



TI-AIE

Tackling mathematical anxiety: combination shapes and solids

This publication forms part of the Open University module [module code and title]. [The complete list of texts which make up this module can be found at the back (where applicable)]. Details of this and other Open University modules can be obtained from the Student Registration and Enquiry Service, The Open University, PO Box 197, Milton Keynes MK7 6BJ, United Kingdom (tel. +44 (0)845 300 60 90; email general-enquiries@open.ac.uk).

Alternatively, you may visit the Open University website at www.open.ac.uk where you can learn more about the wide range of modules and packs offered at all levels by The Open University.

To purchase a selection of Open University materials visit www.ouw.co.uk, or contact Open University Worldwide, Walton Hall, Milton Keynes MK7 6AA, United Kingdom for a catalogue (tel. +44 (0) 1908 274066; fax +44 (0)1908 858787; email ouw-customer-services@open.ac.uk).

The Open University,
Walton Hall, Milton Keynes
MK7 6AA

First published 200X. [Second edition 200Y. Third edition] [Reprinted 200Z]

Copyright © 200X, 200Y The Open University

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted or utilised in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without written permission from the publisher or a licence from the Copyright Licensing Agency Ltd. Details of such licences (for reprographic reproduction) may be obtained from the Copyright Licensing Agency Ltd, Saffron House, 6–10 Kirby Street, London EC1N 8TS (website www.cla.co.uk).

Open University materials may also be made available in electronic formats for use by students of the University. All rights, including copyright and related rights and database rights, in electronic materials and their contents are owned by or licensed to The Open University, or otherwise used by The Open University as permitted by applicable law.

In using electronic materials and their contents you agree that your use will be solely for the purposes of following an Open University course of study or otherwise as licensed by The Open University or its assigns.

Except as permitted above you undertake not to copy, store in any medium (including electronic storage or use in a website), distribute, transmit or retransmit, broadcast, modify or show in public such electronic materials in whole or in part without the prior written consent of The Open University or in accordance with the Copyright, Designs and Patents Act 1988.

Edited and designed by The Open University.

Typeset by [name and address of typesetter if applicable or The Open University].

Printed and bound in the United Kingdom by [name and address of printer].

ISBN XXX X XXXX XXXX X

X.X

Contents

What this unit is about	5
What you can learn in this unit	5
1 Issues with learning mathematics	6

What this unit is about



Figure 1 The Taj Mahal

Feeling comfortable with working on combination shapes and solids is important, both in school mathematics and in real life. Buildings, chairs, cutlery, rangoli patterns, mosques and temples all consist of not one shape or solid, but of several put together. People are familiar with combinations of shapes, solids and volumes, but students often find it a difficult topic to deal with in school mathematics.

One of the reasons for this might be that the chapters on volume and surface area are perceived by the students to be about a series of procedures to be followed and complicated formulae to be memorised. This encourages the students to become passive learners and they might experience mathematics as something that is 'done to them', without any possibility for developing their own thinking and being creative. This can result in students feeling powerless, disengaged and despondent about learning mathematics.

In this unit you will focus on how to teach composing and decomposing combination solids and shapes, and the mathematical thinking involved in this process. Through activities you will also think about how to develop students' capacity to make choices and play a more active role in their own learning.

What you can learn in this unit

- How to engage students in thinking about composing and decomposing simple solids into complex solids and vice versa.
- Some ideas on how to support students in developing and valuing their own thinking and learning in mathematics.

- How to facilitate students' reflection on their learning.

The learning in this unit links to the NCF (2005) and NCFTE (2009) teaching requirements as specified in Resource 1.

1 Issues with learning mathematics

'Mathematical trauma' sounds rather dramatic. However research suggests that some students experience real stress while studying mathematics (Lange and Meaney, 2011). These students feel and believe that they are unable to act or think for themselves when learning mathematics. It may seem easy to dismiss or ignore this and say, 'Well, these students just do not get it', or 'They should study harder and practise more'. But there are real reasons to believe that this trauma is stopping some students understanding and then using mathematics in their everyday lives, with many negative consequences to them and society as a whole.

Mathematical trauma can have serious consequences for students who are affected. They may reject mathematics as something that they are not able to do and will never be capable of doing. Students may get into a spiral of self-fulfilling prophecies, because the moment they cannot make sense of an area of mathematics, they believe it is because they simply do not, and never will, understand the topic. This can also affect their belief in themselves as being able to do other areas of mathematics as well. They begin to feel they have no choice or control.

One of the aspects of mathematics that can bring on mathematical trauma is the language of mathematics itself – both the symbolic representation and mathematical vocabulary, which can feel very alien and hard to connect to existing language knowledge and structures.

Activity 1 aims to help you address the issue of how to deal with mathematical vocabulary with your students. It requires the students to devise their own mathematical dictionary with:

- the word
- the official explanation
- their own explanation
- an illustration of what the word means.

Although in this case it is related to the vocabulary encountered in the chapter on surface area and volume, this approach can be taken for all topics in the mathematics curriculum. In Part 2 of Activity 1, students are asked to reflect on their learning in Part 1. This is repeated in most of the activities in this unit. The purpose of this is for students to become more aware of what makes them learn and to become more active in their learning. This will give them a sense of choice and control over their learning.

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 a learner's 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: Making your own mathematical dictionary

Students may do this activity individually or in pairs. It may well be an activity that is repeated with new topics, building over time, or it may be used as a revision activity. Students may even develop their own dictionaries in a separate notebook, or you may develop a class dictionary where students write entries that are then put on display and maybe reworked over time.

Part 1: Making the dictionary

Tell your students to look at the chapter in their textbook about area, volume or surface area, before doing the following:

- Make a table with at least four columns. (Make sure the students read through all the instructions before they decide on the layout of their table.)
- Identify any unfamiliar or unusual words, and write these down in the first column of your table; for example, 'volume', 'capacity', 'surface area', 'cone', 'frustum', etc.
- In the second column, write down your own explanation for the word that makes sense to you. It does not have to be complete yet, or entirely correct, as you will be able to make changes to it as your understanding grows.
- In the third column, write down the explanation that the book or your teacher gives for the word.
- In the final column, make a drawing or sketch of what the word means that makes sense to you. Again, it does not have to be complete yet, or entirely correct, as you will be able to make changes to it as you develop your understanding.

Part 2: Reflecting on your learning

Tell your students that this part of the activity asks them to think about their learning so that they can become better at learning mathematics and feel better about it.

- What did you find easy or difficult about Part 1 of this activity?
- What did you like about this activity?
- What mathematics did you learn from this activity?
- What did you learn about how you (could) learn mathematics?

Case Study 1: Mrs Chadha reflects on using Activity 1

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

When I read about mathematical trauma, I could immediately think of several students who might be experiencing this. I also have to admit that until now I have taken the stance that some students 'get it' and others do not. Perhaps this is because I have never struggled with mathematics that much – which is why I became a mathematician and a mathematics

teacher. So before starting on this activity, I made myself promise I would really try to support students in making their own choices.

I had expected this activity to require quite a bit of prompting by me to get them to engage, but they all got busy over their books and started finding words. It seemed they knew exactly where to look!

After a few minutes, Mina asked whether they had to identify only the ones that they did not clearly understand. Because I wanted them to make their own choices, I suggested that they could do what they felt was best and that it would be nice if we all could share their ideas, thoughts and descriptions about the words they had selected. This sharing of ideas led to interesting mathematical discussions. It also brought out some of the misconceptions that the students had and made it possible to discuss those in an informal way.

For example, we had a great conversation about the term 'volume': Rohit described volume as what can be put inside a figure; Sohan said volume is what a solid is made of; Rina said volume is the amount of liquid it can hold. The discussion that followed was lively with students willing to share their ideas and I was pleased to see that students did not appear to be crushed by others commenting on their ideas or suggesting other descriptions. Several concepts were talked about and clarified in the process.

Reflecting on your teaching practice

When you do such an exercise 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 Mrs Chadha, did some quite small things that made a difference.

