted for use, plus ideas developed by the author. It is not, therefore, possible to source all the individual items directly, but thanks are due to a large number of contributors. No expensive resources or vast amounts of preparation time are required and virtually all items are reusable. It is not, of course, suggested that the map skills should be taught in isolation from the rest of the Geography course or in one continuous unit, but that they should be integrated as appropriate and linked to other areas of work.

Materials Required

(Apart from the usual blackboard (or preferably overhead projector), copies, etc.)

Class set of OS Map extracts

Local 1:50 000 or 1:63 600 maps (ideally one per two students)

Several margarine tubs or one fish tank

Modelling clay and/or polystyrene

String

Rulers

Cocktail sticks (for making lines and dividing up modelling clay - much safer than blades!)

Recognising Landforms from Contour Patterns

A number of studies have shown that even when students appear to understand the basic concept of the contour, they may still have considerable difficulty in

conceptualising the relationship between this and the overall height and shape of the landscape. For example, Boardman (1989) reported that when students were asked to shade the land above the 91m contour on a map many shaded only the land between this contour and the next one above it. This section of the course begins, therefore, with a general consideration of the relationship between contours and height.

Inspection

Maps should be distributed to students, who are asked to identify how height is shown on the map. Usually they note the coloured shading first. Attention can then be drawn to the key, relating the boundaries between the various colours to the appropriate heights listed along side. Reference to the map will illustrate that these divisions are marked with lines on the map, which will allow an initial appreciation of the concept of a line joining together places of equal height. I have found it helpful to stress at this point that the colours do not represent what the land actually looks like (i.e. not all mountains are brown or all lowland a bright green).

Modelling

Having introduced the idea of lines illustrating height, use should then be made of simple models to illustrate how these work.

(i) Heights above the Table

A memorable introduction to the basic idea can be done with the aid of a co-operative student, who is tied up with string at measured distances from the ground (or the table top, if you can rely on their standing still!) e.g. 20 cm, 40 cm.

(ii) Hardware Models - relating the contours to real relief

Ideally this work should be done by small groups of students using simple equipment such as margarine tubs and rulers. I have, however, found that with some classes it can be very messy and so a class demonstration is probably safer.

(a) Place modelling clay model of a simple hill in fish tank. Place a ruler in the tank and pour in water to a measured depth, e.g. 10 cm. Mark around the hill at water level and then put in more water to increase the depth to 20 cm. Mark again at water level and repeat the process until the top of the hill is reached. Drain out water and the "contour" lines can now be seen at appropriate heights on hill. (If the students are using smaller scale equipment for group work, they must remove the hill from the tub to see it clearly.)

(b) The students can now see the lines marked on the model hill, and I have introduced a formal definition of the contour line at this point.

(c) After looking at the model from above, it should then be sliced along the contours. These slices are then laid side by side on paper and a drawing made around their outlines, each one labelled with its correct height. Cut these outlines out of the paper and place on top of each other in order of height. Hopefully, the students will identify for themselves the likeness to the map, if not it should be

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For real relief groups of students using simple equipment have, however, found that with some demonstration is probably safer.

A model hill in fish tank. Place a ruler in the tank, e.g. 10 cm. Mark around the hill at intervals to increase the depth to 20 cm. Mark again at the top of the hill is reached. Drain out the water at appropriate heights on hill. (If the model is for group work, they must remove the

Marked on the model hill, and I have a line at this point.

When the model is sliced, it should then be sliced along the vertical side on paper and a drawing made of its correct height. Cut these outlines together in order of height. Hopefully, the relationship to the map, if not it should be

relatively easy to make that point clear. They can then glue these shapes together, making a contour "map", which can be compared with real maps.

(d) It is helpful at this stage if pupils can try this for themselves. If they have not been working in small groups, I have used small polystyrene models, ready sliced and useful for this. They have the advantage that they can be reused.

(e) The same approach can then be used to examine a depression with care being taken to draw attention to decrease in height towards centre, despite similar overall shape to a hill.

(f) Apply teaching to simple examples on real maps, initially getting students to identify hills or valleys which are of simple types.

(iii) Relating the Model to the Map

If local maps are available the whole exercise can become very real when a visit can be made to some local feature, and the map representation compared with this. If this is not possible sketches or photographs of various features on the OS extract can be provided and related to the appropriate areas of the map.

Understanding Cross Sections

(a) Map Descriptions

Students should be asked to describe a fairly simple feature from a map, e.g. a regular shaped hill. They should then describe a real landscape feature with which they are all familiar (or the shape of the model which they used for the previous section). They can then consider which task was easier. (Hopefully, it will be the real feature - I have never had the map chosen!). The students can then be asked to explain why this was so. I have always received the appropriate answer - that they can *actually* see what the real hill or the model looks like. From this point it is relatively easy to introduce the cross section as a way to enable the class to *see* what the features on the map look like.

(b) Using the Model

(i) The model (or models) used in the previous exercises should be reassembled as whole shapes (or similar new ones created) and then sliced in half vertically, so that students can see the cross-sectional shape. It is also helpful to put one model against the board and draw around it to produce something which looks rather like a conventional cross-section. Alternatively, students could draw around their own small models on paper. It is helpful at this point to ask students to consider how height of the feature could be indicated. I have generally found that the idea of marking on the height from the contour lines is suggested, although I have sometimes had to work very hard before this happened. These should then be marked on the diagram and then on a grid, as on a standard cross section.

(ii) At this stage it is helpful to remind students that the purpose of the exercise is *not* to describe slopes of features already shown in 3 dimensions, but those shown

on maps. It can then be explained that the contours marked on the map can be used to produce a diagram similar to that produced from the model. The method for producing a cross-section should then be demonstrated, using the "map" produced by gluing the contour shapes together. (This is not described here as it is described fully in most mapwork sections in the standard texts).

(iii) Students should then practice the technique for hills and for valleys, initially on simplified maps and then on the OS map. The technique can then be developed further by marking features such as roads and rivers on the map and model and transferring their location to the cross-section.

Problems may arise with vertical scale - initially the teacher should specify an appropriate one and should stick to simple examples (i.e. not very high mountains with very close contour spacing. Eventually it will be necessary for students to learn about the need for vertical exaggeration, but I have found it a needless complication at this stage.

Calculating Gradient

Similar concepts and calculations are covered in both Geography and in Maths. While it would be foolish to assume that transfer of learning will occur automatically between the two subjects, a degree of co-ordination in timing and explanation would clearly be of benefit both to students and to teachers who wish to avoid boring their students and wasting valuable class time.

(a) Using a Cross-Section

Students should draw a simple cross-section of a hill with one steep and one shallow slope. They should then be asked to describe this. Other cross-sections should then be shown, one fairly similar and one very different and these should also be described. The answers should be used to bring out problem of describing slopes in qualitative terms - i.e. *exactly* what is the meaning of steep, etc. It would be helpful to have a map and cross-section from somewhere like the Andes or the Alps and/or the Netherlands to make this point more clearly. This will then allow the idea of quantitative measures to be introduced.

(b) Range of Height

(i) Using the map from which the steep and shallow slope cross-section was drawn, ask students to find range of height between two contour lines on shallow slope, e.g. 500 m and 200 m. Students should also measure the horizontal difference between the two lines (This also has the benefit of revising grid references and scale on maps).

(ii) Repeat for same contours on steep slope. If necessary, draw attention to the difference in horizontal difference, despite the vertical distance being the same.

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(c) Gradient

(i) Students should now be asked to suggest a way in which these measurements of horizontal and vertical distance could be used to describe the differences in slope of the land. Hopefully, they will suggest stating the vertical and horizontal distances, e.g. 300 m vertical in 2km or 6km or whatever. Sometimes students did not make the correct suggestion; sometimes it required considerable prompting.

(ii) Lead students to realise that this would be clearer if the figures were simplified, e.g. 1m vertical for every 40m horizontal, then demonstrate standard calculation for gradient, using two examples already measured on simple hill model/map.

(iii) Explain that this is the *Gradient*. Allow students to practice on simple examples, then move on to map examples. Ideally local features should be used as some students find it hard to translate the calculated gradient into the *actual* slope experienced. Alternatively (or additionally) the gradients could be calculated for the slopes involved in the cross-sections which were drawn previously.

Bibliography

Boardsman, D. (1989) The Development of Graphicacy: Children's Understanding of Maps, *Geography*, 74 (4), 321-331.

Gillmor, D.A. and Waddington, S.B. (1993), Topographical Mapwork in Geographical Education, *Geographical Viewpoint*, 21, 101-109.

Additional Useful Reading

Boardman, D. (1986), Relief Interpretation, in D. Boardman (ed), *Handbook for Geography Teachers*, Sheffield, Geographical Association.