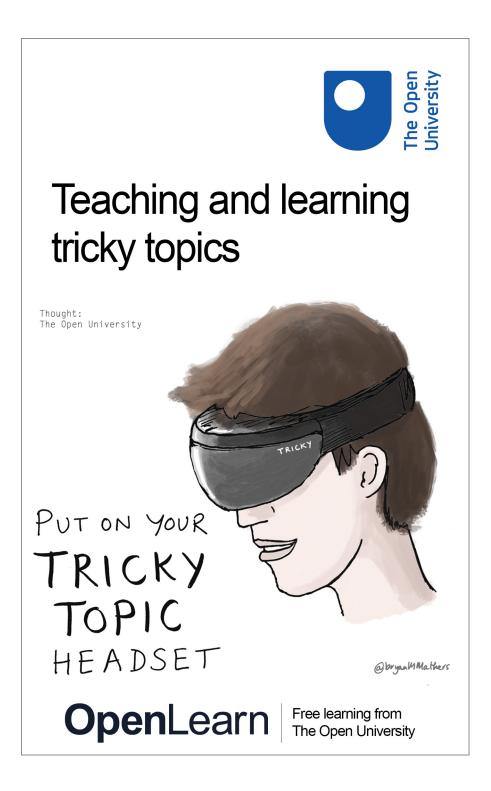
## **Open**Learn



### Teaching and learning tricky topics







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#### Introduction and guidance

#### Introduction and guidance

Welcome to this free course, Teaching and learning tricky topics.

The course lasts 8 weeks with approximately 3 hours of study time each week. You can work through the course at your own pace, so if you have more time one week there is no problem with pushing on to complete another week. The eight weeks consist of the following:

- Tricky topics and threshold concepts
- 2. Identifying tricky topics
- 3. The tricky topics process
- 4. Introduction to learning design
- 5. Developing your learning design
- 6. Innovating pedagogies and targeted interventions
- 7. Assessment and tricky topics
- 8. Reflection, sharing and becoming a champion

Through the first three weeks you will be focusing on the background to tricky topics and how to apply the process to your practice. In Week 3 you will be asked to look at IRIS Connect, the sharing platform, to develop your understanding of the tricky topics process. This will require you to sign up and login to the platform. While this would be beneficial to you, it is not compulsory for gaining your badge. You can sign up for a free IRIS Connect account <a href="here">here</a>. The next two weeks will focus on the role of learning design and how to use this approach with tricky topics. The final three weeks will help you to look at the wider picture of using tricky topics and learning design to help innovate, assess and embed your understanding with others. At the successful completion of this course you will be able to receive a statement of participation certificate.

There are lots of opportunities to check your learning. This includes interactive quizzes; Weeks 4 and 8 will provide you with an opportunity to earn a badge to demonstrate your new skills. You can read more on how to study the course and about badges in the next sections.

After completing this course, you will be able to:

- understand the background to tricky topics and how they relate to the subject area
- apply the tricky topic process to support identifying student learning barriers and why they occur
- understand how learning design activities can help to identify the 'student voice'
- apply student and activity profiles and discover how they can inform a tricky topics intervention



 understand why and how to develop a targeted tricky topic intervention, as well as how to assess student learning of a tricky topic.

#### Moving around the course

In the 'Summary' at the end of each week, you can find a link to the next one. If at any time you want to return to the start of the course, click on 'Course content'. From here you can navigate to any part of the course. Alternatively, use the week links at the top of every page of the course.

It's also good practice, if you access a link from within a course page (including links to the quizzes), to open it in a new window or tab. That way you can easily return to where you've come from without having to use the back button on your browser.

#### What is a badged course?

While studying *Teaching and learning tricky topics* you have the option to work towards gaining a digital badge.

Badged courses are a key part of The Open University's mission to promote the educational well-being of the community. The courses also provide another way of helping you to progress from informal to formal learning.

To complete a course you need to be able to find about 24 hours of study time, over a period of about 8 weeks. However, it is possible to study them at any time, and at a pace to suit you.

Badged courses are all available on The Open University's <u>OpenLearn</u> website and do not cost anything to study. They differ from Open University courses because you do not receive support from a tutor. But you do get useful feedback from the interactive quizzes.

#### What is a badge?

Digital badges are a new way of demonstrating online that you have gained a skill. Schools, colleges and universities are working with employers and other organisations to develop open badges that help learners gain recognition for their skills, and support employers to identify the right candidate for a job.

Badges demonstrate your work and achievement on the course. You can share your achievement with friends, family and employers, and on social media. Badges are a great motivation, helping you to reach the end of the course. Gaining a badge often boosts confidence in the skills and abilities that underpin successful study. So, completing this course should encourage you to think about taking other courses.





#### How to get a badge

Getting a badge is straightforward! Here's what you have to do:

- read each week of the course
- score 50% or more in the two badge quizzes in Week 4 and Week 8.

For all the quizzes, you can have three attempts at most of the questions (for true or false type questions you usually only get one attempt). If you get the answer right first time you will get more marks than for a correct answer the second or third time. If one of your answers is incorrect you will often receive helpful feedback and suggestions about how to work out the correct answer.

For the badge quizzes, if you're not successful in getting 50% the first time, after 24 hours you can attempt the whole quiz, and come back as many times as you like.

We hope that as many people as possible will gain an Open University badge – so you should see getting a badge as an opportunity to reflect on what you have learned rather than as a test.

If you need more guidance on getting a badge and what you can do with it, take a look at the OpenLearn FAQs. When you gain your badge you will receive an email to notify you and you will be able to view and manage all your badges in My OpenLearn within 24 hours of completing the criteria to gain a badge.

Get started with Week 1.

Introduction and guidance Introduction and guidance





# Week 1 Tricky topics and threshold concepts

#### Introduction

Welcome to Week 1 of this badged open course. Each week builds on the understanding you have developed during the previous week's study, and you should expect to spend 3 hours per week studying.

By the end of this week you should be able to:

- understand what constitutes a threshold concept, and why this is a problem for both students and teachers
- see how the term 'tricky topics' relates to threshold concepts
- begin to consider tricky topics in your subject area.

You'll start by thinking about threshold concepts.

The Open University would really appreciate a few minutes of your time to tell us about yourself and your expectations for the course before you begin, in our optional <a href="mailto:start-of-course survey">start-of-course survey</a>. Participation will be completely confidential and we will not pass on your details to others.



#### 1 Why don't they understand?

How often have teachers uttered these words, frustrated by their students' failure to grasp what they are teaching them? Why do some students appear to just 'get it' whereas other students encounter real barriers to learning? Often students will give the appearance of having understood. The students will believe they have understood. Their teacher will believe they have understood only for some students to fail spectacularly when confronted by tricky exam questions.



Figure 1 I don't understand

At the end of many lessons, students complete short tests to review their learning during the class. These tests contain questions that map onto each topic covered during the lesson. A typical example from a GCSE physics class might be:

Work done is measured in:

- a. Joules
- b. Watts
- c. Coulombs
- d. Newtons

Having just finished the class, most students will be able to select the correct response, a). However, this does not necessarily mean that they have a deep understanding of what 'work done' represents, nor how to calculate it.

They may have memorised terms or equations well enough to be able to select the correct multiple choice answer, but without the deep understanding that would enable them to answer more probing exam questions.

Some concepts regularly cause problems of understanding and can inhibit student progression in a subject, sometimes causing students to give up the subject altogether. Such concepts have been referred to in the literature as threshold concepts.

Threshold concepts were first identified by Meyer and Land:

'A threshold concept can be considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress'

(Meyer and Land, 2006)





Figure 2 Threshold concepts

Threshold concepts are more than just 'key' or 'core' concepts (Harlow et al., 2011, Lucas and Mladenovic, 2007). Threshold concepts focus on the cognitive (thinking) domain of learning rather than the affective (feelings, moods and emotions) or behavioural (physical/kinaesthetic) domains of learning (see Bloom's (1956) characterisation of learning).

## 1.1 Why do misunderstandings occur in threshold concepts?

Why do some topics present a threshold concept for many students, yet other seemingly equally complex topics do not? Much research on threshold concepts and the causes of student misconceptions has focused on the sciences and mathematics. For example, research has highlighted that 'intuitive beliefs' lie at the bottom of many misconceptions. Intuitive beliefs are assumptions that students make about the world around them. Sometimes these beliefs are mistaken, yet they are so engrained that students may not even realise they are making them. These intuitive beliefs may therefore persist until they clash with new knowledge. At this point, students need to identify and 'unlearn' these intuitive beliefs in order to assimilate the new knowledge.

Intuitive beliefs lie at the origin of a diverse range of misconceptions in biology (Coley and Tanner, 2012). These misconceptions lead to basic misunderstandings which impair the students' ability to understand biological concepts. For example, a common type of causal reasoning presupposes that all actions are directed toward some sort of goal, even assuming agency in non-living objects, 'the rocks were pointy so that animals wouldn't sit on them and smash them'. In Biology, this goal-driven assumption often results in students of all levels explaining biological processes with reference to a supposed purpose or goal. For example, some students believe that evolution is caused by a 'collective striving toward higher forms of life'. This belief, which is intuitively appealing, mistakes evolution for a purpose rather than a process. Students who hold this belief will have a fundamental misunderstanding of evolutionary theory (a threshold concept) and as a result, would struggle to understand the threshold concept genetic drift which relies on an understanding of the role of natural selection in evolutionary theory.

Such misconceptions are not limited to the field of Biology. Students of Physics, even at university level, reveal equally fundamental misunderstandings. For example, many are unclear on how a moving object will behave in different situations. Circular impetus theory holds that if an object is moving in a curve, say a ball being swung on the end of a string, that when released the ball will continue to follow the curved path. This theory is intuitively attractive, yet factually incorrect since the ball will actually move off in a straight line at a tangent to its original circular path (see Figure 3).



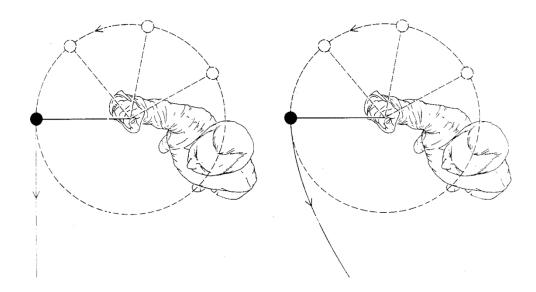


Figure 3 A demonstration of circular impetus theory

McCloskey (1983) reported that only 51% of college level students were able to correctly predict the path of a ball released in such a fashion, the remainder preferring some variant of the intuitive explanation, showing a lack of understanding of Newtonian theories.

In order to master a threshold concept, the theory suggests that students may travel through a tunnel or 'liminal space' (see Figure 4) where they 'get stuck' and may be in a state of uncertainty. Flanagan et al. (2010) define the liminal state as an ever-changing process, where students live with this uncertainty as they search for an understanding and begin to focus in on the concept.

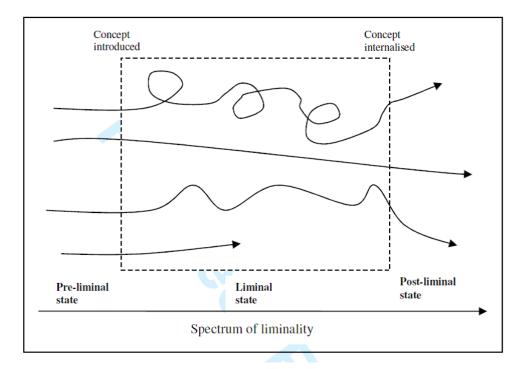


Figure 4 Liminal Space, Harlow et al (2011, p2)

Students adopt a range of strategies to cope with threshold concepts. Mimicry (Harlow et al., 2011) is often used by students and results in a situation where the students may appear to have understood because they can repeat the information verbatim, but then



this apparent understanding breaks down when the student is required to use the knowledge in practice.

#### 1.2 Identify threshold concepts in your subject

The following table lists a few of the threshold concepts that have been identified alongside examples of the types of misunderstandings students demonstrate:

**Table 1 Threshold concepts** 

Subject	Threshold concept	Student misunderstand	ings
Biology	Photosynthesis	Photosynthesis as consul	mption
		A product's reaction to su	ınlight
Biology	Evolutionary theory	Macro evolution	
		Timeframes in evolution	
		Transfer of genetic chara-	cters
		Understanding nature of	science
Chemistry	Acids, bases and	Describing neutralisation	
	neutralisation	Strength of acids	
Chemistry	Atoms and atomic structure	Atomicity	Animism of atoms
		Chemical equilibrium	Probability in
		Chemical bonding	atomic structure
		Intermolecular forces	Size of atoms
		Energy quantisation in atomic structure	Structure/shape of atoms
			Weight of atoms
Chemistry	Ideal gas equations	Gas volume calculations	
		Pressure volume	
		Temperature relationship	
		Unfamiliarity with thermoo	dynamics
Computing/	Java programming	Boolean conditions	
Technology		Iteration: loops or repeat, starting value; what goes versus for loops	
		Selection	
		Understanding a problem	
		Writing a trace table	
Computing/ Technology	Polymorphism: Object oriented programming	Inheritance, loose couplin binding, abstraction, relat	
Physics	Heat transfer	Mathematical formalisatio functions	n, equations,
Physics	Magnetism	Charge distribution	



		Coulomb's third law
		Induction
		Charge and electric field
		Magnetic field
		Magnetic force
Physics	Potential difference	Electrons carry positive charge
		Current is related to potential energy
		Voltage and current are the same
Pure Maths	Complex numbers	Real numbers
		Imaginary numbers
		Square root
		Abstraction
Maths	Limit	The limit of ratio $\sin \times / \times$ is 1, as $\times$ tend to 0, suggesting $0/0 = 1$
		Limit as infinity

You may already know some threshold concepts in your subject area. In Activity 1 you will conduct a search which will help you to confirm the threshold concepts you know about or help you find some new ones.

#### Activity 1 Identify threshold concepts in your area

Allow approximately 10 minutes

Use a search engine such as <u>Google Scholar</u> to search for literature on threshold concepts in your subject area. Find four examples of threshold concepts then make a note of the threshold concepts and related student misunderstandings in the table below.

#### Table 2 Examples of threshold concepts

Provide your answer	
Trondo your anonom	
Threshold concept	Student misunderstandings
1	
Provide your answer	Provide your answer
2	
Provide your answer	Provide your answer
·	



Provide your answer	Provide your answer
4	
Provide your answer	Provide your answer

## 1.3 Reflect on your personal experience of threshold concepts

Apart from the actual threshold concepts you found in Activity 1, think about other concepts that you have encountered in either your teaching practice (things that have been difficult to get across to your students) or your personal learning (the things that you have found difficult to understand).

Do any of these concepts match the criteria for being a threshold concept?

#### Activity 2 Map characteristics onto your threshold concepts Allow approximately 20 minutes

List the concepts you have identified alongside whichever defining characteristic(s) you think applies to them. Use the five criteria used to identify a threshold concept identified in the 'Innovating Pedagogy report' (see further reading at the end of the week). The criteria are:

- Transformative once understood, a threshold concept may potentially cause a significant shift in the perception of a subject (or part thereof); sometimes it may even transform one's personal identity.
- **Irreversible** it is unlikely that a threshold concept is forgotten or unlearned once acquired due to transformation.
- **Integrative** a threshold concept is able to expose 'the previously hidden interrelatedness of something'.
- **Bounded** a threshold concept can have borders with other threshold concepts which help to define disciplinary areas.
- **Troublesome** threshold concepts may be counter-intuitive (moving against and beyond a common-sense understanding towards an expert understanding)

Please note that if you save your responses here, they will be available later in Activity 4.

Provide your answer...

Provide your answer...



# Table 3 Difficult concepts Your subject: Provide your answer... Concepts you have identified as difficult Threshold concept criteria 1 Provide your answer... Provide your answer... Provide your answer...

Provide your answer...

Provide your answer...

3

4



## 2 Tricky topics as a practice-based application of threshold concepts

Tricky topics are a practice-based application of threshold concepts. The term 'tricky topic' emerged from a European project called JuxtaLearn which was investigating the use of creative video-making by students as an intervention to help them overcome the barriers presented by threshold concepts. Initial workshops were held with science teachers to explain the aims of the project and how to identify threshold concepts, very much as you have been presented with information at the start of this week's work. The teachers were encouraged to focus on the examples of student misunderstandings they encountered in their practice, either in direct face-to-face teaching or in homework. The initial reaction of teachers was to say that everything was a threshold concept, because all topics presented challenges, though clearly this was not the case. Using the threshold concept criteria, the teachers then identified three initial threshold concepts in secondary school science which were:

- Chemistry moles
- Physics potential difference
- Biology Alleles or cells (for students who hadn't yet studied Alleles)

The teachers then focused on and identified discrete elements within each threshold concept that caused problems for the students. They mapped out these elements using paper and pen. One of the Chemistry concept maps for moles is shown below.

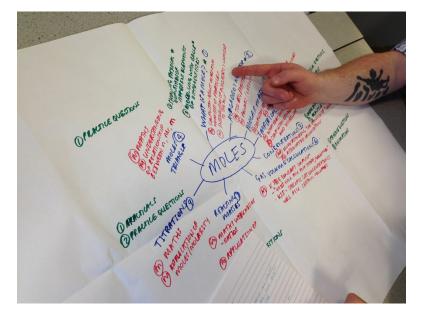


Figure 5 Teacher's mind map of the threshold concept moles

At the suggestion of the teachers, threshold concepts were referred to as 'tricky topics'. This fulfilled two goals. It framed the research in language that was familiar to both teachers and students, making it much easier to explain. It also removed the restriction on what difficult topics the project could engage with. The teachers pointed out that some of the tricky topics they struggled with year on year were not actually full-blown threshold



concepts, however it would be of great use to them if they could help their students overcome those barriers.

Thus the term 'tricky topic' was adopted to refer to any troublesome topics as identified by teachers and practitioners. Such topics may not have been given the status of 'threshold concept' by academics but as practitioners have identified these topics, they merit attention. The students in the project were then helped to overcome the barriers to understanding these tricky topics by being encouraged to use creative video-making to explain their understanding to others, thereby revealing the gaps in their understanding. You will meet these video making interventions again in Week 6.

Below is a video on tricky topics to help your understanding. In this short video, which talks about the JuxtaLearn project, a maths teacher explains how tricky topics have successfully underpinned a process that used creative video-making as the intervention to help students understand long division in mathematics.

#### Activity 3 Tricky topics video

Allow approximately 5 minutes

Watch Video 1, which is about the JuxtaLearn project and its use of tricky topics.

Video content is not available in this format.

Video 1 JuxtaLearn project



#### 2.1 Identify your tricky topics

In the next activity, you will review the threshold concepts you have found in the literature and assess whether these concepts would be useful tricky topics.



#### Activity 4 Identify your tricky topics

Allow approximately 10 minutes

Refer back to your list of difficult concepts from Activity 2. If you saved your responses in Activity 2, they will appear in Table 4 below. State in the last column whether you think it is a tricky topic.

#### Table 4 Difficult concepts revisited

	Υοι	ur subject:		
	Di	isplay of content entered previously		
		Concepts you have identified as difficult	Thresh	old concept criteria
	1	Display of content entered previously	Displa	y of content entered previously
	2	Display of content entered previously	Displa	y of content entered previously
	3	Display of content entered previously	Displa	y of content entered previously
	4	Display of content entered previously	Displa	y of content entered previously
-				



#### 3 This week's quiz

Check what you've learned this week by doing the end-of-week quiz.

Week 1 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



#### 4 Summary of Week 1

In this week you have been introduced to threshold concepts. You should now understand what constitutes a threshold concept, and why this is a problem for both students and teachers. You have also seen that some topics present a threshold concept for many students, yet other seemingly equally complex topics do not. You have also been introduced to tricky topics which are the practical application of threshold concepts. Hopefully you now have an idea of the threshold concepts and tricky topics in your subject area. In Week 2 you will learn more about tricky topics, what they consist of and how they can be identified, laying down the foundations for the rest of the course.

You should now be able to:

- understand what constitutes a threshold concept, and why this is a problem for both students and teachers
- · see how the term 'tricky topics' relates to threshold concepts
- begin to consider tricky topics in your subject area.

In Week 2 you will learn more about tricky topics, what they consist of and how they can be identified, laying down the foundations for the rest of the course. You can now go to Week 2.





# Week 2 Identifying tricky topics

#### Introduction

As you saw in Week 1, **tricky topics** are the practical application of **threshold concepts** and their theoretical underpinning. Your understanding of tricky topics will be developed over weeks 2 and 3 by identifying and breaking down tricky topics in practice and the tricky topic process. You will learn the many ways in which you can identify tricky topics and the problems that students have in understanding them. You will know many ways of finding out why students have problems with them. You will then be in a position to begin to think about how to design learning to specifically overcome them (in Week 4).

In this week, you will consider what makes tricky topics tricky. Why are these topics so difficult to learn and teach? This week you will see how tricky topics are made up of several assessable parts (which are referred to as **stumbling blocks**) and how each of the stumbling blocks can be identified and constructed from students' specific problems in the topic. The students' problems (which are referred to as **problem examples**) highlight their misunderstanding of the tricky topic in general and may identify one or two of the stumbling blocks in particular. You will learn how the students' problem examples can be grouped together to form stumbling blocks or visa-versa, and how stumbling blocks can be defined by many problem examples.

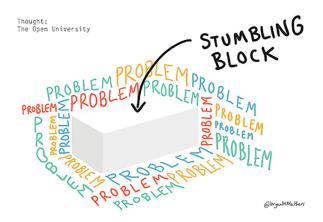


Figure 1 Stumbling block cartoon

By the end of this week you should be able to:

- identify tricky topics and their key components
- conduct a mini 'needs analysis' to identify students' problems in tricky topics



- use the 'problem distiller' to examine why students have these problems
- begin to appreciate the relationship between stumbling blocks and students' problem examples.



#### 1 What are tricky topics again?

Tricky topics are topics which contain difficult concepts that students struggle to understand and which teachers find difficult to teach. Some of the tricky topics will be full-blown threshold concepts (identified according to the complex theories you read about in Week 1 and once learned will be transformative for the student) but others will not. You can find some of the tricky topics through existing literature in your subject area or through your own teaching experience. For some subject areas, personal experience may be all there is, because relevant literature on the topics which students find difficult, may not exist.

Here are some definitions for the terms that are used in this course:

**Tricky topics:** Topics which are challenging concepts that students find hard to learn and teachers find difficult to teach. They may also be threshold concepts (which once learned are transformative).

**Stumbling blocks:** Identifiable and assessable component parts of a tricky topic which are common to a variety of students' problems. You would expect to find at least three or four key stumbling blocks in a tricky topic but there may be as many as six.

**Problem examples:** Examples of the problems students have which display their misunderstanding of the tricky topic and are symptoms of one or more stumbling blocks in that tricky topic.

**Problem distiller:** Classification table which helps you to identify why students have specific problems in tricky topics.

Figure 2 is a structure chart of a tricky topic which shows the relationship between these terms. This chart shows that students' problem examples can be related to more than one stumbling block and stumbling blocks can have more than one problem example. What is not clear from this diagram is that each stumbling block usually has many problem examples (by definition).

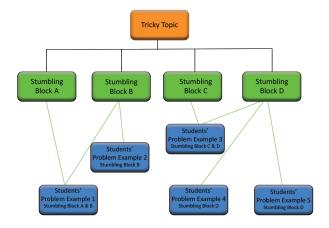


Figure 2 Template structure of a tricky topic

Figure 2 represents a template, now let's look at a real example. Figure 3 shows the tricky topic of Moles in Chemistry. Interestingly Moles is also a threshold concept which you met in week 1. You will see many more interesting tricky topics as you work through this course.



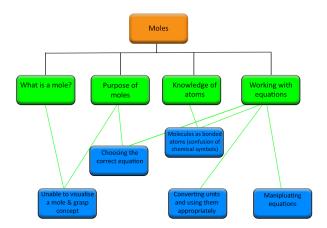


Figure 3 Example of tricky topic – moles

Figure 2 illustrates the connections between tricky topic, stumbling blocks and students' problem examples. Figure 3 provides concrete examples from the tricky topic moles to show how each problem example may be linked to more than one stumbling block. Before investigating how to define tricky topics further it is important to discuss how to find out what students understand or misunderstand about tricky topics in order to define those stumbling blocks and problem examples. Section 2 explains how you can conduct a needs analysis that is tailored to identifying and capturing details of your students' misunderstandings.



## 2 What is it that students don't understand?

Identifying what tricky topics exist in any particular subject area can be very difficult, even for teachers who appear to understand their students' learning needs in great detail. Teachers often feel frustrated when trying to understand their students' difficulties, saying:

'I just don't understand why they don't understand'



Figure 1 (repeated from Week 1) I don't understand

Through the work with teachers, the tricky topics that drills down to the causes of student misconceptions and helps teachers target their teaching interventions so that they make a difference. The first step in this process is to work out what it is that the students are struggling to understand. This can be done through a 'needs analysis'.

## 2.1 Using a needs analysis to identify misunderstandings

One way to overcome the frustration of not knowing why your students just do not understand a tricky topic, is to conduct a focused 'needs analysis' to identify their misunderstandings. In the context of tricky topics, the misunderstandings are specific to each student, therefore the needs analysis will take the form of discussions or semi-structured interviews with focus groups of students in order to draw out these misconceptions. It could be considered as a **diagnostic step** in developing a deeper understanding of your students' needs and is therefore a valuable first step in the tricky topics process (i.e. a series of steps to unpick the tricky topics which will be explained further in Week 3). As an experienced teaching practitioner, you may already feel that you understand your students' needs very well. However, there may be areas where students are having difficulties understanding which have not yet become obvious. Consider this section an opportunity to have a fresh focus on your students' understanding.

This step of understanding your students' needs feeds directly into the tricky topic process. The process involves understanding learning needs, then planning and designing your learning intervention according to those needs and then assessing students' progression to assess if those needs have been met and there is a deeper understanding of the difficulties (see Figure 4).



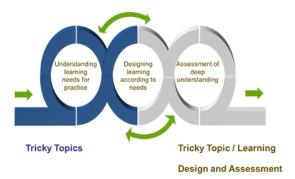


Figure 4 Tricky topic process cycle

When looking at your own practice and reflecting on it, this clearly links with wider research cycles that you find in action research and the related method of practitioner inquiry (see Figure 5).

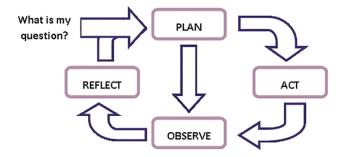


Figure 5 Practitioner inquiry cycle (adapted from Reason and Brandbury 2001)

As you can see from Figure 5, a needs analysis with your students must be planned, conducted, observed (i.e. analysed) and then reflected upon. If you already have a detailed understanding of your students' needs it could be that you can use the planning stage to record this understanding and move directly to observing/analysis which is the process of identifying tricky topics, stumbling blocks and problem examples as shown earlier, and in Week 3 activities.

#### 2.2 Preparing a needs analysis

To conduct a needs analysis with students there are several key points that need to be considered. For a detailed description of how to collect students' needs and understanding it would be good to read Adams and Cox (2008):

'Questionnaires, in-depth interviews and focus groups'

This paper details key tips on how to capture accurate information when talking to students. They are in reference to both face to face and digital interactions which could be applied when interviewing an individual or a group. The tips below have been restructured from this paper to focus specifically on students of all ages. Tips for accurately capturing students' misunderstandings:

- Focus on the students as learners, not on you as teacher, so they should do most of the talking. You should talk at most for 5–15 per cent of the time.
- Keep students focused, not allowing them to drift off topic (more likely in a focus group than with an individual).



- Be flexible about their responses to questions. Don't restrict them to answering
  questions in the order they have been asked. This is more important for younger
  students or for those students with less confidence.
- Ensure all students speak equally in a focus group by not allowing a dominant personality to steal the limelight by giving you all the answers.

As a teacher you ask questions all the time, but asking students 'needs analysis' questions is particularly difficult. You are not assessing the students, merely finding out about their understanding or more importantly, their misunderstanding. The guidance below has been provided by experienced teachers in order to alleviate some of the issues that have been identified as problematic in conducting needs analyses:

- Ask open questions which allow students to talk in their own words. So, don't ask leading questions which contain hints or closed questions which can receive simple yes/no responses. Allowing them to talk freely in their own words frequently reveals their depth of understanding without mimicking what they think they should say. This is especially true for younger or less experienced students who can feel less confident in using their own words in a subject they feel the teacher 'owns'.
- Ask questions that probe without prompting for a response. If a student gives a vague response ask them to qualify it (e.g. 'What do you mean by that?'), but don't give them a response to agree to (e.g. 'Do you mean this...?'). Once again this is especially true for younger or less confident students who may say yes to fulfil what they think is the 'right' answer from a teacher.
- Ask students to clarify what they mean when they use jargon as they may be using it
  without understanding its true meaning.
- Remember that there are no right or wrong answers in a 'needs analysis' as it is only
  the students' understanding you want to hear (however far that is from the correct
  meaning).
- Be careful not to give the student *your* view on the topic as this can lead towards a teaching session and will not elicit the students' own ideas on the topic. This may be the hardest thing to remember as a teacher but the teaching must be left to a later point in time so that the students feel free to give you their 'real' understanding (or misunderstanding). However, open debate among students in a focus group who disagree on a topic can be enlightening (if managed well).

The next section provides some guidance on methods for collecting data from your needs analysis.

#### 2.3 Planning an effective needs analysis activity

When conducting a students' needs analysis in order to identify their (mis)understandings it is useful to consider how you are going to:

- 1. structure an activity to best capture students' thoughts
- 2. record the students' thoughts and understanding
- 3. analyse those thoughts.



#### Structuring to capture students' thoughts

Students are most likely to provide their own thoughts, views and potential (mis) understandings if they are engaged in an activity which will stretch their understanding of difficult concepts. Your questions should then tease out students' thoughts while they are busy with the activity.

For example, the following table (Table 1) of items was made into a set of cards by science teachers and given to secondary school children to establish (mis)understandings about living things. The students were asked to group the cards into living and non-living and then asked to explain why they have grouped the cards in that way.

Table 1 Alive or not cards

fire	water	tree	wood
egg	baby	monkey	worm
flower	cactus	wind	nut
meerkat	jellyfish	bee	elephant

It is important to emphasise before the task that this is not a test and that you are only interested in what they **think**. The students should be prompted where necessary with non-leading questions such as, 'That's interesting – can you say why?' and 'You said ... that's interesting, can you say more?'

#### Recording students' thoughts

Table 2 looks at the different methods of recording student's views.

#### Table 2 Recording students' views



Figure 6

It is important to consider how to record students' thoughts so they can be fully analysed. There are many ways to do this, such as writing notes as they talk or audio-recording the discussion. However, it is worth bearing in mind that it is difficult to effectively write down what is said while also paying attention to what students' are saying. It can also be off-putting to students if you are writing rather than engaging with what they say.



Figure 7

Audio-recording or video-recording. The discussion can be less intrusive but the student will know you are recording them and this may be a distraction, especially if it involves a video recorder. With most mobile phones now supporting audio-recording, it has become a lot easier for teachers. Transcription into a textual document is not essential, although this obviously makes it easier to read and review. There may, of course, be ethical issues associated with recording students (whether over or under 18 years of age), especially if using video and you will need to check requirements for your particular organisation and circumstances.

Once you have collected understandings from your students you need to identify key points which will provide the tricky topics, stumbling blocks and problem examples.

#### Analysing thoughts

There are four very broad steps that will help you to review your information:



**First Step:** When listening to a recording or reading a transcript / notes it is important to **consider** that when students describe their understandings they often talk about specific examples rather than broader terms. It is these specific examples that are referred to as problem examples. When many students give examples of problems with one particular concept, then this concept will probably relate to a tricky topic you need to cover.

**Second Step:** Discuss these tricky topics with your colleagues to get their feedback on how tricky their students have found these topics. Also it is useful to search for literature about these topics and for comments from other teachers about how tricky these topics might be in other contexts. You will see other methods of collaborating using the tricky topic process in Week 3.

**Third Step:** Next you should review the students' examples of (mis)understandings and try to group them together in a way that helps you to understand them. This could be around causes, or some aspects of the student's needs, or specific elements of the topic they misunderstand (more about this in Section 3.2 the problem distiller is introduced). This can also be done collaboratively using the tricky topics process (see Week 3).

**Fourth Step:** It is then useful to put a short label (of a few words) to those groups of students' problem examples that fit together in some way. These labels will probably form the stumbling blocks within a tricky topic.

Now, try to conduct your own needs analysis. You may wish to do a full needs analysis on students that you teach and this would be very worthwhile but obviously very time-consuming. The activity below is a mini needs analysis and should only take you about an hour to complete, although the analysis may take longer.

#### Activity 1 Conduct a mini needs analysis

Allow approximately 60 minutes

Use the principles in 2.1, 2.2 and 2.3 to conduct a mini needs analysis to uncover misunderstandings about a tricky topic in your subject area.

If you are a practising teacher you may wish to interview one or more of your own students or do an activity in class which will identify misunderstandings of a potential tricky topic in your subject area. If you do not have access to students you could conduct a mini needs analysis on colleagues, friends or family members.

If you have no topics or activities of your own, you may wish to base your questions around an activity using the cards for 'living things' above. If so, you should know that the UK Secondary, Key Stage 3, definition of living is as follows 'Living things are organisms that display all of the following: respiration, reproduction, growth, excretion, movement, sensitivity and nutrition'.

Remember to tell your participants before the task that it is not a test and that you are only interested in what they **think**. Also remember that your role as interviewer is to prompt with non-leading questions and never to give hints.

Write a list of students' (colleagues'/friends'/family's) thoughts and misunderstandings (problem examples). You will use this list next week.

Provide your answer		



Armed with students' thoughts and (mis)understandings, you can start to analyse the tricky topics into their component parts. The following section will delve more deeply into how you can categorise tricky topics in order to help you break them down into identifiable, assessable parts in preparation for designing the learning to overcome the difficulties.



#### 3 Categorising trickiness in tricky topics

In this section you will learn how to classify students' problems in tricky topics according to **why** they are tricky.

Classification of any items into groups can be difficult as there are always different ways of looking at something, especially if there is not a clear definition to follow. You will find later that grouping problem examples into stumbling blocks is not a straight forward business either.

Look back at the <u>'living things' example</u>, can you think of some of the problems that students might have in understanding the concept of 'living'? Here are a few reasons why students may mistakenly think that these 'non-living' items are alive.

Table 3 Reasons for student errors

Non-living item	Reason why students may think they are alive	
Fire	'We talk about living flames. The flames dance around and fire crackles and uses oxygen to burn which is like food.'	
Water	'Water flows and is made up of oxygen and hydrogen and it is forceful.'	
Wind	'The wind moves and it can make things fall over. It often makes a lot of noise. It has force and carries particles with it.'	

Some of these misunderstandings of living things may be due to a lack of underpinning knowledge in Biology or Chemistry, or they could stem from different cultural or spiritual beliefs. Other misunderstandings may be due to specific beliefs about how the world works which may have been held since early childhood. Students' problems can be classified according to 'why' they don't understand.

#### 3.1 Why are tricky topics tricky?

In Week 1, you saw that threshold concepts focus on cognitive understanding so it will be no surprise to learn that students' misunderstandings in tricky topics are also focused on cognitive (thinking) understandings, rather than affective (emotional) or behavioural (environmental) issues.

For example, in a mathematical tricky topic such as 'manipulating decimals', students might have cognitive misunderstandings about 'decimal places' or 'use of significant figures'. These two problems could be considered as key stumbling blocks of that tricky topic. However, 'fear of mathematics', although perhaps present in some students, would not be a specific stumbling block, because it is an affective (or emotional) problem, not a cognitive problem.

Again, following the links to threshold concepts, students' problems can be categorised according to the theory behind **why** they have these difficulties in understanding the tricky topics. As tricky topics are a practical form of threshold concepts, the categorisation of them is more practical than the complex theories behind threshold concepts.

Based on a simplified criteria from the original threshold concept theory, there are four main categories used to identify why students have problems in understanding tricky topics as follows:



- 1. incomplete or flawed prior knowledge
- 2. lack of linked concepts
- 3. terminology
- 4. intuitive belief

#### 1) Incomplete or flawed prior knowledge

Students may lack an understanding of, or have an incomplete or flawed understanding of underpinning topics, or scientific method, process or discourse. For example, to understand genetic drift in Biology, students would need a prior knowledge of the process of natural selection. Similarly, in mathematics, students cannot understand scientific notation such as  $6.022 \times 10^{23}$  if they do not understand powers, decimal places or multiplication. Also, thinking they understand when their prior knowledge is flawed can lead students to poor causal reasoning and incomplete conceptualisation (Coley and Tanner, 2012; Keleman et al., 2012). Sometimes flawed knowledge would need to be unlearned before the new knowledge can be accepted.

#### 2) Lack of linked concepts

There are chunks of information that students need to learn alongside the tricky topic (so should be taught at the same time). They are smaller, effectively 'sub-concepts' that a student needs to understand in order to grasp the overall tricky topic. Institutional factors might influence how students understand the tricky topic, depending on whether and how these sub-concepts that are closely linked with the topic, have been explained. Without those linked sub-concepts the new knowledge may appear alien. For example, a student believing that fire is alive may be unaware or confused about the formal definition of living or have an alternative belief system. Similarly, when learning about potential difference in Physics, students also need to know about current, volts, voltage and Ohm's law.

#### 3) Terminology

Words, phrases or symbols can be vague, complex or have multiple meanings (such as having both a common meaning and a scientific meaning) which can be confusing and can inhibit understanding. If students are unable to overcome the difficulty of terminology, they may turn to alternative mental models (Harrison and Treagust, 1996) which are flawed. For example, the term 'inheritance' usually means that a child inherits from two parents, but in object-oriented programming inheritance comes from only one predecessor. This causes problems when students later use the term with other related programming concepts.

#### 4) Intuitive belief

The new knowledge may contradict commonly held 'truths' or misconceptions, often held since childhood. These 'truths' are informal, intuitive ways of thinking about the world which may be strongly biased toward causal explanations. In many cases, as students advance in their understanding of science and technology subjects, they may need to grasp principles which are fundamentally counter-intuitive. Inaccurate presumption of



cause and effect can lead to assumptions of meaning. For example, fire moves, crackles and uses oxygen therefore it must be alive or birds have wings so all creatures with wings must be birds. Such issues can also occur if real-life analogies which have been taught previously are too simplistic or flawed.

The next section takes a look at how these categories can be arranged into a problem distiller table.

#### 3.2 Problem distiller

These categories have been compressed into a table called the problem distiller (see Table 4). The problem distiller helps drill down to the reasons that underpin a student's misconception which, later on, helps guide the development of an effective teaching intervention.

Table 4 The problem distiller

Categories	Explanations for lack of understanding of new knowledge
Incomplete or flawed prior knowledge	a) Prior underpinning knowledge, assumed to be known, is missing or incomplete.
	b) Prior underpinning knowledge is flawed and may need to be 'unlearned' to allow new knowledge to be acceptable.
2) Lack of linked concepts	a) There is a misunderstanding of linked concepts so new knowledge appears confusing.
	b) Complementary concepts, learnt at the same time for cohesion, are not linked or not taught so new knowledge appears alien.
3) Terminology	a) Word, phrase or symbol is alien, vague or complex.
	b) Multiple meanings for same word, phrase or symbol.
	c) Multiple words, phrases or symbols with similar meaning.
4) Intuitive belief	a) New knowledge contradicts commonly held 'truths' or misconceptions.
	b) Real-life analogy is too simplistic or just wrong.
	c) Flawed causal reasoning.
	d) No immediate real-life analogy.

The problem distiller can be used to classify students' problem examples. For example, 'birds have wings therefore all creatures with wings are birds' is an intuitive belief because it could be classified as 4c (flawed causal reasoning). Some students' misunderstandings will have more than one classification. For example 'fire is alive' will be 'intuitive belief' and 'lack of linked sub-concepts' as it would be classed under 4a) as this is a 'truth' and 2a) or 2b) as the student may not know or understand the definition of 'living'.

This adds one more level to our structure of tricky topics. See Figure 8.



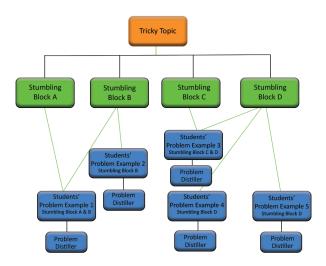


Figure 8 Structure of tricky topics including the problem distiller

# Activity 2 Categorising students' misunderstandings Allow approximately 10 minutes Look back at the example tricky topic of moles in Figure 3. Using the problem distiller (in Table 4) can you think of reasons why the five problem examples may be problems? Provide your answer... Answer See our answer below Moles Working with equations Working with equations

Figure 9 Structure of moles tricky topics including the problem distiller

From what you have seen so far the relationship between stumbling blocks and their problem examples may seem quite straight forward. However, that is not always the case. As you saw with the living things (Activity 1) there are many ways to group items, which



will depend on your perspective and the definition you seek. The key thing about stumbling blocks is that they are common to many problem examples and are assessable. However, the process of definition is recursive and a problem example may become a stumbling block for a different set of students and similarly a stumbling block may become a tricky topic, depending on the level required.

# 3.3 Identifying stumbling blocks

Now watch this video of trainee teachers talking about the problems that students have with the tricky topic of optics and ray diagrams. They are discussing the problem examples and stumbling blocks for this particular tricky topic.

Video content is not available in this format.

Video 1 Optics and ray diagrams

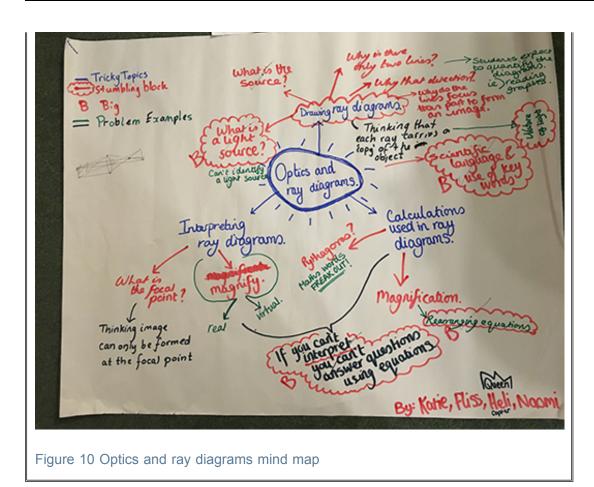


#### Activity 3 Mind maps

Allow 15 minutes

Here (in Figure 10) is the mind map which was drawn by the teachers in Video 1. Can you see how they have grouped the problem examples into stumbling blocks? It's clearly not straightforward is it?





You will meet this mind map again next week when you will learn more about the relationship between stumbling blocks and problem examples in the tricky topics process.



# 4 This week's quiz

Check what you've learned this week by doing the end-of-week quiz. There are five questions in this quiz. Some require you to pick one or more options, some to match against drop down options and some a few words.

Week 2 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



# 5 Summary of Week 2

In this week, you have begun to identify what makes tricky topics tricky. You have learned how to carry out a needs analysis in order to identify students misunderstanding of a tricky topic and you have seen how tricky topics are made up of several assessable parts. You've seen how these assessable parts are called **stumbling blocks** and that each stumbling blocks can be identified and constructed from students' specific problems in the topic **problem examples**. You have used the problem distiller to examine why students have these problems and begun to appreciate the relationship between stumbling blocks and students' problem examples.

You should now be able to:

- identify tricky topics and their key components
- conduct a mini 'needs analysis' to identify students' problems in tricky topics
- use the 'problem distiller' to examine why students have these problems
- begin to appreciate the relationship between stumbling blocks and students' problem examples.

Armed with a knowledge of the difficulties that students have in tricky topics, you are now in a better position to be able to identify and break down tricky topics in practice in order that they can be dealt with appropriately. Next week you will see how to break them down effectively and use the tricky topic guide, a dedicated website which helps teachers to get to grips with the tricky topics process. Now go to Week 3.





# Week 3 The tricky topics process

# Introduction

In this week, you will build on the knowledge of tricky topics that you gained in Week 2 by extending your knowledge of the relationship between problem examples and stumbling blocks and classification of problems according to the problem distiller. You will use the dedicated website for tricky topics, the Tricky-Topics-Guide and the sharing platform IRIS Connect, to develop your understanding of how the teaching tricky topics process works in practice and to use its resources.

By visiting the tricky topics website and IRIS Connect, you will see how teachers can come together in different ways to identify and capture tricky topics and their stumbling blocks.

By the end of this week you should be able to:

- identify stumbling blocks and problem examples and vice versa
- understand how the tricky topic process works to improve the teaching and learning of tricky topics
- understand the different ways that the tricky topics process can be conducted
- provide feedback of your experiences to IRIS Connect.





Figure 1 Teaching tricky topics



# 1 Stumbling blocks and problem examples

In Week 2 you learned how to identify students' problems in a tricky topic from a needs analysis and began to see how those problem examples could be grouped into stumbling blocks, the assessable component parts of the tricky topic. You also learned how to classify problem examples according to the problem distiller.



Figure 2 Change the way you teach cartoon

Let's look into this a little more. Begin by identifying the stumbling blocks in the tricky topic of project planning for teaching. This is an example of a tricky topic which has been identified by staff in a Higher Education Institute. Remember, **stumbling blocks** define key issues, whereas **problem examples** are detailed descriptions of the specific problems that students (or in this case other staff in the institution) are having. Stumbling blocks are referred to as SBs below to keep descriptions short.

# 1.1 Tricky topic of project planning

In this project planning tricky topic example, there are four stumbling blocks with at least one problem example underneath each. You may not understand the topic yourself but you should be able to see the four stumbling blocks.

The stumbling blocks and problem examples are shown below:

- SB1: understanding the value of project planning
  - problem example: funder doesn't expect a plan
- SB2: knowing how to plan effectively
  - problem example: planning done in isolation
  - problem example: non-delivery of key items
- SB3: conflicting need for control
  - problem example: loss of control
- SB4: perception of responsibility
  - o problem example: it's not my role

In effect, the problem examples are the symptoms, and the stumbling blocks represent the cause. Addressing the cause, i.e. helping the student overcome the stumbling block will alleviate the symptoms, i.e. eliminate the problem example. So, for problem example 'non delivery of key items' addressing SB2 'knowing how to plan effectively', will help eliminate non-delivery of key items.



This tricky topic can then be structured using the structures in Week 2, in the form shown in Figure 3:

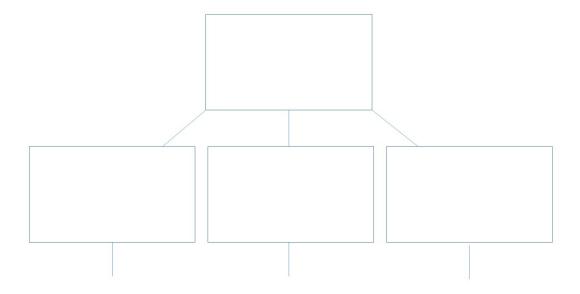


Figure 3 An example structure for identifying a tricky topic

#### Activity 1 Structuring tricky topics

Allow approximately 20 minutes

Sketch the structure of the stumbling blocks and problem examples into the tricky topic structure. This is the beginning of the structures that were used in  $\underline{\text{Week 2}}$ . In the next part of this activity you will be using the IRIS Connect platform.

IRIS Connect is an online platform created to empower teachers to reflect on, analyse and collaborate through video technology. The platform allows you to develop your understanding of the tricky topic process through example videos from workshops and provides a space in which you can share, discuss and collaborate with other teachers and learners. It uses secure, cloud-based storage for you to share your on-going tricky topic process.

- 1. Go to the IRIS Connect website.
  - b. If you do not have an account with IRIS Connect, you can create a free account here.
  - c. If you already have an account with IRIS Connect, you can log-in and go straight to the '<u>Teaching and learning tricky topics</u>' Group or go to the groups tab > followed by the group store to find the 'Teaching and learning tricky topics' group.
- Once you've created your account and you are on the homepage, go to the groups tab > followed by the group store to find the 'Teaching and Learning tricky topics' group.

On the 'Teaching and Learning Tricky Topics' Group on IRIS Connect (see Week 3, Activity 1) you will see the video and mind map from Week 2, Activity 3. Reviewing this example may help you to formulate your ideas and see how the process is conducted in practice.



Share your reflections of the video with other teachers using the discussion box on IRIS Connect. Towards the end of the course you will see how you begin to consider sharing your own reflections using this platform.

#### Answer

Here is the structure in reality. Did you realise that some of the problem examples may be connected to other stumbling blocks?

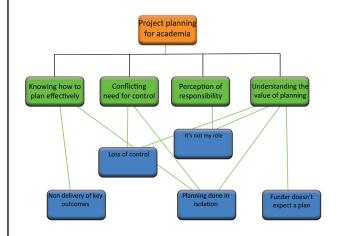


Figure 4 tricky topic structure and problem examples for academia

#### Atomic structure theory

Let's now look at another tricky topic. This time it is atomic structure theory. Again, this may not be a topic that you are familiar with but see if you can recognise the stumbling blocks.

#### Activity 2 Finding more stumbling blocks

Allow approximately 10 minutes

In this atomic structure theory tricky topic, there are four stumbling blocks with at least one problem example for each. Can you tick the four stumbling blocks?

- □ Understanding energy levels.
- □ Difficulty in explaining bonding and chemical reactions and how to predict reactants and products.
- □ Unable to grasp that subatomic particles are attracted and repelled by each other.
- □ Understanding space in atomic model.
- □ Difficulty in seeing trends and differences in groups and periods in the periodic table.
- □ Visualisation of atoms and subatomic particles.
- □ Difficulty using terminology to describe the subatomic model e.g. atomic number, relative atomic mass.
- Understanding charges in atoms.



- □ Inability to recognise charges of protons, neutrons and electrons.
- Difficulty seeing that atoms have different sizes and mass.

#### Answer

In Table 1 you see the stumbling blocks highlighted. You may have found it difficult to see them initially but once you see them highlighted they begin to make sense.

# Table 1 Atomic structure theory tricky topic stumbling blocks identified

#### SB1: understanding energy levels

Problem example: Difficulty in explaining bonding and chemical reactions and how to predict reactants and products.

Problem example: Unable to grasp that subatomic particles are attracted and repelled by each other.

#### SB2: understanding space in atomic model

Problem example: Difficulty in seeing trends and differences in groups and periods in the periodic table.

#### SB3: visualisation of atoms and subatomic particles

Problem example: Difficulty using terminology to describe the subatomic model e.g. atomic number, relative atomic mass.

#### SB4: understanding charges in atoms

Problem example: Inability to recognise charges of protons, neutrons and electrons.

Problem example: Difficulty seeing that atoms have different sizes and mass.

Here is the structure chart for those stumbling blocks and problem examples in the atomic structure theory tricky topic. Unless you are a science teacher you would not be expected to be able to link the problem examples to all the stumbling blocks but this is something you should be able to do in your own subject.

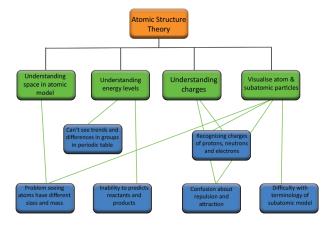


Figure 5 Atomic Structure stumbling blocks and problem examples

This structure is becoming quite complicated isn't it? In actual fact there are many more problem examples that define these stumbling blocks so you can imagine that if you tried



to include them all, that this structure would become very complex indeed. In Section 3, you will find another structure which is used as part of the tricky topics process and will help you to structure your own tricky topic.



# 2 The tricky topics process

Armed with a knowledge of the difficulties that students have in certain topics and having learned the difference between a tricky topic, a stumbling block and a problem example, this section will look at how you actually go about identifying and breaking down a tricky topic in practice in order to deal with it appropriately.

The tricky topics process has three main stages:

- **Identify:** a set of collaborative group activities in which teachers will be encouraged to think of a tricky topic and break it down into assessable parts.
- Capture: capture the problem examples and use the problem distiller to help to
  uncover why students find these tricky. This helps to define the stumbling blocks in
  more detail in order to be able to assess them.
- Assess: multiple activities to guide teachers to develop interventions which help to
  overcome the stumbling blocks and to create quiz questions which fully assess the
  stumbling blocks and evaluate the intervention.

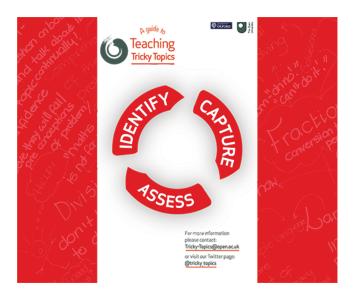


Figure 6 The tricky topic process

In the next activity you will go to the tricky topics guide, the website dedicated to helping teachers (both experienced and trainee) to perform the tricky topics process. You will record your reflections on IRIS Connect.

#### Activity 3 The teaching tricky topics guide

Allow approximately 30 minutes

Go to The tricky topics guide on the website.

Read through the different steps in the tricky topics process. Pay particular attention to Step 3 (Mind Maps).

You can also explore this information on our tricky topics group on IRIS Connect. Just head to the 'tricky topic process' tab.



- Write a few sentences about your thoughts on the tricky topics process (using the questions below as a guide) in the comment box below or on IRIS Connect under Week 3, Activity 3.
- Did it make sense to you?
- Is it something you have done before or something you feel you can do now?
- How could this process be applied to your own practice?
- How does this relate to your experiences previously or your thought about the needs analysis last week?

Did you see the different structure charts in the guide? Did you recognise the optics and ray diagram mind map? The identify and capture stages of the tricky topics process will be used this week, which will take us up to Step 6 in the guide. The Assess stage with its interventions and quizzes will be dealt with in the next few weeks of this course.



# 3 Structuring tricky topics

In this section you will learn more about the tricky topics process and how that leads to identifying the structure of a tricky topic and its component parts. You will see some examples of mind maps that teachers have drawn during a tricky topics workshop and how these can be structured using the structured mapping diagram. You will also watch a short video on the difficulties encountered in creating a structured mapping diagram for a tricky topic. You will then be asked to create your own mind map and structured mapping diagram for your tricky topic.

In the tricky topics guide you saw how the identification of tricky topics is a collaborative process in which teachers come together to discuss their thoughts on students' problems in their subject area. They may all have completed their individual 'needs analyses' (see Week 2) or they may be using their teaching experiences and exam results as their basis for knowing what their students' problems are. Either way, they each have a view of what are tricky topics. The mind map is, by necessity, unstructured. It needs to capture all the teachers' ideas, many of which might be missed if they are constrained too soon to think in terms of a pre-defined structure.

However, there comes a point when it is necessary to begin to identify which problems are specific stumbling blocks and which are just examples of problems, symptoms of stumbling blocks. Further still, which are tricky topics in themselves? In Activities 1 and 3 you saw how the structure charts used are not able to clearly show the complexity of the many problems in a real situation whereas the mapping diagram used in the tricky topics guide appears to have a more open format which allows the structure to be created.

# 3.1 From mind maps to structured mapping diagram

In Week 2 you saw a video in which trainee teachers were working out the difference between a stumbling block and a problem example. Let's take another look at the tricky topic that they were working on. First of all, let's look again at the mind map they created while thinking about the problems that secondary students have with optics and ray diagrams. You saw that mind map again in Step 3 of the tricky topics guide. It's shown again in Figure 7:



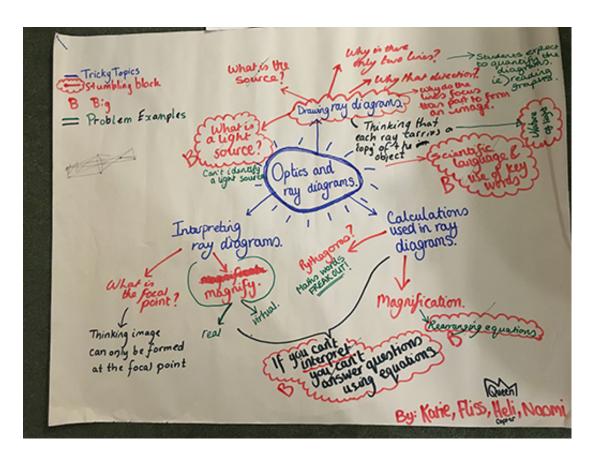


Figure 7 (repeated from Week 2) Mind map of optics and ray diagrams

# Activity 4 Create a mapping diagram from a mind map Allow approximately 20 minutes

Go to the tricky topic website <u>downloads page</u> and download a blank tricky topic structure chart.

You can also download this from the IRIS Connect group under the 'downloadable resources' tab.

If you can print the structure chart out, it may be better to do this exercise by hand. If you do not have a printer, no problem, you can fill in the mapping diagram electronically in the PDF.

Use the mind map created by the trainee teachers and their comments from the video to think about how they formulated that into tricky topic, stumbling block and related problems.

Now, fill in your mapping diagram with the tricky topic, stumbling blocks and problem examples for the optics and ray diagrams tricky topic.



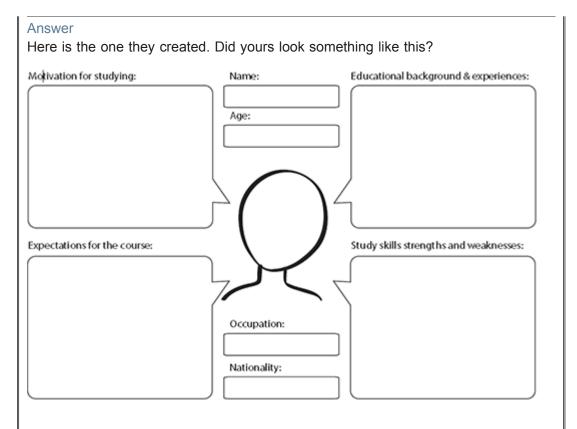


Figure 8 Optic ray diagram map

As you can see, it's not a simple process. It's an iterative process – it may take several attempts before you are happy with what the tricky topic consists of. Remember that some of the problem examples may link to more than one stumbling block. Notice also that they have begun to classify why students may have these problems, using the problem distiller.

# 3.2 States of matter tricky topic

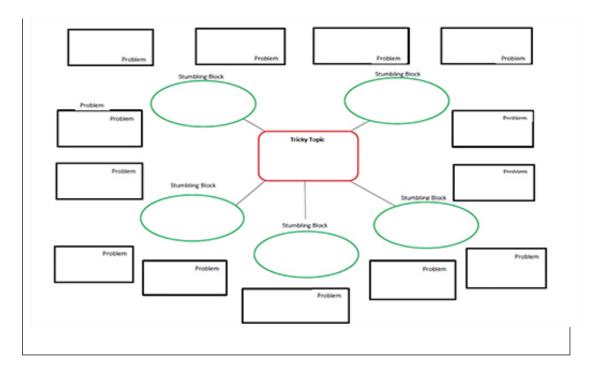
Now watch Video 1, the first part of a mapping diagram for the states of matter tricky topic in which you will see the common mistakes made when mapping specific stumbling blocks and their problem examples. You will meet this tricky topic again in Week 6 but for now it will be useful to know that there are three states of matter: solids, liquids and gases and materials can be changed from one state to another by heating or cooling. The stumbling blocks in this tricky topic have been identified as:

- particle movements in all states of matter
- 'existence' of gases
- differences between melting and freezing
- differences between evaporation and condensation
- differences between heat and temperature.

Video content is not available in this format.

Video 1 States of matter





Now you are in a position to look further into the tricky topic you found from your needs analysis in Week 2.

#### Activity 5 Structure your tricky topic

Allow approximately 60 minutes

- Start by revisiting your list of problem examples from Week 2, Activity 1. If you were not able to share these with colleagues or friends last week, do so now if possible. Try to build your list up with others' ideas. You may want to write these down again in free-form mind-map fashion, along with any other problem examples that you have found in your tricky topic.
- 2. Group your problem examples into stumbling blocks. Using a highlighter or pens, split the list of problem examples into groups according to a common theme. Give names to these groups, which will form your key stumbling blocks that define several problem examples. If a problem does not merge with others it may already be a stumbling block in itself.
- 3. **Capture your structure**. Download a blank tricky topics mapping diagram from <a href="http://tricky-topics-guide.ac.uk/downloads/">http://tricky-topics-guide.ac.uk/downloads/</a> and fill it in.
- 4. Complete your structure by distilling the problems. Use the problem distiller (see Week 2, Table 4) to classify why students have these specific problems in your tricky topic. You can add problem distiller categories to each of the problem examples in the Structure chart you created (see Figure 3 for example) or you could structure your tricky topic like the moles tricky topic which was the solution to Activity 3 in Week 2 (see Week 2, Figure 9).
- 5. Reflect on this activity. Start by answering these questions:
  - How well do the title of your tricky topic and stumbling blocks reflect the problems?
  - How well does your structure reflect your tricky topic?
  - What went well in this process?



- What problems did you have?
- Feedback your tricky topic, stumbling blocks and experiences in structuring to the tricky topics team using the feedback section of IRIS Connect under Week 3, Activity 5.

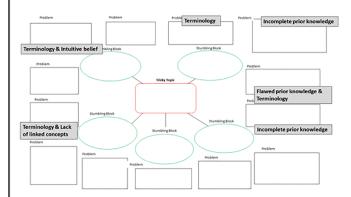


Figure 9 Structure chart with added problem distiller categories

Now sit back and admire your tricky topic structure! You will use this when you design your learning intervention later in the course.

You probably worked alone on the activities in this section and, of course, the tricky topics process can be conducted alone, once the initial needs analysis has been completed. However, as you have seen from the tricky topics guide website, the tricky topics process is normally conducted through a collaborative process in which teachers/practitioners come together to share their knowledge. In the next section you will see the different ways in which the tricky topic process can be conducted collaboratively.



# 4 Different ways of conducting the tricky topics process

As you learned from the tricky topics guide, the tricky topics process works best when teachers/practitioners can come together to discuss the problems that their students have, and are able to share their ideas about specific tricky topics.

There are many different ways of collaborating. You may already work with teachers collaboratively or have chance to work with other colleagues collaboratively. The tricky topics guide was specifically designed around face-to-face workshops in which teachers can brainstorm the topics without restriction, enabling 'blue sky' thinking. However, time is often short, as well as costly, and some teachers, such as distance learning tutors, are miles away from each other. So, it is now very common for us to conduct meetings and conferences online and it is also possible to conduct the collaborative tricky topics process online.



Figure 10 Colleagues mapping their tricky topics

Here are a few tips for collaborative workshop as part of the tricky topics process. These tips are split into three sections as it is necessary to consider 1) the planning of the workshop, 2) the facilitation of the workshop on the day, and 3) the post-workshop activities which will ensure that the outcomes are followed through to develop interventions in order to improve teaching and learning.



## 1. Planning the workshop

As specified in the tricky topics guide, facilitation of a workshop is key and it is necessary to keep participants focused on the task, providing guidance about what is, or is not, a tricky topic, stumbling block or problem example. Therefore, all workshops should be manageable in size. It is recommended that no more than 20 teachers in groups of four or five for a face-to-face workshop, although a recent workshop in Africa was successfully conducted with 40 teachers. Fully online workshops should be smaller as facilitation and producing output can be more difficult (see below). However, it is possible to mix some online with face-to-face workshops as long as this is planned in advance.

Each group in a workshop will be expected to share their knowledge of problems with the aim of coming to a shared decision on what are tricky topics, stumbling blocks and problem examples. Therefore, the people invited to a tricky topics workshop should be able to work together in this way. Multiple teaching areas in one workshop is fine, so long as those working in each group can find some common ground, for example science teachers.

Resources required are minimal – they include paper, pens, highlighters and blank structure diagrams for a face-to-face workshop. Online workshops will require collaborative software which allows break-out rooms that can complete whiteboards and pre-prepared blank structure charts collaboratively. Pre-workshop activities such as carefully focused forums can be helpful to provide some focus for discussion, especially where workshops will only hold a small proportion of all teachers/tutors. The forums can enable many more teachers/tutors to feed into the discussion and give their examples of problems. However, forum discussions will need to be monitored and summarised before the workshop.

## 2. On the day

If recording is required, recording equipment will be needed for each group and the tables of a face-to-face workshop should be far enough apart so that the audio equipment does not interfere with each other. Only one facilitator is essential but more than one is helpful, especially with larger workshops.

Online facilitation is more difficult as individual groups require breakout rooms with separate facilitation and may not be recordable so the plenary must discuss outputs from each break-out room and must occur in the main room which can be recorded. A mixture of online and face-to-face is possible. For example an audio/video device with an additional online participant can be added to each face-to-face group relatively simply but this will require much forward planning.

The tricky topics identification stage of the process can be lengthy (up to 2 hours) even if pre-workshop forums are used, so adequate time must be allowed. Capturing the tricky topics into neat structures can be completed afterwards but these will need to be completed by knowledgeable participants rather than administration staff who do not know the terminology (as terminology is very important and can be easily confused). Some form of plenary is vital for all workshops to ensure that there is consensus about how to move forward with interventions and evaluation.



## 3. Post-workshop activities

Whether the workshops are face-to-face, online or mixture of both, they will all have outputs which will require processing afterwards. Ideally the workshops should finish with neat tricky topics structures, solid plans for interventions and ideas for questions which will be used in order to evaluate success of that intervention.

However, most workshops will not reach this stage and a good plenary is necessary to pull the ideas together and plan for follow-on procedures. Even if the plenary is very good and the follow-on procedures to develop interventions and evaluations are fully decided and discussed, some after-workshop activities will be required to tidy up the tricky topic structures and manage those follow-on procedures.

As will be seen in the following weeks, the interventions will require careful design to ensure that they adequately overcome the stumbling blocks of the identified tricky topics. Similarly, quiz questions need to be carefully designed to ensure that the intervention is fully evaluated so that the teaching and learning of the tricky topics is improved.



# 5 This week's quiz

Check what you've learned this week by doing the end-of-week quiz.

Week 3 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



# 6 Summary of Week 3

This week you have built on your knowledge of tricky topics in Weeks 1 and 2 and have been introduced to the tricky topics process and its online guide and saw how the tricky topics process can be completed in different ways depending on the context.

You have learned about the constituent parts of a tricky topic and how to structure them effectively in order to fully identify how and why the students have problems. You have developed a tricky topic in your subject area and fed back your understanding to the tricky topics team at The Open University.

You should now be able to:

- identify stumbling blocks and problem examples
- understand how the tricky topic process works to improve the teaching and learning of tricky topics
- understand the different ways that the tricky topics process can be conducted
- provide feedback of your experiences to IRIS Connect.

Armed with this knowledge of tricky topics and how to identify and break down them into their constituent parts, you are now in a position to be able to consider how you might design an intervention to overcome one or more of the stumbling blocks. You probably have lots of experience of designing lessons. You will learn some different learning design methodologies in Week 4. You can now go to Week 4.





# Week 4 Introduction to learning design

## Introduction

Welcome to Week 4 of the course.

In common with an increasing number of universities both in the UK and worldwide, The Open University has adopted a process of learning design to structure the writing of student materials and learning activities for its modules and qualifications at a macro level. This provides a consistent, structured design, specification and review process using a simple set of tools and resources that enable a student-activity based approach that puts student experience at the heart of what teachers do.

Weeks 4 and 5 of this course will draw from this approach and apply it to the tricky topic process. We will take you through these activities and help you consider how you might use them in your own practice in order to overcome the tricky topics you find.

A key feature of this learning design approach is the strong focus on students and how they learn so it links well to the learner-centred approach of the tricky topics process.

During this week (Week 4) you will cover activities relating to the student-focussed aspect of learning design and consider how these can help you to design an effective intervention for your chosen tricky topic.

By the end of this week you should be able to:

- use the 'student voice' to inform your approach of a tricky topics intervention
- develop a range of student profiles to inform the design of the activities in the intervention.





Figure 1 Teachers and students collaborating



# 1 OU learning design

The 'learning design' approach adopted by the OU is similar to, but not exactly the same as, approaches from other universities. You may well have experienced a different style of learning design, or you might want to look into approaches you may have encountered in more detail. If you are especially interested, there is an active

<u>Learning Design Cross Institutional Network (LD-CIN)</u> in which practitioners from many universities and other institutions share good practice at regular meetings around the UK.

The learning design approach established by Grainne Conole defined it as:

'A methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design. A key principle is to help make the design process more explicit and shareable. Learning design as an area of research and development includes both gathering evidence to understand the design process, as well as the development of a range of resources, tools and activities.'

(Conole, 2013, emphasis added.)

As a result of using this learning design approach, it has been found that teachers/ designers were able to be more creative, and think more critically about teaching and learning and the student experience and they felt more confident about the design decisions they had made.

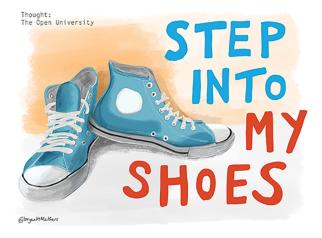


Figure 2 Step into my shoes



# 2 Hearing the student voice



#### Figure 3 Student voice

You have already seen (in Week 2) one way of hearing the 'student voice' with a needs analysis to establish what problems a student is having. Hearing the student voice is important in identifying the problem examples in a tricky topic and a first step in the tricky topics process. Thinking now about how to overcome those tricky topics and thinking about an intervention that will help students, one of the first things to think about when designing the intervention is what you want your students to say about their learning. Once again, there are many ways to listen to the 'student voice'. Start by reading this excerpt from Olney et al. (2017) which discusses how classroom teachers are already accessing the student voice in many ways but interpreting the information is not always easy. They suggest that learning design principles may help classroom teachers to interpret their information to provide more effective interventions.

Putting the students at the heart of the learning experience is generally easier for classroom teachers than learning designers involved in online or distance learning. The day to day interaction with students builds a relationship which fosters empathy between student and teacher and there is far more scope for flexibility when needed. Classroom teachers have, to some extent, the benefit of being able to respond to fluctuations in class mood, spend extra time reinforcing particularly difficult concepts, or receiving visual cues that support expectations that genuine learning has taken place. Classroom teachers can employ strategies to gain immediate feedback from students to better understand their progress and understanding. Tacit knowledge and common sense can drive design.

However, there may still be much for the classroom teacher to learn from the learning design approach. For example, consideration is rarely given by teachers as to how they would like their students to respond to their pedagogical decisions, especially using qualitative data.

As part of a push towards the use of a more evidence based approach to teaching and learning teachers may find themselves collecting data from their students in a similar way, using common online tools such as *Survey Monkey*, or paper based approaches, to obtain feedback on questions such as 'how I teach' and 'what I teach'. This set of qualitative data can then be used to demonstrate at review a teacher's learning and teaching practice, or ... how curriculum design has been improved. However, it is sometimes problematic interpreting this data and turning it into action.

We hope that a better understanding of this approach to Learning Design might help.

Olney et. al., 2017



#### 2.1 Word wheel



Figure 4 Word wheel

Now look at this <u>word wheel</u> (right-click on this link to access the wheel in a new tab or window). The word wheel is part of the OU's free Open Educational Resources. It has three toggles on the outside of the wheel allowing the user to move wheels to reveal different words in three windows, level 1 controlling the central window, level 2 the middle window and level 3 the outer window. The user can build up a set of three words. The language used in this word wheel was derived from the feedback provided by Open University students during 2014 and 2015, so it provides a set of authentic student language showing what students value in their learning. Using these words enables the OU to design an approach for our materials and to think about how to target our planning. Refer to Activity 1 in Week 2 for a reminder of the needs analysis process.

Alternatively, here is a table which shows the sets of words in a more static format:

Table 1 Table of contents from the word wheel

Toggle 1	Innovative		
Toggle 2	Different	Amazing	Interactive
Toggle 3	Distinctive	Extraordinary	Collaborative
	Innovative	Ingenious	Co-operative
	Pioneering	Exceptional	Connecting



Toggle 1	Demanding		
Toggle 2	Ambitious	Complex	Challenging
Toggle 3	Enterprising	Involved	Thought- provoking
	Adventurous	Multifaceted	Stimulating
	Aspiring	Intricate	Questioning
Toggle 1	Professional		
Toggle 2	Skills	Independent	Practical
Toggle 3	Ability	Self-sufficient	Pragmatic
	Capability	Self- supporting	Functional
	Proficiency	Self-regulating	Competent
Toggle 1	Supportive		
Toggle 2	Effective	Rewarding	Confidence
Toggle 3	Relevant	Worthwhile	Encouragement
	Applicable	Valuable	Buoyancy
	Constructive	Fulfilling	Trust

# 2.2 Describing learning experiences

Now complete Activity 1 which further introduces you the word wheel.

# Activity 1 Describing learning experiences Allow approximately 1 hour

#### Part A Choose 3 words to describe a good learning experience

Think of your own teaching or look back to the needs analysis you conducted in Activity 1 of Week 2. Choose 3 words that you would like students to use to describe the learning experience from one of your lessons or tutor session. If you have no teaching experience perhaps consider how you would describe a good learning experience from your past.

- 1. Select a high level word from the header boxes, *or using toggle 1 on the word wheel* (e.g. one from: innovative, demanding, professional or supportive).
- 2. Then choose one of the three specific words on the next row that describes the first word more precisely *using toggle 2 on the word wheel* (e.g. If you selected 'Innovative' you can then choose from: different, amazing or interactive).
- 3. Finally select one of the three more granular words that describes the second word more precisely *using toggle 3 on the word wheel* (e.g. 'pioneering').

You should now have selected three words which you would like students to say about your teaching, such as 'innovative', 'different' and 'distinctive'.



Provide your answer...

#### Part B More practice of the word wheel

Now use the wheel to find three words to describe your learning experience of this course so far. Why not write a tweet to @Tricky\_Topics telling us what you think? Record your three words here and keep these words in mind as you design your tricky topics learning intervention.

#### Answer

Here's one example using three words:



Figure 5 Example tweet

Learning management systems such as Moodle and Blackboard have become immensely popular in schools, colleges and universities in recent years as a means to distribute lecture notes and other course information. They are a portal for students to upload assignments and to check them for plagiarism, and as chat forums where students can communicate with their teachers/lecturers and with each other. Both platforms allow for easy integration with social media services so that teachers can push content automatically to Apps like Twitter, Facebook or LinkedIn. With most people now owning a smart phone, and social media usage accounting for approximately 30% of online smart phone activity, using social media to engage with others in a teaching and learning environment is becoming far more popular. How might you engage with social media and continuing professional development?

#### Part C Engaging with social media

Consider how using social media can be useful in your own context.

Whether you already use Moodle or Blackboard to engage with your students or receive feedback about your teaching, think now about how you can develop your current practice to use more social media. Can you use it to hear the student voice? Can you learn more about tricky topics, either from your students or from other teachers, through incorporating Twitter or other social media into your current practices?

Write a few notes here.

Provide your answe	r
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Hearing the student voice is an overarching learning design principle and will inform the design of the activities of your tricky topic intervention. The three words you thought of can be used as a reference point throughout the design and execution of the intervention.



Obviously these three words are not the actual student voice, only the ones you have decided you would like students to say about your teaching. However, they will guide you to develop an intervention which should deliver what you want.

#### For example:

- Janine is writing materials about computer coding. She would like learners to consider her interventions 'demanding' and 'stimulating'.
- Alex is Head of Learning at the NHS. He would like his learners to consider their learning to be 'professional' and 'practical'.

As a result the materials they both produce will look very different if they apply these principles throughout their design.

You may wish to find out what your students really think about your teaching by asking them for three words after you have delivered your learning intervention.



# 3 Student profiles

Before you start to create your tricky topic learning intervention, you need to know your audience. You may already know your students very well but if not, look back at the notes you made in Week 2, Activity 1 and the structure that you created in Week 3, Activity 4. Think about the audience for your intervention and keep that in mind as you complete the rest of this week's activities.

# 3.1 Creating a student profile

If you have a wide audience, such as the audience for this badged open course, you might need to consider a range of student characteristics to ensure that you cater for different learning styles and backgrounds of students. One way to achieve this is by creating some fictional examples of student profiles (see Figure 6).

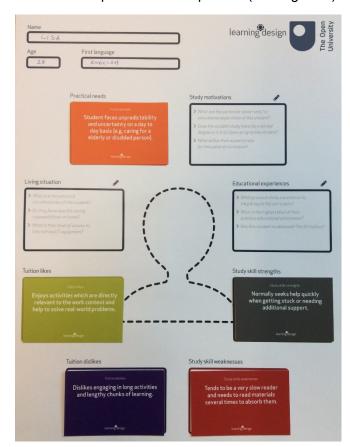


Figure 6 Example of a fictional student profile

Here, in Figure 7, is a profile that has been created for an adult distance learning student:



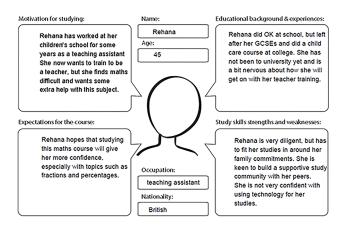


Figure 7 Completed student profile

The example student profile above explains a fictional student called Rehana. Rehana is British, 45 years old and is an adult distance learning student. She works as a teaching assistant alongside her studies. Rehana's motivations for studying builds upon her experience as a teaching assistant at her children's school where she has worked for several years. She now wants to train to be a qualified teacher but she finds maths difficult and wants some extra help with this subject.

Rehana's educational background and experiences explain that she did OK at school but left after her GCSEs to do a child care course at college. She has not been to university yet and feels nervous about how she will get on with teacher training. Rehana's profile regarding study skills (both strengths and weaknesses) are that she is a very diligent student. However, she had to fit her studies in around her family commitments. She is keen to build a supportive study community with her peers. She is also not very confident with using technology for her studies. Rehana's expectations for the course are that she hopes the studying will give her more confidence in maths: especially with topics such as fractions and percentages.

There may be additional points to include in the design features, such as:

- Rehana is keen to link up with her peers to form a learning community, so it is
  important to look for ways to introduce her to other students at an early stage in the
  course.
- Rehana is not very confident with maths, so she needs to have a gentle introduction
  to this topic and build up gradually, offering additional support along the way. This
  might be a tricky topic for her, so a needs analysis would help to identify the specific
  interventions that would help her to overcome the stumbling blocks.
- Rehana is new to online study so she would benefit from some help to navigate her way around the learning materials perhaps via an early tutorial session.

# Activity 2 Identifying and reflecting on student profiles Allow approximately 15 minutes

Examine Figure 7 and these additional points to include in the design features. What other issues can you think of either for Rehana or for your own student profile?

Think carefully about your own experiences or the issues that your students have. Write them down now and use them in Activity 3.

Provide your answer...

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#### Tricky topic intervention

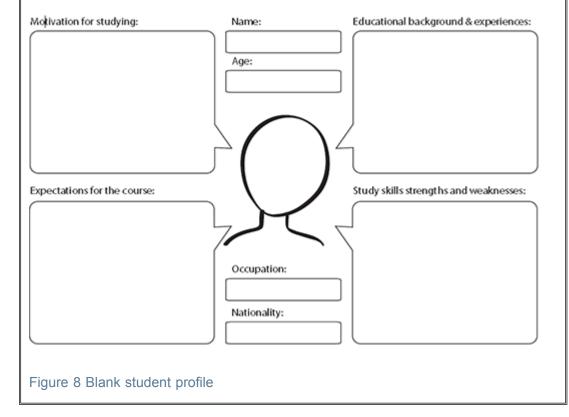
Now complete Activity 3 to create a student profile in the context of your teaching and the tricky topics intervention.

# Activity 3 Create a student profile for your tricky topic intervention Allow approximately 30 minutes

Use the <u>Student profile template</u> to create a student profile for the tricky topic intervention you have identified. You can print the template or fill in an electronic version. You will need to think about the student's:

- 1. Personal details such as name, age, occupation (if adult) and nationality
- 2. Motivation for studying
- Expectations of the learning
- 4. Educational background and experiences
- 5. Study skills, strengths and weaknesses.

For children in school, 1 and 2 may include their home situation and when, why and how they engage with learning (or not). If you're feeling artistic, give your student a face and hair too.



## 3.2 How to use a student profile

When considering your student profile and how the characteristic you have identified could influence the design of your intervention, you might like to think about some of the following:



- What guidance can be provided so that the student makes the best use of their time?
- What signposting could be put in place to help this student access additional materials?
- What can you do to ensure that the content and resources reflect social diversity?
- What can you do to ensure your materials are accessible to everyone?

Designing accessible materials is a particularly important topic. For example, traditional teaching and learning approaches pose barriers for many learners because they focus on three core activities with text as a core element: listening, reading and writing. These activities disadvantage learners with a print impairment (potentially 10% of learners), learners with English as a second language and learners with other disabilities such as sensory impairments or concentration and memory difficulties.

Technology enhanced learning can be used to transform traditional teaching and learning and improve accessibility, engagement and ultimately achievement but only if students have access to the required technologies and software.

#### Activity 4 Sharing your profile

Allow approximately 15 minutes

Once you have created your student profile, you should share it with colleagues explaining what steps you might take to design an intervention that meets the specific needs of this student. You might encourage your colleagues to create one too, then comment on each other's profiles.

Now share and write some aspects of your student profile with the tricky topics team using the IRIS Connect group under the Activities Tab, Week 4, Activity 4.

Your activities for Week 4 are complete. Now work through the Week 4 quiz which includes questions for all the work you have covered in this course so far.



# 4 This week's quiz

Check what you've learned this week by doing the end-of-week badge quiz. It's similar to previous quizzes, but this time instead of answering five questions there will be 15.

#### Week 4 compulsory badge quiz

Remember, this quiz counts towards your badge. If you're not successful the first time, you can attempt the quiz again in 24 hours.

Open the quiz in a new window or tab then come back here when you've finished.



# 5 Summary of Week 4

This week you have reached the 'assess' stage of the tricky topics process. You have begun to think about designing a learning intervention to overcome the tricky topic which you identified and captured in Weeks 2 and 3.

We have provided some materials which could help you to think about your students and what they will want from your learning intervention. So, you have seen how to use the 'student voice' to inform the approach of your intervention and developed a range of student profiles to inform design of activities for your intervention.

You should now be able to:

- use the 'student voice' to inform the 'tone' of a tricky topics intervention
- develop a range of student profiles to inform the design of the activities in the intervention.

During Week 5 you will cover activities relating to the student focus aspect of learning design and consider how these can help you further to design an effective intervention for your chosen tricky topic.

You are now half way through the course. The Open University would really appreciate your feedback and suggestions for future improvement in our optional <a href="mailto:end-of-course survey">end-of-course survey</a>, which you will also have an opportunity to complete at the end of Week 8. Participation will be completely confidential and we will not pass on your details to others.

You can now go to Week 5.





# Week 5 Developing your

# learning design

# Introduction

Last week focused on describing your students and considered how to meet their learning needs.

During this week, you will be introduced to the learning design activity types (Figure 1, below) and consider how you could use these to design an effective intervention for your chosen tricky topic.

By the end of this week you should be able to:

- create an activity profile to inform the design of your chosen intervention
- understand how the use of a profile helps to create a balanced student experience.

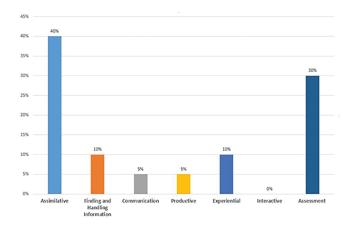


Figure 1 A bar chart showing relative proportions of the 7 activity types

This approach has been used to design course materials at The Open University for several years and has shown that teachers are able to be more creative, and think more critically, about teaching and learning and the student experience, and feel more confident about the design decisions they make. It is recognised that students are more successful in their learning when they engage in a range of different activities. In particular, talking about a tricky topic with their peers enables students to get a better grasp of the concepts and gives teachers an opportunity for informal assessment of learning by listening to the student discussion.



## 1 To the classroom

Read this excerpt from Olney et al. (2017) which explains the importance of activity profiling and how teachers may begin to use activity profiling in practice.

The introduction of mandated subject coverage in the UK, Australia, and other places mean that developing and documenting transferable (between teachers) curriculum has never been more important. Valuable resources are wasted year on year reworking curriculum that is unclear or that only concentrates on content rather than the student experience. Increasingly high turnover of staff can mean valuable expertise and consistency is lost as teachers move between schools or move into other fields of education. Due to this turnover it would seem sensible, and it is suggested, that teachers consider establishing an activity profile early in the design process when presented with new curriculum.

Therefore, in the first instance it is suggested that teachers might gain benefit from mapping their practice retrospectively in order to generate some usable data for their peer teachers and their students. That is, taking five minutes after a lesson, or at the end of the day, to jot down the approximate time spent by students on different activities. Further, students might have a very active role to play in this. Why not get the class to do it? Or, alternatively, it could be included in peer observation sessions.

Coding student activity in this way will allow teachers greater insight into their own practice for it may be that it is only through assigning numerical values to student activity that will allow teachers to step back from their work and reflect on how their practice may have impacted on their students. For example, it is likely that teachers may be surprised if presented with data that suggests that their students are predominately required to engage with assimilative activities when they may believe they promote communicative activities in their classroom. An action arising from this might be to build more group work activities where appropriate.

Without the hard and fast deadlines of presentation schedules it is likely that most schools design processes are already more iterative than those focussed on e-learning in so far as teachers design as they go. With the increased use of online learning in all learning institutions, the introduction of upfront learning design will become more and more important.

Typical curriculum plans for units of work often consider what the students will be doing during class time but rarely seek to classify this activity according to a taxonomy such as the one above. This can be a very powerful way to generate data and provide an evidence based way for teachers to reflect on their own practice.

## 1.1 Why is learning design required?

Learning Design is a bit like the design phase of a building project. It involves a choice of materials, layout and measurements, with the option at this stage to make changes



depending on the requirements of the project. If you don't pay sufficient attention to the plans, your building might fall down.

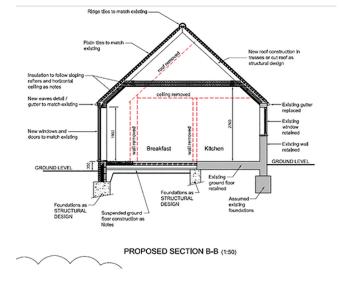


Figure 2 A building project design



# 2 Learning design classification

In this section you will be introduced to the learning design classification, which is a way of describing different types of student activity. These are like the materials for the building project – foundations, walls, windows and ceilings. You could think of your tricky topic as being the foundation stone for future learning.

From student surveys, it's clear that OU students tend to prefer learning that takes the form of reading an article or watching a video, followed by making some notes or answering some questions. This is called an 'assimilative' activity and students (and teachers) are usually quite comfortable with it. However, students learn better if they are pushed out of their comfort zone and encouraged to do things they might find more challenging, such as presenting an opinion backed up by facts, or finding examples of data that contradict a given viewpoint.

If students are encouraged to engage in a range of different types of activity then the evidence shows that their learning is likely to be more effective.

The Activity Planner has been designed to help you visualise what students will be doing as they study and ensure an appropriate balance of activity types that meet the aims of your intervention and produce an activity profile for your intervention. This tool is also useful for checking that the materials and activities you have prepared to teach your intervention deliver the right amount of study time and the amount of assessment work students will be doing for a particular piece of learning. Have you done enough to enable students to understand the tricky topic?

#### Activity 1 Activity categories

Allow approximately 45 minutes

The Open University Activity Planner classifies student activity into seven categories, which are listed below. You can find more information <a href="here">here</a>. Think about what each category means and make a note of your thoughts before revealing the explanation.

#### 1. Assimilative

Provide your answer...

#### Answer

Attending to information

Students study and think about theories and concepts encountered in materials and resources, case studies, etc.

Often this is the first part of a learning cycle where students receive and begin to make sense of new information, before they then apply or test their new knowledge, or go on to reflect, review and communicate their understanding.

**Examples include:** Read, Watch, Listen, Think about, Access, Observe, Review, Study.



#### 2. Finding and handling information

Provide your answer...

#### Answer

Searching for and processing information

Students are actively and critically engaged in gathering and manipulating information.

These activities might include conducting research, extracting information from databases, analysing information, synthesising data and evaluation.

**Examples include:** List, Analyse, Collate, Plot, Find, Discover, Access, Use, Gather, Order, Classify, Select, Assess, Manipulate.

#### 3. Communication

Provide your answer...

#### Answer

Discussing learning with at least one other person (student or teacher)

This will be achieved through dialogue, as students begin to take a position in relation to problems and debates, and internalise complex and interrelated concepts.

Collaboration is a step further where students (and teachers) work together to produce some end product and through that process make new make new connections and develop a shared understanding of the topic.

**Examples include:** Communicate, Debate, Discuss, Argue, Share, Report, Collaborate, Present, Describe, Question.

#### 4. Productive

Provide your answer...

#### Answer

Actively constructing an artefact

Here students apply their knowledge and skills together or alone in order to create a piece of work. This could be a list, a piece of narrative text which answers a question, a reflective account, a report, a video or a presentation etc.

Because something concrete is produced, it can be reviewed, evaluated or assessed, and feedback can be received. It can also be used to support revision and further study.

**Examples include:** Create, Build, Make, Design, Construct, Contribute, Complete, Produce, Write, Draw, Refine, Compose, Synthesise, Remix.



#### 5. Experiential

Provide your answer...

#### Answer

Applying learning in a real-world setting

This activity is most often found in work-based learning or practical science modules. Students are required to apply their skills, knowledge and understanding in a real-world setting.

This does not include role play and simulated scenarios but could include a case study if it is taken from the student's real-world setting. The key is that students receive real-life feedback on the activity e.g. from customers or clients, work colleagues or the environment and have an opportunity to reflect in context.

**Examples include:** Practise, Apply, Mimic, Experience, Explore, Investigate, Perform, Engage.

#### 6. Interactive/adaptive

Provide your answer...

#### Answer

Applying learning in a simulated setting

'Interactive/adaptive' does not relate to the technology but the student activity itself. Students apply their knowledge and skills in a simulated setting, receive immediate feedback and are then given the opportunity to adapt their approach.

Activities falling into this category might include role play, problem-based scenarios, simulated case studies and simulated experiments.

Examples include: Explore, Experiment, Trial, Improve, Model, Simulate.

#### 7. Assessment

Provide your answer...

#### Answer

All forms of assessment, including a quiz, an assignment or an exam

**Examples include:** Write, Present, Report, Demonstrate, Critique.



# 2.1 Activity profiles

Not all activities will be relevant for every type of learning. For example when this course was designed, it was decided to aim for the profile in Figure 3:

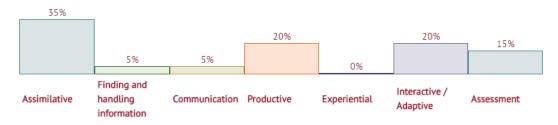


Figure 3 Profile of the course

The profile for this course reflects the following design decisions:

- In order to explain the tricky topics process, there is quite a bit of reading and watching (assimilative).
- It has been designed to provide some opportunities for you to find your own examples of issues which relate to your own context (finding and handling information).
- Within a course such as this, there are limited opportunities to communicate with other students due to the fact that people are not all studying at the same time, but it is hoped that some of you will engage with IRIS Connect and its community members on our group (communication).
- A number of activities require you to make notes or produce your own ideas on your chosen tricky topic (productive).
- It is not possible to direct you to any real life work experience because there is not
  enough information to know at this stage who our students will be and whether you
  are able to apply your learning in a real world setting (experiential).
- However there are situations where you can develop your materials in a simulated setting and it is hoped that you will be able to apply this in your own context. (interactive/adaptive).
- To test your learning, there is a short quiz at the end of each week (assessment).

#### Activity 2 Create an activity profile

Allow approximately 40 minutes

Now that you are doing this course, what do you think? Does this profile reflect what you have been doing so far?

Imagine you are designing your own course. This might relate to your chosen tricky topic and to a specific intervention that you are planning to overcome one or two of the stumbling blocks, or you might want to come up with an entirely new topic for this activity. How about one of these?

- Level 1 Chinese language
- 2. Level 3 Counselling skills
- 3. Postgraduate Aeronautical engineering



Use this  $\underline{\text{Activity profile template}}$  to decide on the balance of activity types you might use for your learning activity.



# 3 Using activity types to plan interventions

Assimilative activities are often used to introduce a topic and they tend to form a core part of all learning. However, Open University research shows that students tend to learn better when they are challenged to be more active with their learning and to debate, discuss, create, analyse, or explore, rather than passively receive information by reading, watching or listening. This means that using non-assimilative activity types is a useful way to help students to overcome the stumbling blocks you have identified for your tricky topic. For example, if you think back to the optics and ray diagrams shown in Week 3, you will see that the teachers identified that students needed help with drawing ray diagrams and went on to design some 'productive' activities to help them overcome the stumbling blocks.

Another example might be that when teaching fractions, the teacher could ask a student to explain to a peer the difference between 2/3 and 5/8. This 'communicative' activity would be a good way to test if the student understands the component parts of fractions. Assessment will always form part of the tricky topics process because there is a need to test students' understanding of the topic.

# Activity 3 Identify an activity type for your stumbling block Allow approximately 45 minutes

Using your own tricky topic, identify an activity type that you might use to create an intervention and describe why this would help the student to overcome one or more stumbling blocks.

Write your comments in this text box and then feedback your activity design through IRIS Connect (see Week 5, Activity 3).

Provide	vour	answer	

#### Optional

You might also like to spend a few minutes looking at the <u>Innovating Pedagogy report</u> from 2016 (Sharples et al., 2016) to look at which activity types have been used in these examples. List the examples in the report together with the activity type(s) that are represented in the text box below.

Provide	vour	answer
	, ,	a

#### Answer

#### **Table 1 Activity types**

Example from Innovating Pedagogies 2016	Activity type	
productive failure	communicative and productive	
teachback	communicative	



formative analytics assessment block chain for learning productive/assessment	learning through video games	interactive/adaptive
block chain for learning productive/assessment	formative analytics	assessment
	block chain for learning	productive/assessment

#### Share your activity profile

Describe why you have chosen this profile and how it will meet the needs of your students. You could refer back to the needs analysis you did in Week 2 or the student profile you created last week. After you have done this, go to IRIS Connect and feed these thoughts back to the tricky topics team under Week 5, Activity 3.

Provide your answer	

It is important to note that this activity type classification is something that our learning design team has identified as a tricky topic for many staff at The Open University, so please don't worry if you find it difficult to grasp straight away.

## 3.1 Benefits of the activity type approach

The Activity Planner allows educators to see what 'shape' the overall course has, and whether that reflects the learning requirements. There are no 'right' or 'wrong' answers – what is important is that the profile is appropriate for your learning and teaching context.

#### Some things to consider when using the activity planner:

- You may have a set number of hours, if you increase/reduce hours spent engaging in one type of activity you may have to increase/reduce hours elsewhere.
- Not all activity types have equal value in terms of how much will be learnt in the space of an hour, and to what level.
- Do you or others in your team have the skills required to design and produce the learning planned?
- What are the skills and expectations of your learners? How far do you want to, or will need to, develop these through your course materials?
- Teachers are often 'time poor' and may wish to skip some things but an hour spent planning is worth many hours later on.



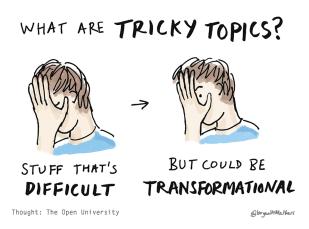


Figure 4 What are tricky topics?

# 3.2 Learning design applied to tricky topic interventions

The following example shows how learning design was used to structure tricky topic interventions in two UK secondary schools, where students had problems with the tricky topic long division in mathematics.

In both schools, students repeatedly encountered stumbling blocks when learning long division. The teachers went through the tricky topic process to identify the key stumbling blocks. Both schools used creative video-making as part of an intervention designed to uncover and address the students' problems with this topic.

The students in school A were bottom set Year 8 (12 year-olds) maths students who were having remedial maths classes during lunch time. The intervention therefore needed to be structured to fit into a series of six 30 minute slots.

The students in school B were top-set students from Year 7 (11 year-olds) and the intervention was structured to fit across four maths lessons held two days per week in two consecutive weeks.

Students from both schools spent 4-5 hours on the intervention.

The interventions were designed as follows:

- Assimilative: teacher teaches the topic to students in class.
- Assessment (formative): students take a diagnostic quiz to assess their level of understanding of the topic.
- **Interactive**: students are given homework to view, explore and interact with a video 'pen-cast' created by their teacher to explain long division, reinforcing their learning using a 'flipped learning' approach.
- Communication/productive: students work in groups of three or four to create a
  paper storyboard for a video to illustrate long division. They are asked create a story
  that is set in a context that has meaning for them and which enables them to explain
  long division using characters and terms that are relevant to them as school children.
  During this activity, the teacher goes around the room from group to group so that
  students can share their ideas and get feedback.



- Communication/Productive/experiential: students work in their groups to shoot footage and perform their video using Flip videos, iPads or their personal smart phones. They adopt and change film-making roles as needed, working as producer, cameraman, actor, prop creator, animator as required. The teacher is available for advice and discussion on any stumbling blocks.
- Communication/Productive: students edit the footage to create the narrative outlined in the storyboards. As they do this, the teacher is available for advice and discussion on any stumbling blocks.
- Assessment: students repeat the diagnostic quiz to assess whether their understanding has improved.
- **Communication**: students view, comment on and applaud each other's videos as a whole class activity. Constructive commenting helps students reflect on their learning by viewing their own and each other's videos to reinforce their understanding.

Using the learning design activity planner, the creative video-making intervention has the activity profile in Figure 5:



Activity Planner - Bus Stop Method Tricky Topic Invervention

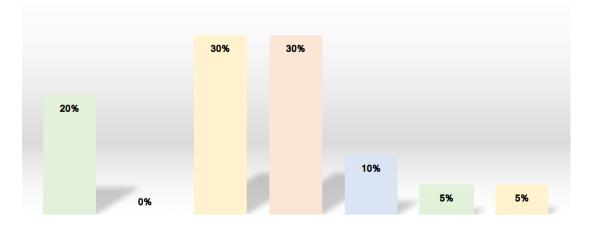


Figure 5 A learning design activity plan from the creative video-making intervention

You can see that this intervention relies heavily on collaboration and performance. Week 6 will demonstrate how it was able to reveal student misunderstandings to the teacher.



# 4 This week's quiz

Check what you've learned this week by doing the end-of-week quiz.

Week 5 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



# 5 Summary of Week 5

This week you have further developed your understanding of learning design principals aimed at designing activities for use in interventions which can effectively overcome students' misunderstandings in tricky topics. You have learned about learning design activity types and how they are classified. You have seen that the learning design process is like the design for building a house. If you don't plan carefully, your house is likely to fall down! In Activity 3 you identified an activity type which is suitable for a stumbling block in your tricky topic.

You should now be able to:

- create an activity profile to inform the design of your chosen intervention
- understand how the use of a profile helps to create a balanced student experience.

Next week you will see how others have created different types of learning interventions which have been designed to overcome specific tricky topics in a variety of contexts. You will be able to put into practice your new knowledge of learning design that you have gained over Weeks 4 and 5, by designing an effective intervention for your tricky topic. You can now go to Week 6.





# Week 6 Innovating pedagogies and targeted interventions

# Introduction

This week you will read about 'innovating pedagogies' and see some examples of specific interventions that have been successfully used to overcome tricky topics in several different contexts. You will then put into action your knowledge of tricky topics from Weeks 1 to 3, and the learning design principals that you learned in Weeks 4 and 5, in order to design an intervention for a tricky topic.

By the end of this week you should be able to:

- know what is meant by 'innovating pedagogies'
- develop understanding of how targeted interventions can be used to overcome tricky topics and their individual stumbling blocks
- begin to create a targeted intervention for a given tricky topic.



# 1 Innovating pedagogies

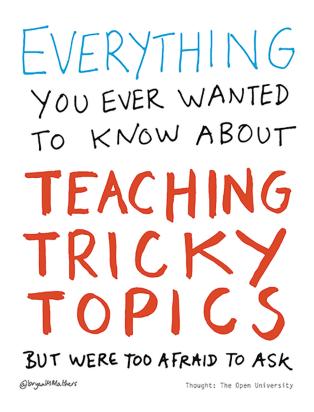


Figure 1 Everything you ever wanted to know

Teaching and learning which is designed to overcome tricky topics should be innovative. A topic may be 'tricky' because traditional methods such as where students attend a lesson, listen to the teacher's explanation and complete their homework, are not working. There are many different forms of innovation.

Read now about two particular examples of innovative pedagogy from the <u>Innovating Pedagogy Report (2014)</u>, 'Flipped classroom' and 'Bring your own devices' (Sharples et al., 2014).

The next section describes some more innovating pedagogies. These are targeted learning interventions which have been designed specifically to overcome a tricky topic.



# 2 Targeted learning interventions

Four examples of innovative teaching and learning interventions have been selected, each of which was designed to overcome a specific tricky topic. The examples name the tricky topic which the teaching is designed to overcome, summarise what was taught and suggest some additional reading should you wish to look into it a little deeper. The four examples are listed below with the section number, the type of innovative intervention and the tricky topic(s) they are designed to overcome:

- 2.1 Digital storytelling: 'States of Matter'
- 2.2 Creative Video Making: 'Long division (Bus stop method)'
- 2.3 Game-based learning: 'Rapport' and 'Appropriate Questions'
- 2.4 Story-telling in a face-to-face tutorial: 'Programming object-oriented collections in Java'

These four examples have been selected to demonstrate a range of innovative pedagogies that can be used. The first three interventions; digital story-telling, creative video making and game-based learning make extensive use of technology. However, the fourth example, story-telling in a face-to-face tutorial shows that you don't have to use technology in order to be innovative.

# 2.1 Digital storytelling

Stories have always been important in classrooms because educators can use them to stimulate pupils' critical thinking skills (McDrury and Alterio, 2003) and to help them develop a variety of skills in communication, search, collaboration and task completion (Di Blas et al., 2009).

Digital tools enrich the process of storytelling by providing new ways to support story authoring and fostering new forms of creativity (Di Blas et al., 2009). Digital storytelling enables computer users to become creative storytellers through the traditional processes of selecting a topic, conducting some research, writing a script, and developing an interesting story (Robin, 2008).

Digital storytelling is usually shorter than a typical oral presentation – between 2 and 10 minutes in length, and it can include computer-based graphics, recorded audio, computer-generated text, video clips, animation, music and most importantly, a narration in the author's own voice.

## The digital story-telling intervention

This intervention explores the use of digital storytelling in the tricky topic of the 'states of matter'.

As you saw in Week 3, the three states of matter are solids, liquids and gases. Materials can be changed from one state to another by heating or cooling.

The stumbling blocks that the students struggle with are:

- particle movements in all states of matter
- 'existence' of gases



- differences between melting and freezing
- differences between evaporation and condensation
- differences between heat and temperature.

Digital storytelling enables students, while using a digital device such as computers, tablets and mobile devices, to become creative storytellers through the traditional processes of selecting a topic, conducting some research, writing a script, and developing an interesting story.

This intervention uses iPads and a 5-minute-long digital story, prepared by the class teacher. The teacher can create a digital story using animated clips available online that are free-of-charge. This digital story can be presented to students in different ways, to stimulate leaning through reactive storytelling. Two versions are demonstrated below.

In Figure 2 (Version 1 of this intervention), the digital story, an animation in the tricky topic of 'states of matter', is presented to students as a sequenced story. This means that the images are presented as a sequence of scenes or events in the correct order, but they are missing any visual (text) or audio narration. The learning takes place as students work together in groups of two and three to 'invent' their own storyline and audio-record it, so that the digital story becomes a personalised narration.



Figure 2 Version 1: sequenced story

In Figure 3 (Version 2 of this intervention), students with the story scenes in a random order. Students are asked to order the scenes in a way they think of as more reasonable, then 'invent' the plot of the story, audio-record it and have a personalised narration. This is more challenging for the students than Version 1, and as they discuss the sequencing and narrative, misconceptions may be revealed and explored through collaborative reflection supported by guidance from the teacher.

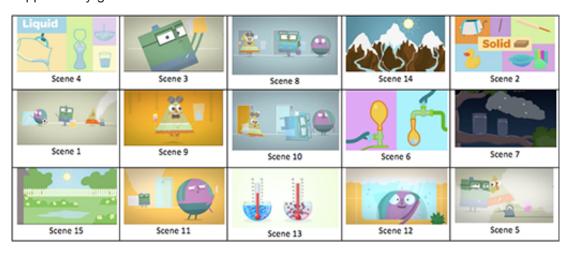


Figure 3 Version 2: random-ordered story

Sources: BBC Bitesize/Youtube



Finally, instead of iPads you can use laptops or desktops and instead of animated videos, you can use still images. Note: Still images are not as engaging or informative as the animated scenes.

This intervention can be supported using pre- and post-quizzes that will evaluate students' understanding in the specific learning topic (see Week 7).



Figure 4 Students working on digital story-telling

# 2.2 Creative video making

In this intervention, teachers use video-making to help students understand the Mathematics tricky topic 'Bus stop method'.

'Bus stop' is the term used to refer to 'long division' so that students will remember it. The bus stop method is used when you are dividing a large number (usually three digits or more) by another number (possibly two-digits or more). It is so named because the line you draw between the numbers looks a little bit like a bus stop (see Figure 5).



Figure 5 The Bus Stop method of division

### The Creative video making intervention

(See Section 3.2 of Week 5 for the design of this intervention.)

UK secondary school mathematics teachers identified division by 'bus stop method' (previously known as 'long division') as a tricky topic for students aged 11–12. They broke down the tricky topic into the following stumbling blocks as follows:

- · times tables
- place value
- converting fractions into decimals
- bus stop method
- remainders

It is very unusual to include a stumbling block of the same name as the tricky topic. In this example, the tricky topic was actually 'long division' but in school, the topic was referred to



by the method that was taught (i.e. the 'bus stop method'), and it was the bus stop method which was a major stumbling block for students.

The video-making intervention takes 4–5 hours. It can be run either within planned teaching hours, or as an extra-curricular activity, as follows:

- During maths classes: video-making intervention timetabled into five consecutive maths classes
- During lunch break: video-making intervention run over five weeks during Monday lunch time for pupils aged 12–13 attending remedial maths classes
- As an extra-curricular day out: students and teachers attend a full-day video-making tricky topics workshop at The Open University.

Students are provided with craft materials (e.g. iPads or flip video cameras) with which to perform their video stories. Students form groups of four or five and storyboard ideas for a video to explain the bus stop method. They can choose to address some or all of the stumbling blocks and work together to create their videos, developing their understanding together, explaining difficult concepts to each other and referring back to the teacher for expert information as necessary.



Figure 6 Students working from storyboard

Misconceptions are revealed through this process. These can then be addressed by the teacher using the students' own representations in terms that are meaningful to the students. By the end of this creative process, students have internalised the tricky topic. The following two examples illustrate how a misconception about division emerged with two different groups of students.

#### Example 1 High ability group

A group of confident, top set maths students decided to demonstrate division using a theme of a school sports day. Their characters were seven people running a race and getting thirsty. They had five litres of water to share between the athletes. As they were explaining their story to the teacher, a common misconception emerged; students often instinctively divide the smaller number into the larger number. In this case, the students explained to the teacher how they would share the water out between the people by dividing 7 by 5. Initially they could not see where they had gone wrong.

By using the students' storyline of the sports day, the teacher asked them to explain how, with only 5 litre bottles of water, each of the 7 athletes could end up with more than one bottle of water. The students immediately realised their mistake and corrected their story.



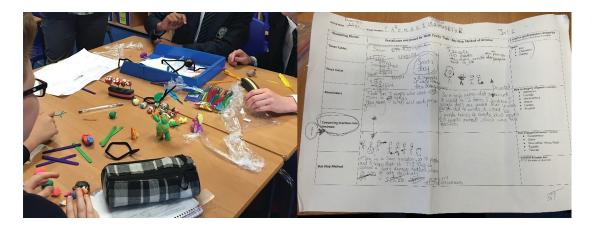


Figure 7 Students working on sports day video based on storyboard

## Example 2 Low ability group

This video was the outcome of a series of workshops held during lunch time sessions with students aged 12 and 13. These students were in the lowest ability group (set) and were attending extra lunch time sessions in maths. Their lack of confidence was evident as they explained the bus stop method of division to each other over and over again. The teacher provided reassurance and slowly their confidence increased as they worked on their video.

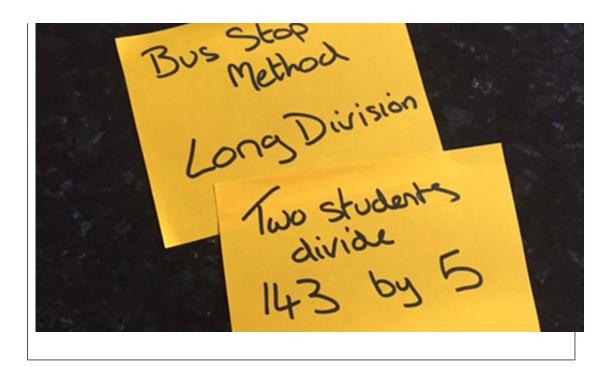
The video footage produced by the students is correct. However the students decided to explain what was happening in the video with a voice-over narrative. In the recording, the student explains the division the wrong way round. She is dividing 143 by 5. However, in her voice-over as she starts dividing the 5 into the hundreds column, she describes dividing 5 by 1 even though what was portrayed in the video was attempting to divide 5 into 1 and carrying the 1 over to the tens column.

This error was repeated by two students from this group and is illustrated in this video.

Video content is not available in this format.

Video 1 Student misconception clip





The teacher was able to see that the student was reverting to dividing a smaller number into a larger one and that she had not fully grasped the concept and was able to help overcome this misunderstanding using the examples that were created by and meaningful to the students.



Figure 8 Students using iPads and flip video cameras to create video

This confusion between which is the number you divide *into* and which is the number you are dividing *by* emerged repeatedly during the video interventions. As these two examples illustrate, this confusion was demonstrated in both lower ability and higher ability students. The video-making intervention highlighted this misconception to the teachers who were then able to clarify the concept for the students. The task of re-explaining the concept to the students was made easier for the teachers because they were able to reuse the setting and characters created by the students for their video. In effect, understanding was facilitated because the teachers were able to frame their explanation in terms that had been selected by the students, and which were therefore meaningful to them.

## 2.3 Games-based learning

Games-based learning has, for several decades, been an interesting focus for solving teaching and learning problems. The main drive behind using games is the perceived inherent engagement that children (and adults) find in playing games. Although the learning value of using games has been hotly debated, research has shown that the interface of a serious game can restrict emotional complexity and increase focus on key factors such as emotional recognition, which can contribute significantly to perceived quality of communication and rapport-building (Magoudi et al., 2016). A game-based



intervention was, therefore, considered most appropriate for overcoming tricky topics which have been identified in training police in the difficult and highly emotional role of interviewing vulnerable children who are witnesses to a crime.

Despite intensive training, police officers, especially new recruits and early career front line police who may have limited real-life experience of interacting with children, find it difficult to build a rapport with a child-witness and ask appropriate questions. The game is therefore specifically designed to effectively support those learning barriers. Evaluation through pre- and post-game quizzes, suggested that the game did significantly increase the police officers' understanding of the identified tricky topics.

#### Game-based learning intervention

This intervention explores the use of games-based learning for police training in a 'first response child interviewing' situation, which is when the police officer is the first person to arrive on a crime scene and needs to question a child witness about the incident. The intervention was designed to specifically overcome the tricky topics of 'Rapport' and 'Appropriate questions'.

Through further discussions the following stumbling blocks and problem examples for each tricky topic were identified. Note another slightly different format for the tricky topics structure, developed for easier direct digital input.



Figure 9 Rapport tricky topic

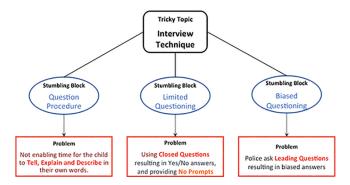


Figure 10 Appropriate questions (interview technique) tricky topic

## The child interviewing simulator

The police game that was developed, the Child Interviewing Simulator (CIS) provides an interactive scenario (of approximately 30 minutes duration) where the player assumes the role of a police officer who is first on the scene of an incident in which a child is a witness. Within the game, the officer needs to interview a 9 year-old boy, who allegedly witnessed



a woman being attacked on his way home from school (Hart et al., 2017; Margoudi et al., 2016).



Figure 11 Child interviewing simulator

The tricky topics of 'Rapport' and 'Appropriate questions' was built into the games architecture. There was also a feedback mechanism which informed the game player when there was an increase in rapport (i.e. the green bar went up). This rapport bar increased if the player chose appropriate responses which would increase the rapport with the child.

The game-based training (see video below) was provided as part of a randomized control trial across three different UK police forces during their 13–20 week 'Initial Police Learning and Development Programme'. The trial consisted of the regular 3–5 day face-to-face witness training (control group) and the game-based training (experimental group). The time that the training was given was rotated to counter-balanced practice effects. That is, half were given the games-based training and then the face-to-face training and the other half were given face-to-face training and then games-based training. There were an equal number of men and women, the majority of whom were aged below 35.

#### Activity 1 Video of child interview

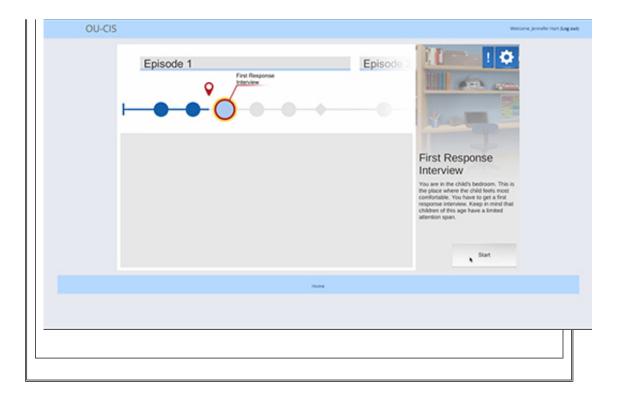
Allow approximately 20 minutes

Go to IRIS Connect and go to the Activities tab labelled 'Week 6, Activity 1'. You will see a video for a games-based child interview simulator. Answer the discussion questions in the discussion board below the video. The video can also be viewed here:

Video content is not available in this format.

Video 2 Games-based child interview simulator (please note this video has no spoken audio)





A tricky topic quiz was created and the quiz data was collected from a total of 116 of the new recruit police officers as part of a detailed evaluation of the trial. The tricky topic quiz results identified statistically significant findings for simulation trainings improvement in understanding compared to face-to-face training. The face-to-face training produced a decrease in understanding. This was thought to be attributed to the lack of specificity in the current training confusing the police when they had to deal with the specific issues of interviewing a child. The tricky topic approach supported a more detailed analysis of these findings. It was then identified that the game was specifically improving tacit understanding around rapport building with the child that was improving more than procedural understanding around completing forms appropriately.

# 2.4 Face-to-face storytelling

In distance learning environments, the few face-to-face tutorials that students receive take on a special meaning. Tutors must make the most of the student interaction and concentrate on the really important topics that the students find difficult. Hence the need to focus the tutorials on tricky topics with a face-to-face teaching intervention.

The face-to-face story-telling intervention explains how a tutor uses participative storytelling in a face-to-face tutorial in order to focus on the tricky topic of object-oriented programming in an Open University computing module.

# The face-to-face story-telling intervention

Computing students often find difficulties in understanding object-oriented concepts. The context was a two-hour face-to-face tutorial for adult distance learning students, which would tackle some difficulties in object oriented programming.



The aim is to get students to concentrate on collections of objects, discuss them, apply them to something of their own choice and peer review their ideas. Distance learning materials provide the presumed initial knowledge.

Using a story-telling approach supports students' learning and would encourage students to interact and participate.

#### The intervention

The tutor gives an initial short presentation of the topic and quiz. Students create their own presentation. The tutor can encourage creation of a fun and engaging story to get students into a flow (Csikszentmihalyi, 1990). Groups of students should aim to juxtapose their story with a standard tutorial, by exploring and analysing the topic before creating a story.

This intervention uses paper storyboards to plan the performance and share ideas. Each student group:

- 1. discusses and plans their presentation
- 2. presents to the other groups
- 3. feeds back as a plenary
- 4. re-looks at the quiz.

If any misconceptions of the material are present, the tutor intervenes by questioning further and helping students to re-think through their misunderstanding.

Groups have developed interesting scenarios related to every-day lives. For example, one was set in an aquarium full of fish tanks with a character that was a fish, called Nemo. The plot was that Nemo had a problem of choosing the best fish tank for his holiday. (See Figure 12).

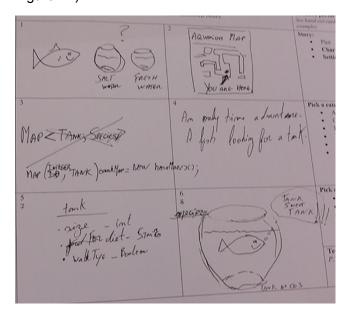


Figure 12 Storyboard group A - a fish called Nemo

Another group had a setting of school lunches, and the characters were students picking lunches and rating them, shown in Figure 13.



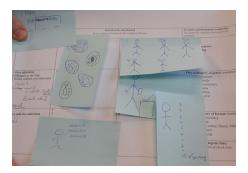


Figure 13 Storyboard group B - school meals

The stories and plenary discussions reveal students' misunderstandings of collections. Students come up with questions and elicit questions from the other groups which help their overall understanding of the concepts. This approach reveals additional students' problems, allowing the tutor to provide students with suggestions of how to tackle their next assignment.

This performance approach is a somewhat startling method for teaching computing, yet it is an appropriate method that uses the benefits of occasions when students come together. It takes advantage of the opportunity for face-to-face discussion and peer learning. Students enjoy this exercise because of the interactions with class and peers. Nevertheless, a tutor needs to set the activity up with sensitivity because some computing students are averse to social interaction.

Reflecting on this as a teaching experience, clarifies how students should tell a story. Groups whose presentation lacked a storyline or plot gave presentations closer to the tutor's example teaching activity. It is important to encourage students to identify plot, character, aim and obstacle. This process not only benefits the students, but also benefits the tutor as they learn from the students' reactions and intra-group discussion. The students reveal the depth of their problems and understanding as they attempt to articulate concepts through their performance and subsequent class discussion.

This intervention could be supported using pre- and post- quizzes that can evaluate students' understanding of the specific topic. Assessment techniques will be introduced next week.



# 3 Planning an intervention

In Section 2, you have seen descriptions of some innovative interventions designed to help students overcome specific tricky topics. In this section you will build on the work you have done already on your own tricky topic and plan an intervention which would help students to overcome your tricky topic or at least one or more of its stumbling blocks.

#### Activity 2 Plan your own intervention

Allow approximately 40 minutes

Look back to your tricky topic structure that you developed in Activity 5 in Week 3. Using ideas from the innovative methods described above (or a different method that you would like to try out) and the design skills you developed in Weeks 4 and 5, design an intervention to overcome your tricky topic. (It could aim to teach the whole tricky topic or it could focus on one or more stumbling blocks.)

If you do not yet have a tricky topic of your own, you can use one that you have met in this course.

Reflect on this exercise and provide feedback about your design through the IRIS Connect under Week 6, Activity 2.

This activity brings your learning in Week 6 to a close. Now complete the quiz.



# 4 This week's quiz

Check what you've learned this week by doing the end-of-week quiz.

Week 6 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



## 5 Summary of Week 6

This week you have further developed your understanding of the tricky topics process by seeing examples of innovating pedagogies and targeted interventions that have been successfully used to overcome specific tricky topics in several different contexts.

You have built on the knowledge you developed in previous weeks by using the learning design skills (from Weeks 4 and 5) in order to design an intervention for the tricky topic you identified and captured (in Weeks 2 to 3).

You should now be able to:

- know what is meant by 'innovating pedagogies'
- develop understanding of how targeted interventions can be used to overcome tricky topics and their individual stumbling blocks
- begin to create a targeted intervention for a given tricky topic.

Your planned intervention, targeted at overcoming your tricky topic will require evaluation. In Week 7 you will learn the details of how to create the right questions which will fully evaluate your intervention and also how to display the findings from your evaluation in order to best identify progress in individual stumbling blocks of your tricky topic. You can now go to Week 7.

Week 6 Innovating pedagogies and targeted interventions 5 Summary of Week 6





# Week 7 Assessment and tricky topics

## Introduction

Welcome to Week 7 of this badged open course. This week builds on the work carried out so far on tricky topics and further develops your understanding of the 'assess' stage of the tricky topics process.

By the end of this week you should be able to:

- understand where the quiz fits into the tricky topic process
- · create tricky topic quiz questions which evaluate learning of specific stumbling blocks
- identify different approaches to using tricky topic quizzes
- set up and use some quiz questions for your tricky topic.



Figure 1 Creation of quiz questions



## 1 What are tricky topic quizzes and assessment?

Approaches to assessment and standardised exams haven't changed since they were first created in China in 605AD. The tricky topic process takes a fundamentally different approach to assessment, in order to assess deep learning rather than surface learning. Its approach also seeks to ensure accurate formative feedback to students and teachers on the students' progression. Finally, the tricky topic process not only supports identifying and designing different types of interventions, based upon students problems and their causes, it also helps to create assessment approaches to evaluate if those interventions have been successful.

While great advancements in general student-directed learning support have been made there is a slower development in supporting assessment systems' pedagogical underpinning, social/organisational test creation and implementation procedures.

Similarly there needs to be a greater understanding of how assessment results are integrated into innovations in student-directed learning pathways. Most research has focused on the test creation, storage and marking. However, what is often missing are the links between assessment and personalised understanding for the student themselves.

This requires a shift in thinking about assessment from a competitive way of comparing students to a way of supporting them to develop deeper understanding. This requires teachers to use assessment to help support students' understanding where their gaps in understanding are, and how to overcome those gaps. Tests, in themselves, are learning and can inform teaching practices after the assessment and support student-directed learning.

It is important to note that this does not suggest that the means increase the number of tests students take, rather to carefully create tests (through tricky topic processes) and use creative ways to engage students in the tests.



## 2 Creating a tricky topic quiz

In Weeks 2 and 3 you saw how the tricky topic process supported you in identifying a tricky topic and breaking it down into smaller, more manageable chunks or 'stumbling blocks'. The process also supported you in identifying students' problems or 'problem examples' which are examples of the students' barriers to understanding one or many stumbling blocks. In Week 2 you also used the problem distiller which further supported you to reflect on why students have these problems by categorising the problem examples and stumbling blocks according to the theoretically underpinned classifications and developed a structure for your tricky topic.

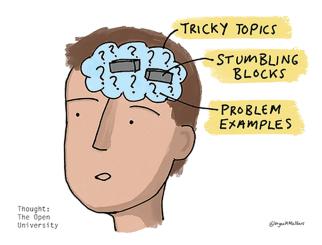


Figure 2 In my head

You then spent two weeks (Weeks 4 and 5) developing your knowledge of learning design in order to design interventions which adequately address the needs of learners. All this work led you to be able to identify what sort of interventions might help your students to overcome their barriers to understanding (in Week 6). This week you are going to design a quiz which will evaluate that intervention by targeting questions in order to identify gaps in students' knowledge of specific stumbling blocks. The visualisation in Figure 3 shows how the different tasks of the tricky topic process are all mapped together and how this then relates to creating quiz questions with different complexity. For example a question that links to several stumbling blocks is more complex 'tricky' than one that relates to only one stumbling block. Although, obviously, you will need to have sufficient questions assessing individual stumbling block to be able to evaluate the students' understanding of it.



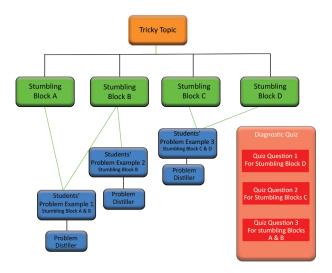


Figure 3 Quiz questions related to stumbling blocks and problem examples

Look back at the structure of your tricky topic which you created in Activity 5 of Week 3. Then work through the next section before actually creating some quiz questions for your tricky topic in Activity 1.

## 2.1 Creating a question

This section will now support you in turning all the detailed information you have collected (about your students/friends/family/colleagues, their problems in your tricky topic and the possible causes of these problems) into quiz questions. The following steps will help you to create quiz questions based upon tricky topics. It is suggested that you start with simple multiple choice questions before moving onto more complex question types.

There are six steps in creating a tricky question:

Table 1 steps in creating a tricky question

Step	Description
1 Review tricky topic and choose stumbling blocks.	The first step when creating a tricky topic question is to review your tricky topics and decide on which stumbling block(s) you are going to focus on for your quiz question. The use of one or several stumbling blocks should be based upon looking through the problem examples and how they link through to one or many stumbling blocks.
2 Label your question.	Label the question with the appropriate stumbling blocks or multiple stumbling blocks. At this stage, you should also consider how many marks each question is worth. For example, questions addressing 2 or 3 stumbling marks may have a greater mark weighting to those addressing one stumbling block.
3 Identify mistakes.	Review the list identified (Week 1, Activity 1) from the problem distiller linked to the problem examples and stumbling blocks (see Figure 3). This should give you an understanding of what mistakes students make and why they make them.
4 Write question to trigger mistake.	Write a question that could lead your student to a response which matches the problem examples you have identified.



5 Write responses that are identified mistakes.	Provide questions responses (i.e. the answers) that fit with the problem examples you have identified. Make sure that there are multiple responses to the question that cover the mistakes that students commonly make.
6 Review questions & answers.	Review the problem distiller reasons to help guide the question responses (i.e. the answers) you created in Step 5. For example, if the mistakes are based upon problems with language misunderstanding try to create responses that would trigger these mistakes. Try to include all relevant problem distiller items.

Make sure when creating your whole quiz to:

- Ensure that single stumbling block questions are easier to answer than multiple stumbling block questions and the weighting of marks should reflect this.
- You create sufficient questions that cover each stumbling block to ensure that you
  have effectively checked that students have a deep understanding of that stumbling
  block.
- Ensure there is a balance of both single stumbling block questions and multiple stumbling block questions since this will balance out the complexity of the quiz.
   There may also be several questions that cover one problem example depending on the complexity of the problem example. It is important to note that creating questions is not a one to one mapping, i.e. there is not one question per stumbling block or problem example.

## 2.2 Wording your question

Below are six top tips for wording questions:

- 1. When designing questions consider if each question has the same meaning for everyone. Using a term from students' learning is important but when introducing new language be careful that these terms are clearly understood or explained. Without this your students may simply not understood an additional term you used rather than the concept in the learning itself. Providing definitions or examples is a useful way to overcome these problems.
- Keep quiz questions as short and simple as possible. This will increase the likelihood that the quiz will be understood and that the responses are the students' real understanding of that concept without additional barriers to them revealing their understanding.
- 3. Make sure that questions are not complicated by double negatives or loaded words which make it harder for the student to find an answer even if they do understand the concept for example: 'which ..... did you not consider?').
- 4. Although you maybe including more than one stumbling blocks in a question try not to ask more than one question in the same question. For example: 'How to respond to ... and ...?').
- 5. Try not to ask a question that requires that students interpret your meaning of a term (e.g. 'Does ..... require regular input?' What is meant by the concept 'regular input', is it once a day or once a week?). Providing a range within which to choose a response will help to clarify these choices.



6. Try not to include responses that are obviously socially undesirable or positively desirable and thus make the response obviously wrong or right such as positive or negative terms connected to the concept. For example words like good, accurate, formulated etc. encourage the student to look for these responses rather than the content that the answer is giving.

Here is a very simple example of a question for the Moles tricky topic (designed purely to show how it links to the stumbling blocks and problem examples).

Question 1: What is Avagadro's Constant?

- 6.02 × 1023 (correct answer)
- 6.02 × 1022
- 6.00 × 1023
- 602 × 1023

Check back to Week 2 and see how this links to the stumbling blocks and problem examples.

It links as follows:

- stumbling blocks: working with equations, purpose of moles
- problem example: choosing the correct equation
- distiller categories: terminology, lack of linked concepts

Now complete Activity 1 where you will create a short quiz which you can use to partially evaluate the success of the intervention you designed in Week 6 Activity 2.

#### Activity 1 Create a quiz for your tricky topic

Allow approximately 40 minutes

Using the structure of your tricky topic you created in Activity 5 of Week 3, create at least two questions for each of your stumbling blocks. Remember one question can cover two stumbling blocks but you must have at least one question for each individual stumbling block.

Feel free to use whatever quiz system you have in your school/education establishment or any online system. If you wish, you can simply write them in a word document.

To start off with, write simple multiple choice questions, similar to the moles question above, and similar to some that you have been answering at the end of each week in this course.

These can be used to evaluate the intervention you designed in Activity 2, Week 6.



## 3 Using the quiz

It is often thought that the process of taking the test is more important than looking at the results. With this in mind, exams and test conditions have been strongly controlled and monitored. Ensuring that students can't find the answers during a test or copy from each other takes up teacher's time and energy. Also making sure that those who are completing tests at a distance aren't cheating, has been a massive barrier to distance learning. Plagiarism checking has taken up a huge amount of time and resource in higher education. However formative assessment (which is used purely to help students to improve) has tried to focus on the learning that can be achieved through completing tests. When a student is looking up an answer they are motivated to learn the answer – as long as this requires some thought rather than simply repeating an answer. Again this comes back to carefully constructing the quiz questions rather than controlling the test conditions. How you present the results from a quiz can make a major difference to how they are understood by the students and by a teacher. Even presented with a breakdown of which questions they answered correctly and which ones were wrong, it can still be difficult to pinpoint the precise gaps in understanding.

If a student received a 17 out of 20 score, which is the standard way to receive results, they simply get feedback that they are doing quite well or if they get 5 out of 20 that they are doing quite badly. Listing the questions or the topics that they got right as red or black can start to give them a bit more information on where the gaps in their understanding are. However, presenting results from a guiz in a spider or radar chart, with the stumbling blocks represented on each axis, is a powerful way to represent depth of understanding since the multiple scores on one stumbling block show that area as larger. This would mean that the student who received 5 out of 20 had either increased their understanding across the board a little or that they had actually totally understood one stumbling block out of the 4 or more in a tricky topic. Both the listing of the colour coded answers and radar charts can help the student and teachers to understand how a student is progressing more accurately. Emotionally this can also be rewarding to help understand where their gaps in understanding are. In contrast the student who received 17 out of 20 may have thought they were doing well but it could be that they were only doing very well in 3 of the 4 stumbling blocks. See Figure 4, for example, which shows the results for one student in a chemistry quiz. The student has improved their score slightly on two stumbling blocks but there is still some lack of understanding on the 'gas volume'. It could be that the student who only got 5 out of 20 actually is doing very much better on that one stumbling block than the student who got 17 out of 20. For a teacher this could help with matching up students for peer learning.



Figure 4 Quiz visualisations for one student before and after an intervention.

Within the tricky topic process, the quiz visualisation feedback was initially envisaged as a mechanism to support students interpreting their depth of understanding for the tricky



topic and related stumbling blocks. However, it has been found that teachers' usage of the data from quizzes can be far more nuanced if they have class-wide visualisation. Teachers have noted impacts on their future teaching practices, as well as the students own directed learning activities based upon the quiz visualisation.

Figure 5 shows results for the chemistry class of eight students. Each shade represents the results for a student. The teacher deconstructed the visualised results and identified different ways to pair learners for peer learning activities.

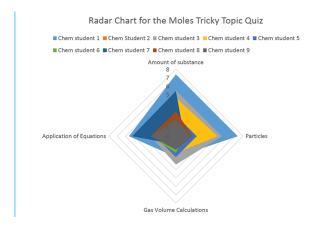


Figure 5 quiz visualisations for a class

It makes me think that students can peer teach and try and unpack their learning. This makes me think the intervention could be with them.

(ChemistryTeacher1)

Upon further reviewing of the visualisation, the same teacher identified that there was also a more generic issue of understanding across all the students on the 'gas volume' stumbling block, which had been answered correctly by only two students. The teacher explained:

But this [gas volume calculations] has to be a bit more about my teaching. I've then got to go look at it again and go, what is it about that that doesn't work? ... it could be me?... possibly re-teaching it again could be useful.

(ChemistryTeacher1)

## 3.1 Appropriate mark schemes

When you set up your quiz, you will need to decide what marks you give for each question. You may have chosen to have one question which covers more than one stumbling block. Therefore, in order to display your results correctly you will need to assess how much of the mark is appropriate to each stumbling block. It may be simply 50:50 in which case, for a question which covers two stumbling blocks, you could give that question two marks and give one mark for each stumbling block.

However, if it was a more basic question which covered two stumbling blocks you may wish to give it only one mark and have half a mark for each stumbling block. Similarly, you may decide that one of the stumbling blocks was more important in a question than



another so you could split the marks appropriately. You must use your professional judgement in setting the mark scheme.

Before doing Activity 2, you may wish to go back to the quiz that you designed in Activity 1 and adjust it. Perhaps you would like to change the way the answers are provided in some way, to help your students to learn from them. Or perhaps you would like to rephrase your questions so they are more meaningful. Or perhaps you would like to think more carefully about which stumbling blocks are covered by each question and whether the marks are appropriate.

Once you are happy with your quiz, do Activity 2. Give your quiz to your students or other people you know.

#### Activity 2 Test your quiz

Allow approximately 30 minutes

Test your quiz that you constructed in Activity 1 out on your students (or colleagues, friends, family). Give it to at least five people if possible.

Ask them to answer the questions and give feedback regarding the wording, marks and which stumbling blocks it addresses. You can use this feedback to edit your quiz.

## 3.2 Creating the charts

Once you have your results from Activity 2, you need to display them in some way.

As you saw in Section 3.1, one of the best ways of displaying these results is as a radar or spider chart which is a visual representation used to organise the results data from your quiz in a logical way. It should have one stumbling block displayed on each axis so that you can clearly see the results for each stumbling block.

Creating a radar or spider diagram can be made very simply with the right software. Here it explained here how to create a chart in Microsoft Excel but other software is also available.

#### Activity 3 radar (spider) diagram

Allow approximately 45 minutes

1. Input data into the Excel spreadsheet.

Table 2, below, is a simplified version of the data from the moles tricky topic quiz (note that in reality these numbers may not be whole, as the marks for each stumbling block will be split appropriately):

Table 2 Excel sheet showing simplified data from moles tricky topic quiz

Student	Amount of substance	Gas volume calculations	Application of equations	Particles
chem 1	6	0	4	6
chem 2	7	2	5	7
chem 3	5	1	3	6



2. Click Insert > Other Charts > Radar, and select the radar chart type you like. A simple radar has been selected here as an example. See Figure 6:

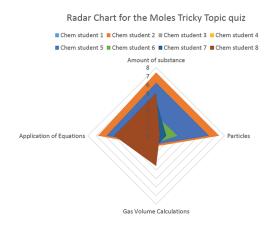


Figure 6 Example radar chart

#### Plot the results from your quiz

Now, try plotting the results from Activity 2 onto a chart, by following the instructions below.

Insert your data into Excel (or similar) and plot your results onto a radar (spider) diagram. The results for each Stumbling Block being mapped separately on each axis.

Show your results to each student (or colleagues, friends and family) in both forms. That is, the numerical score (e.g. 10 out of 20) and then the results plotted onto a spider diagram.

Gather their responses. Are the visual results easier to read? Is it easier to identify gaps in knowledge? Why is that? Write down your findings.

Feedback your findings to the tricky topics team on IRIS Connect. You can find the discussion board on the Activities tab – Week 7, Activity 3.

## 3.3 Reviewing your findings

You should now be armed with all the tools needed to identify, capture and assess your tricky topic. If you have not already done so, you could now give your tricky topic intervention to your students, friends, family and give the quiz again to see if there is any improvement and hence be able to fully evaluate your intervention.

Now complete this week's quiz to assess your own knowledge of this week's learning.



## 4 This week's quiz

Check what you've learned this week by doing the end-of-week quiz.

Week 7 practice quiz

Open the quiz in a new window or tab then come back here when you've finished.



## 5 Summary of Week 7

This week has continued to build on the 'Assess' stage of the tricky topics process that you have been learning through Weeks 4, 5 and 6. It has built on your knowledge of tricky topics that you developed over the previous weeks of this course and the work that you did on identifying and capturing your own tricky topic in Weeks 2 and 3.

You have read, this week, about the importance of evaluation and learned how to create a quiz which can be effectively used to evaluate an intervention. You have created a quiz to evaluate the intervention you designed in Week 6 to overcome individual stumbling blocks in your tricky topic. You have then been asked to test out the quiz and display your results on a spider diagram in order for you and your students (etc.) to visualise progress made in overcoming those stumbling blocks.

You should now be able to:

- understand where the quiz fits into the tricky topic process
- create tricky topic quiz questions which evaluate learning of specific stumbling blocks
- · identify different approaches to using tricky topic quizzes
- set up and use some quiz questions for your tricky topic.

Your work on the tricky topics process is now almost complete. In Week 8 you will be reflecting on the whole tricky topics process in order to evaluate how far you have come and where you need to go next with tricky topics. You can now go to Week 8.





# Week 8 Reflection, sharing and becoming a champion

#### Introduction

Welcome to Week 8 of this badged open course. This final week builds on the work you've carried out so far to further develop your understanding of implementing the tricky topics and learning design processes in your organisation. The previous weeks' activities have given you a good understanding of tricky topics and the tricky topic process that will help you to help your students to succeed. This week's activities introduce you to some of the theories and elements that underpin tricky topics.

By the end of this week you should be able to:

- relate the tricky topics and learning design processes to your own context
- identify how you can adapt tricky topics and learning design processes for your own teaching and organisational needs
- understand how to share your understanding with colleagues through cultivating a learning community
- develop different approaches to becoming a tricky topics and learning design champion.



## 1 Developing yourself and your organisation

Professional development of staff is core to any profession, its quality and support defines an organisation. This course has been developing your own skills and capabilities in tricky topics and learning design. If you want to ensure that your organisation benefits from this work, it is important to start sharing your learning appropriately with your colleagues and develop their skills. Then, together you can support your organisation to put in mechanisms to enable ongoing learning and development.

To develop your colleagues and then your organisation it is pertinent to understand what knowledge they already have and how they need to progress. This requires the creation of communities that share and develop good practice whilst not judging individuals for their lack of expertise in some areas.

Therefore, by developing your skills and capabilities in tricky topics through this course, you can become a 'champion' and a leader in your organisation for tricky topics and learning design. It might be useful to think through your own role in your organisation and how to work with others to enable taking this championing role forwards. One approach to leading here would be to clearly identify, for your organisation, what it is you want people to follow. For example:

- How have you adapted the tricky topic and learning design approaches so they are more applicable to your organisation?
- What are the clear messages you need colleagues to take away on this?
- How are you going to communicate those messages to colleagues?
- How are you going to create momentum in your organisation and keep that momentum going?

A good way to start is to show-case your own learning journey through this course to your colleagues and to highlight what advances you've made. You can also agree to mentor colleagues in their own developmental journeys. Recognition for completing excellent work, such as teaching awards, is another way of developing your colleagues and your organisation. It is worth also looking at online information on mentoring and coaching.

The aim would be to start a tricky topics movement in your organisation. Activity 1 should give you some ideas about starting a movement.

#### Activity 1 First follower

Allow approximately 15 minutes

Watch Video 1 and make some notes in the box below. Think about how you could lead a tricky topics movement in your teaching context or develop a tricky topics community in your organisation. You can also record your feedback on the IRIS connect group. See Week 8, Activity 1 in the activities tab.

Video content is not available in this format.

Video 1 First Follower: Leadership lessons from dancing guy



## Leadership Lessons from Dancing Guy

by Derek Sivers sivers.org/ff

Provide your answer...

#### 1.1 Cultivating communities

You probably already know quite a lot about learning communities but have you ever thought about creating, or cultivating, a new community? To understand how to develop a community within your organisation you need to clearly understand what makes an effective learning community. There has been a lot of research into learning communities over recent years which can help you to envisage what a new tricky topics community within your organisation might look like.

Who we are is very tightly interwoven with what we have learned (Lave and Wenger, 1991). This has been a clear argument behind learning for centuries as students seek to develop themselves through learning. However, as Lave and Wenger (1991) emphasise, learning within any domain is more than a formal acquisition of knowledge, it has a strong social element also. The concept of situated learning highlights how learning and its development relates to sociocultural contexts and how this impacts on our identities. Goffman (1969) similarly highlights that our identities are not fixed commodities that can be simply traded up or down after learning occurs. Students are one person inhabiting multiple social worlds. Each individual has complex identities and one adapts and presents alternative sides for different social situations or communities.

The concept of 'Communities of Practice' emerged from a learning theory developed by Lave and Wenger (1991) called 'legitimate peripheral participation'. Learning, it argued, should be through a process of participation in communities of practice. The theory details how new members are brought into knowledge communities and how knowledge communities both transform and reproduce themselves. This participation is, at first, peripheral but may gradually increase in both engagement and complexity.



However, some people in a community of practice will remain peripheral either because they do not feel fully competent or because they have insufficient time to fully engage. Unlike other groups and societies where half-hearted engagement may be frowned upon, people on the sidelines of a community of practice are important peripheral members (Wenger et al., 2002). For example, teachers who observe a new innovative teaching method or theory may not interact with the designers of that method/theory but it may still impact on their teaching practice. The act of sharing the knowledge is a key component to improving teaching and learning in tricky topics. However, as you have seen throughout this course, the feedback of developing practice is also very important. So a feedback mechanism is required in your community of practice which will encourage fuller participation and improve the sharing of knowledge.

Lave and Wenger (1991) argue that an emphasis within learning should be on the whole person and that learning equally involves an agent, an activity and a world. Wenger (1998) extends this to a framework in which two basic streams are *practice* (from collective social norms of practice to accounts of meanings) and *identity* (from impacts of organisational power and social structures to those of personal subjectivity). This emphasis on identity within communities of practice indicates the importance of both psychological and sociological factors which must be considered within any situation. Wenger (1998) suggests that focusing on participation of communities of practice 'has

Wenger (1998) suggests that focusing on participation of communities of practice 'has broad implication for what it takes to understand and support learning.'

- For individuals, it means that learning is an issue of engaging in and contributing to the practices of their communities.
- For communities, it means that learning is an issue of refining their practice and ensuring new generations of members.
- For organisations, it means that learning is an issue of sustaining the interconnected communities of practice through which an organisation knows what it knows and thus becomes effective and valuable as an organisation.' (pp. 7-8)

If this concept is new to you, or you would like to refresh your memory of learning communities then you may wish to read further on the subject (please see further reading section at the end of this week).

It would be useful for you to think through these elements of communities of practice with regard to your own organisation.

## Activity 2 Sharing and championing of tricky topics

Allow approximately 15 minutes

Review your own organisation with regard to what you've learned from this course and how other colleagues approach their teaching and learning.

Identify, within your own organisation, how you could develop a tricky topics community in which you can lead the sharing and championing of tricky topics and learning design. Make some notes in the box below.

Feedback on IRIS Connect group about how you plan to lead (or already have led) sharing and championing tricky topics and Learning Design within your organisation or community of practice. See Week 8, Activity 2 in the Activities Tab.



## 2 Tricky topics theories

In Week 1 of this course you read about the pedagogical underpinning of threshold concepts and tricky topics. Look back and reflect on the literature of theory and research you met in Week 1.

#### Activity 3 Reflecting on tricky topic theory

Allow approximately 15 minutes

Think about these questions:

- What have you learned about the theory and research of threshold concepts and tricky topics that is relevant to you and your teaching context?
- What has been done to improve the knowledge of tricky topics in your subject area? Who has made a difference?
- What research exists into the tricky topics in your subject area?
- How has that research (or new theories) impacted on the teaching and learning of tricky topics in your subject area?
- Where is the bulk of research happening?
- What countries?
- · Why there?
- Who are the key people developing the theories?

If there is no research or development of new theories happening in your subject area, why might that be? What can be done to improve the situation?

Make notes about the developments of tricky topics theory/research in your subject area, by reflecting on Week 1 and answering some or all of the questions above.

Provide your answer
---------------------

## 2.1 Sharing relevant theory and research

If the theory and research in your subject area is significant, how is it currently being shared across the teaching and learning community? If there is no research, or very little research, in your subject area, how can it be developed further? As you saw in Week 1, the theory of threshold concepts is a vibrant academic topic which has been shared widely among researchers across the globe. Tricky topics, and the more practical application of those threshold concept theories, is a very recent phenomenon, and has therefore, not been shared much at all.

How can you share your knowledge of existing theories to your colleagues in your teaching context? Can you share it through a new tricky topics learning community in your organisation?



#### Activity 4 Sharing tricky topic theory

Allow approximately 5 minutes

If there is research/theory in tricky topics in your subject area, write down two things which can help you to share those developments across your colleagues/organisation. If there is no development in your subject area, write down two things which can help you to improve the situation.

Provide your answer	



## 3 The tricky topic process

In Weeks 2 and 3 of this course you learned how to identify and capture tricky topics through the tricky topics process. In this section you are going to look back at Weeks 2 and 3 and reflect on how you did this. It will be helpful to look at Activities 5 and 8 in Week 3 which built on your work in Week 2.

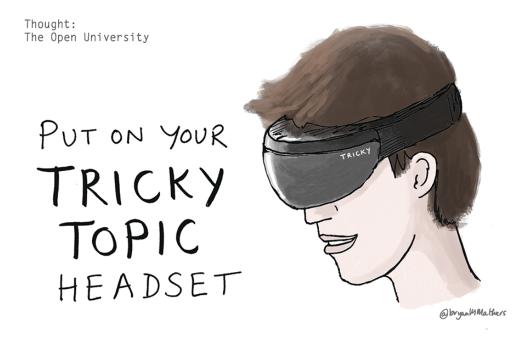


Figure 1 Tricky topic headset

In Activity 5 of Week 3 you wrote a few sentences about your thoughts on the tricky topics process, explaining whether it made sense to you, whether it was something you felt that you could now do, and how it related to your experiences on the needs analysis. You then went on to do some structuring and sharing of your tricky topic. Both these activities involved writing your thoughts and feeding them back to the tricky topics team. Finally, you read about the practicalities of different types of tricky topics workshops that could be conducted in different contexts, in order to collaboratively identify, capture and share tricky topics with colleagues (Week 3, Section 4).

#### Activity 5 Reflecting on the tricky topics process

Allow approximately 20 minutes

- Look back at Activities 5 and 8 in Week 3.
- 2. Now, reflect on the feedback you provided for those activities.
  - How have your thoughts changed?
  - Does the tricky topics process work for you?
  - Has this course helped you to feel more able to conduct a tricky topics workshop in your teaching context or organisation?



- If you have been able to share this with your colleagues, how has that worked for you and your colleagues?
- 3. Write down your thoughts about the 'Identification' and 'Capture' stage of the tricky topics process.
  - What form of collaborative workshop would/does work for your organisation to better identify students' problems?
  - How can you share tricky topics within (and beyond) your organisation?
  - What works for you?
- 4. Feedback your thoughts to the tricky topics group on IRIS Connect. See Week 8, Activity 5.

Provide	vour	answer
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The feedback you are providing via the IRIS Connect is a form of sharing. You are sharing your thoughts and experiences with the tricky topics team at the Open University. But how can you better share your tricky topics with teachers in your organisation and in other organisations and even other countries?

### 3.1 Sharing what works

Common language is an important part of a community of practice. In fact, the reduction of jargon and the simplification of language for sharing tricky topics is a tricky topic in itself. The tricky topics guide website you visited in Weeks 2 and 3 is supporting a tricky topics community by enabling teachers to share their thoughts and experiences and read about other teachers' thoughts and experiences. However, it is not interactive and does not enable you to directly communicate with others who are working on tricky topics which may be relevant to you and your organisation.

There is however a developing tricky topics community available via IRIS Connect (which you were introduced to in Week 3) and a tricky topics group, 'Teaching and learning tricky topics' which you have been referred to through the weeks.

#### Activity 6 Tricky topics group

Allow approximately 15 minutes

Go onto IRIS Connect and access the tricky topics group, "Teaching and learning tricky topics" and access the videos and activities of other teachers to facilitate your understanding of the tricky topics process. Share your discussions with other users in the group. It also contains further guidance on how you can develop your own ideas and reflections further using video.

You can also share you tricky topics practice by tweeting to @Tricky\_Topics, presenting your work at internal or external conferences or teechmeets, or create your own YouTube video.

A tricky topics movement that is right for your organisation needs to help you to share and understand student's problems and identify key stumbling blocks in order for the solutions



to those blocks to be fully developed, taught and shared. Moreover, it needs to help your colleagues to be able to do the same.



## 4 Learning design

How do you develop learning design in your organisation? What's applicable, what's not? How do you share your ideas of learning design for tricky topics? What's different?

In Week 5 you learned about the activity types that are used at The Open University, but it was also mentioned that other institutions use different versions which might be better suited to their own teaching methods. For example, some education providers base their activity types on Bloom's taxonomy (see Figure 2) which uses a hierarchy of categories to describe the stages of learning and understanding. The framework elaborated by Bloom and his colleagues originally consisted of six major categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. The categories after knowledge were presented as 'skills and abilities', with the understanding that knowledge was the necessary precondition for putting these skills and abilities into practice.

In 2001, a revised taxonomy was developed, which was called a Taxonomy for Teaching, Learning and Assessment which consists of more verbs or 'action words' to describe the cognitive processes.

#### Activity 7 Bloom's taxonomy

Allow approximately 20 minutes

If you are not already familiar with this framework, spend a few minutes reading about how Bloom's taxonomy is used. How do you think it compares to the Open University's framework that you read about in Week 5? Which version do you find more appropriate for your own organisation?

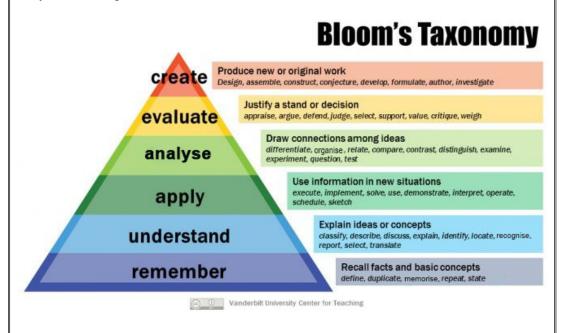


Figure 2 Bloom's Taxonomy

Vanderbilt University Center for Teaching

Now use the template below (Figure 3) to create your own version of this hierarchy showing how the student could develop their thinking for your chosen tricky topic.







## 5 Learning innovations

After completing Week 6 you should have more of an idea of innovations that are relevant for your tricky topics. It is important as you move forwards within your organisation in sharing these ideas, that you identify the effectiveness of these innovations. But what is meant by effective? Evidence-based practice has been an important international movement that has argued for evidence underpinning innovation choices and implementation approaches. But what is meant by evidence-based practice?

### What is evidence-based practice?

Evidence-based practice requires decisions about practice to be based on the best available, current, valid and relevant evidence.

Evidence-based practice came to the forefront in the 1980s through the evidence-based medicine movement pioneered by practitioners and academics like Sackett et al. (1996). Evidence-based medicine has since moved into other disciplines such as evidence based education (Horner et al., 2005; Perry and Smart, 2007). There are many criticisms around a restrictive concept of 'evidence' as experimental.

The evidence-based practice (EBP) movement have complicated this debate further with value statements about one methodology (i.e. randomised controlled trials) superiority over another regardless of the reviews of method effectiveness to answer different practice related questions. It must be acknowledged that in many cases literature on evidence-based practice has taken a very limited view on evidence and thus the guidance for practitioners in assessing and reviewing evidence is often flawed. Practitioners cannot be expected to become research methods experts yet there is an underlying assumption that they should become experts in educational research. While it is important to carefully review what you use as evidence, the argument for rating and evaluating the effectiveness of different interventions is a strong one.

#### Activity 8 What works?

Allow approximately 15 minutes

Read the section on Education (pages 13-17) in What Works Network (2014)

How do you think that this type of rating for innovations would work in your organisation? Think through how innovations could be rated for solving your organisations tricky topics and learning design issues. What other types of ratings your colleagues could share on innovations that they used in teaching and learning. Share your thoughts on rating different innovations and how well they support tricky topics and learning design within your organisation on IRIS Connect. See Week 8, Activity 8.



## 8 Summary of Week 8

This week you have built on your knowledge of tricky topics and learning design that you developed over the previous weeks of this course. You should now have a really good understanding of how to relate the tricky topics and learning design processes to your own context. You should now be able to adapt the tricky topics and learning design processes to develop your own teaching and also to adapt it to the needs of your organisation. You have read about the importance of good leadership, learning communities as well as rating and sharing good practice. You should now have developed your understanding of how to share your knowledge of tricky topics with colleagues, possibly by cultivating a new learning community.

By reflecting on your learning through this course you should have evaluated how far you have come and where you need to go next with tricky topics. This work should help you to develop yourself as a champion for tricky topics and learning design within your community or organisation.

You have learned a lot about how to apply your new skills. This should help you to help your students to succeed but should also prove to be invaluable for your colleagues and your organisation.

You should now be able to:

- relate the tricky topics and learning design processes to your own context
- identify how you can adapt tricky topics and learning design processes for your own teaching and organisational needs
- understand how to share your understanding with colleagues through cultivating a learning community
- develop different approaches to becoming a tricky topics and learning design champion.

Don't forget to complete and pass the Week 8 quiz to become eligible to earn the badge.



## 7 This week's quiz

Now it's time to complete the Week 8 badge quiz. It is similar to the badged quiz that you took at the end of Week 4, with 15 questions in total.

#### Week 8 compulsory badge quiz

Remember, this quiz counts towards your badge. If you're not successful the first time, you can attempt the quiz again in 24 hours.

Open the quiz in a new window or tab then come back here when you've finished.



## 8 End-of-course round up

During this course you have done a lot of work that should have led towards a better understanding of your students' misunderstandings. You identified tricky topics, broke them down into stumbling blocks and problem examples then, through the problem distiller, you identified why students may have these barriers to understanding.

You then identified and designed an innovative intervention to help students to overcome these barriers. Finally, you have evaluated the effectiveness of this intervention by designing a tricky topic quiz which appropriately measured the success of the intervention to overcome specific stumbling blocks in the tricky topic. You have also learned how to display the findings visually in such a way as to help the students and yourself to identify where further work is needed.

Now you should now be able to help others, within your organisation and elsewhere, to learn from what you have learned. Earlier you saw that platforms such as IRIS Connect provide excellent ways of sharing resources and as we can see in the many 'what works' sites, there is already a movement in many organisations to share this type of understanding.

The tricky topics community can support you to share your knowledge appropriately. So, it is time to take the next step. You are a tricky topics champion so begin to share your knowledge of how to overcome tricky topics.

Your work on *Teaching and learning tricky topics* is now complete, we hope you have enjoyed the course. You are a tricky topics champion! The author team wish you the very best of luck in your future endeavours.



## Where next?

If you have enjoyed this course you can find more free resources and courses on <a>OpenLearn</a>, you may find the following OpenLearn content of particular interest:

- Open education
- The digital scholar
- The power of infographics in research dissemination
- Leadership and followership

Why not find out more about studying and gaining qualifications at The Open University? Making the decision to study can be a big step and The Open University has over 40 years of experience supporting its students through their chosen learning paths. You can find out more about studying with us by visiting our online prospectus.



## Tell us what you think

Now you've come to the end of the course, we would appreciate a few minutes of your time to complete this short <u>end-of-course survey</u> (you may have already completed this survey at the end of Week 4). We'd like to find out a bit about your experience of studying the course and what you plan to do next. We will use this information to provide better online experiences for all our learners and to share our findings with others. Participation will be completely confidential and we will not pass on your details to others.

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## Further reading

If you would like a more in-depth understanding, you may like to read Coley and Tanner's 2012 paper on the origins of misconceptions in biology, to get an insight into a range of student misconceptions and how these misconceptions cause problems when they clash with new knowledge.

Coley, J. D. and Tanner, K. D. (2012) 'Common Origins of Diverse Misconceptions: Cognitive Principles and the Development of Biology Thinking', *CBE—Life Sciences Education*, vol. 11, pp. 209–215 [Online]. Available at https://doi.org/10.1187/cbe.12-06-0074 (Accessed 5 June 2018).

If you are interested in finding out more about threshold concepts, read the following extract from the OU's 2014 Innovating Pedagogy report.

Sharples, M., Adams, A., Ferguson, R., Gaved, M., McAndrew, P., Rienties, B., Weller, M., Whitelock, D. (2014) *Innovating Pedagogy 2014* [Online], Milton Keynes, The Open University. Available at



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If you are interested in reading more about how The Open University uses the learning design approach to produce its modules and qualifications and re-evaluate existing modules, a good place to start is this report by Rebecca Galley (2015) (
<a href="http://www.open.ac.uk/iet/learning-design/sites/www.open.ac.uk.iet.learning-design/files/files/ecms/web-content/Learning-Design-at-the-Open-University.pdf">http://www.open.ac.uk/iet/learning-design/sites/www.open.ac.uk.iet.learning-design/files/files/ecms/web-content/Learning-Design-at-the-Open-University.pdf</a>) in which she covers a lot more detail about the processes we adopt, as well as the use of student data to inform module design.

You might like to have a look at some additional information about designing accessible materials. We think these resources provided by <a href="the-OU SeGA team">the OU SeGA team</a> are a good place to start and you might also want to look at information provided by JISC and the Government Digital Service:

JISC (2015a) *Deliver an inclusive digital student experience* [Online]. Available at <a href="https://www.jisc.ac.uk/guides/enhancing-the-digital-student-experience/deliver-an-inclusive-digital-student-experience">https://www.jisc.ac.uk/guides/enhancing-the-digital-student-experience/deliver-an-inclusive-digital-student-experience</a> (Accessed 5 June 2018).

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You can read more about this process in Rebecca Galley's report that we referred to earlier:

Galley, R. (2015) 'Learning Design at The Open University: Introducing methods for enhancing curriculum innovation and quality', Milton Keynes, The Open University.

If you wish to read more innovating pedagogies, you can read more from the Innovating Pedagogies reports as follows:



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Sharples, M., de Roock, R., Ferguson, R., Gaved, M., Herodotou, C., Koh, E., Kukulska-Hulme, A., Looi, C-K., McAndrew, P., Rienties, B., Weller, M., Wong, L. H. (2016) *Innovating Pedagogy 2016* [Online], Milton Keynes, The Open University. Available at https://iet.open.ac.uk/file/innovating\_pedagogy\_2016.pdf (Accessed 6 June 2018).

You may wish to read the following article on the use of digital storytelling in the classroom.

Robin, B. R. (2008) 'Digital Storytelling: A powerful technology tool for the 21st century classroom', *Theory into Practice*, vol. 47, pp. 220–228 [Online]. Available at <a href="http://digitalstorytellingclass.pbworks.com/f/Digital%2520Storytelling%2520A%2520Powerful.pdf">http://digitalstorytellingclass.pbworks.com/f/Digital%2520Storytelling%2520A%2520Powerful.pdf</a> (Accessed 6 June 2018).

If you are interested in developing games-based interventions or find the subject area of this intervention interesting you should read the following articles:

Hart, J., lacovides, I., Adams, A., Oliveira, M., and Magroudi, M. (2017) 'Understanding Engagement within the Context of a Safety Critical Game'. To appear in proceedings of the annual ACM Conference CHI Play 2017, New York, NY, USA, ACM [Online]. Available at https://dl.acm.org/citation.cfm?doid=3116595.3116633 (Accessed 20 July 2018).

Margoudi, M., Hart, J., Adams, A. and Oliveira, M. (2016) 'Exploring Emotion Representation to Support Dialogue in Police Training on Child Interviewing', in *Serious Games JCSG 2016*, Lecture Notes in Computer Science 9894, Springer, pp. 73–86 [Online]. Available at <a href="https://link.springer.com/chapter/10.1007/978-3-319-45841-0\_7">https://link.springer.com/chapter/10.1007/978-3-319-45841-0\_7</a> (Accessed 20 July 2018).

Blessingwhite (2016) The CLEAR Coaching Model - Blessingwhite – Leadership Development and Employee Engagement. [Online]. Available at <a href="http://blessingwhite.com/model/2016/05/17/clear-coaching-model/">http://blessingwhite.com/model/2016/05/17/clear-coaching-model/</a> (Accessed 6 June 2018).

Whitmore, J. (2009) Coaching for performance: GROWing human potential and purpose: the principles and practice of coaching and leadership, 4th ed., United Kingdom, Nicholas Brealey Publishing.

Zachary, L. J. (2002) 'The Role of Teacher as Mentor', *New Directions for Adult and Continuing Education*, Spring 2002, no. 93, pp. 27–38.

It might help to look through additional information about evidence-based practice:

Education Endowment Foundation's What Works Network

What Works? evidence for decision makers report

Read more about the social theory of learning in the following:

Wenger, E. (1998). *Communities of practice: learning, meaning and identity* Cambridge University Press, Cambridge.



## Acknowledgements

This free course was written by Anne Pike, Anne Adams, Gill Clough, Julia Sargent, Liz Hartnett, Ruth McFarlane, Popi Anastasiou, and Jennifer Hart.

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#### Week 1

#### **Figures**

Figure 3 from McCloskey, M. (1983). Intuitive physics. Scientific American, 248(4), 122-130.

https://www.researchgate.net/profile/Dennis\_Proffitt/publication/229706606\_Intuitive\_-Physics/links/0f31753c6a7e3db2bc000000.pdf

Figure 4 from Kabo, J. D. (2010) Seeing Through the Lens of Social Justice: A Threshold for Engineering, Figure 1, A PhD thesis submitted to the Department of Chemical Engineering, Queens University, Kingston, Ontario, Canada

http://qspace.library.queensu.ca/bitstream/handle/1974/5521/Kabo\_-

Jens\_D\_201004\_PhD.pdf?sequence=1&isAllowed=y

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#### Week 2

#### **Figures**

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Figure 9 Courtesy © Anne Pike

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#### Week 4

#### Text

Section 2 Hearing the Student Voice: Extract from Olney, T, Toetenel, L, and Rienties, B., (ed) (2017) Gathering, visualising and interpreting learning design analytics to inform classroom practice and curriculum design: a student-centred approach from The Open University. In Lodge, J., Cooney Harvath, J. and Corrin, L., *Learning Analytics in the Classroom*. London: Routledge.

#### **Figures**

Figure 1 courtesy © Gill Clough

Figure 3 Student Voice Logo https://www.cardiffstudents.com/your-voice/

Figure 4 © The Open University

Figure 6 courtesy © Anne Pike

Figure 7 courtesy © Anne Pike

#### Week 5

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#### Week 6

#### **Figures**

Figures 2 and 3 adapted from <a href="http://www.bbc.co.uk/guides/zsgwwxs#z2nrrdm">http://www.bbc.co.uk/guides/zsgwwxs#z2nrrdm</a> and other unidentified educational resources

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#### Week 8

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Video 1 Dancing Guy courtesy Derek Sivers derek@sivers.org https://sivers.org/

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