

## Creating memorable content

Instead of relying on students finding out what they need to know from the Internet, we should think about how we can give them information that is not just reliable, but that has also been designed for learning.

### Principles of multimedia learning

To understand more about the best way of presenting content, and how technology can help, we need to turn to the work of Richard Mayer. Together with his colleagues, he has developed about 30 principles of multimedia learning which provide a powerful guide to creating memorable learning content.<sup>28-29</sup> Let's explore three of them in detail:

1. The multimedia principle
2. The split-attention effect
3. The redundancy effect

#### The multimedia principle

One of the most fundamental is the multimedia principle, which is that presenting text and images together can enhance learning.<sup>30</sup> This is because our limited working memories have two channels, one verbal and one visual. So presenting verbal and visual information uses the full capacity of our working memory, and allows us to build more sophisticated mental representations of the concept we are trying to learn. When we see words and images together, we work to connect the two, a form of active mental processing that helps build understanding.

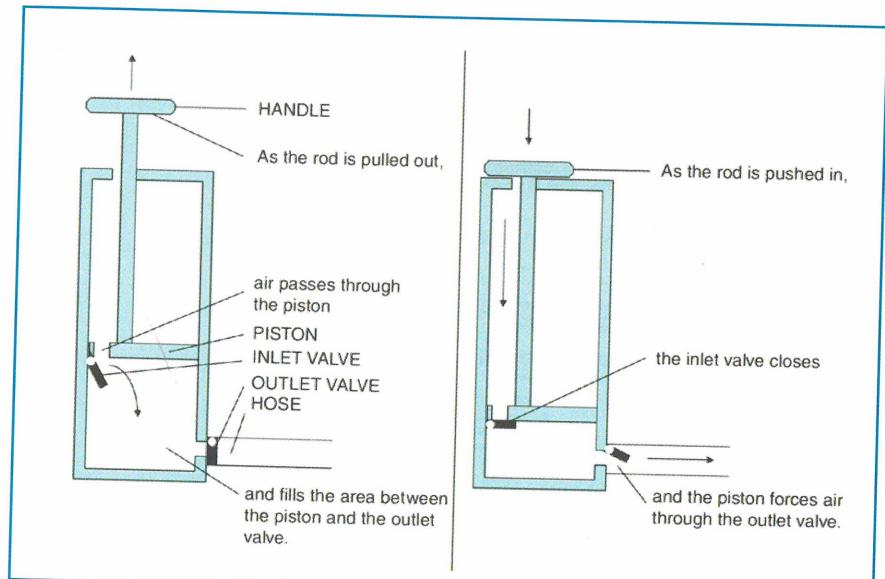
Here is an example from one of Mayer's experiments. One group of students were given the following explanation of a bicycle pump.<sup>31</sup>

## How a Bicycle Pump Works

"As the rod is pulled out, air passes through the piston and fills the area between the piston and the outlet valve. As the rod is pushed in, the inlet valve closes and the piston forces air through the outlet valve."

*Text-only explanation of how a bicycle pump works.<sup>32</sup>*

Another group were given the following explanation.



*Text and image combined explanation of how a bicycle pump works.<sup>33</sup>*

Both groups were then given a test to see not just if they had remembered the details of the pump, but if they could transfer their understanding to different situations; the second group did better than the first. This finding has been replicated in many other studies.<sup>34</sup>

#### The split-attention effect

Some other important principles qualify and develop the multimedia principle and give more detail on how to combine text and images. The split-attention effect shows that closely integrating text and images leads to better learning than providing the text and image separately.

Here's an example taken from an experiment by the academics Paul Chandler and John Sweller.<sup>35</sup> One group of trade apprentices received the following instructional material, consisting of an image and separate text instructions.

**INSULATION RESISTANCE TESTS**

a) CONDUCTORS IN PERMANENT WIRING

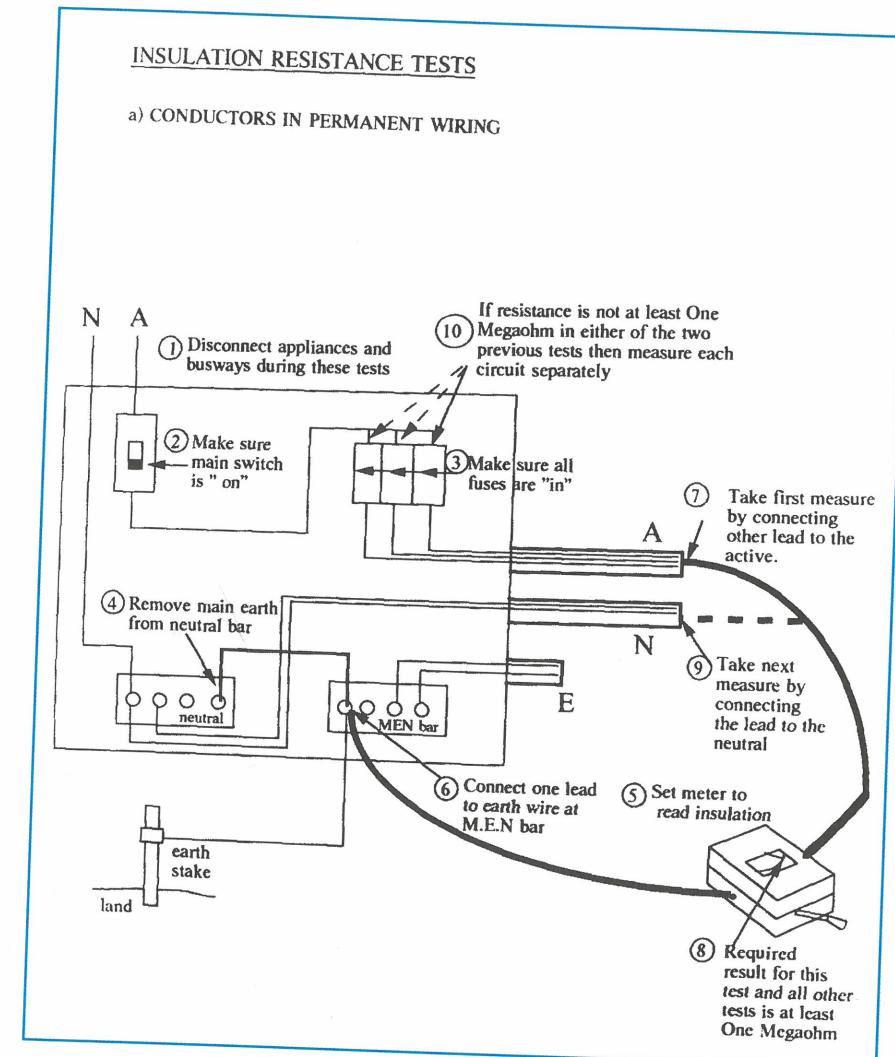
Test : To test Insulation Resistance from conductors to earth

How conducted : i ) Disconnect appliances and busways during these tests. Make sure main switch is "on" and all fuses are "in". Remove main earth from neutral bar and set meter to read insulation. Connect one lead to earth wire at MEN bar and take first measure by connecting the other lead to the active. Take next measure by connecting the lead to the neutral.  
ii) If resistance is not high enough in either of the two tests in i) then measure each circuit separately.

Results required : i) At least One Megaohm  
ii) Same result as i) above

**Text and image kept separate insulation resistance tests.<sup>36</sup>**

The second group received the same information, but the text was integrated with the image.



**Text and image combined insulation resistance tests.<sup>37</sup>**

The second group did better on both the written and practical tests that followed. Sweller and Chandler suggest that the reason for this is that the second group could devote all their attention to understanding the learning material. The first group had to spend more mental effort on a task that was unrelated to learning.

### The redundancy effect

Another important principle that's particularly relevant to lectures and videos is the redundancy effect, which offers guidance on the way spoken word is presented.<sup>38</sup> Consider the resource about the bike pump which contains text and images. If a teacher were to give that resource to a class, how should they present it? Would it help to read out the text to the class, to make sure they were paying attention? The research says no. If learners have to deal with the same written and spoken words at once, they spend working memory resources coordinating the written and spoken words, meaning less working memory is available for learning.

### Applying Mayer's multimedia learning principles

These are just three of about 30 multimedia learning principles. Others give advice on how important information is signalled to the learner, how it can help to progressively reveal content rather than present it all at once, and how it's important for all learning materials to exclude material that's not relevant to the learning objective.<sup>39-41</sup> And the 'expertise-reversal effect' shows that as students gain knowledge and understanding in an area, they can benefit from less-structured and scaffolded instructional materials.

These principles don't depend on certain technologies: Mayer is clear that they can be used in the design of worksheets, textbooks, digital slide presentations, videos and many other formats.<sup>42</sup> However, many of the principles do lend themselves well to newer technology. It's easy to combine images, texts and cues together in a digital presentation or a video, and easy to reveal information in progressive stages too.

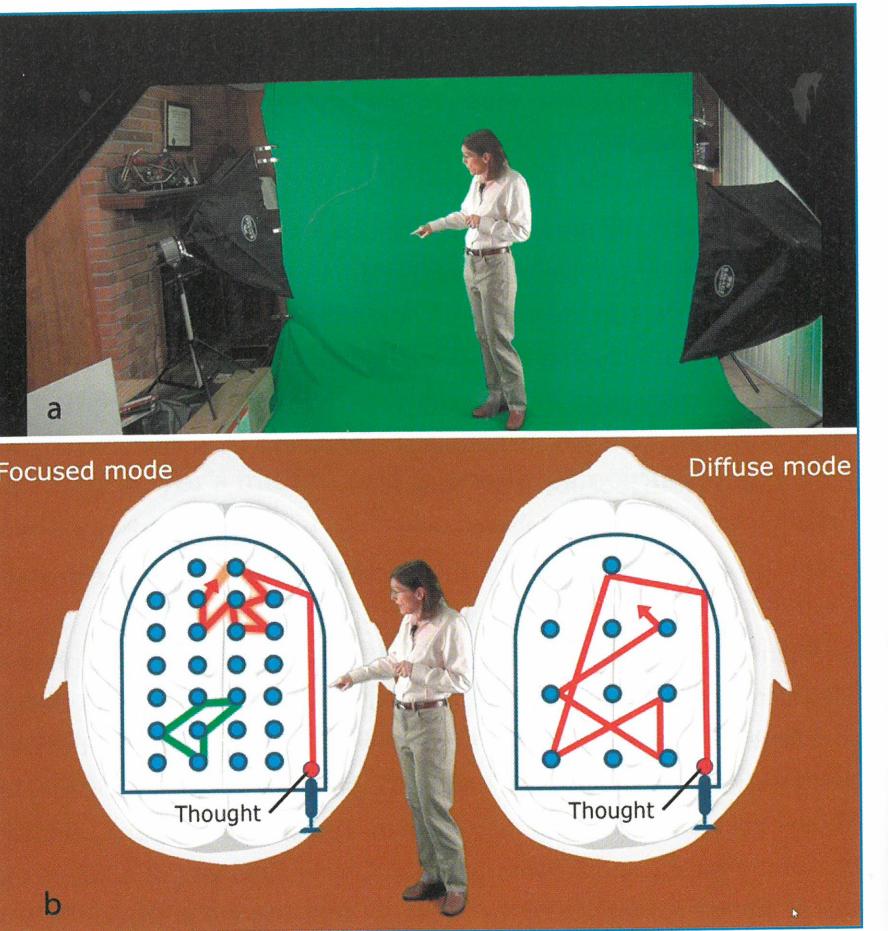
Still, while digital media might make using such principles easy, they don't prevent misuse. Mayer's principles are incredibly powerful, but they are also quite complex and many traditional and digital learning materials

violate them in one way or another. Modern technology makes it easy to integrate images and words in presentations, but it also makes it easy for teachers or lecturers to read out the words on a slide, violating the redundancy principle.

Similarly, while many presentations contain images, often these images are chosen for decorative purposes, and they can end up confusing or distracting learners. In the lesson on how bicycle tyre pumps work, Mayer recommends not including a photo or a video of a person riding a bicycle, as that is not relevant to the learning objective. Instead, he recommends 'using only highly relevant, instructional illustrations and even pointing out in the text what to look for in the illustrations.'<sup>43</sup>

Creating learning materials which fulfil these multimedia learning principles is not going to be easy, and nor will it happen by chance. Fortunately, we can learn from examples of content that has been specifically designed in accordance with these principles. In 2014, two academics, Barbara Oakley and Terrence Sejnowski, launched an online course that was deliberately designed with these principles in mind. Appropriately enough, the subject of their course was learning how to learn. The course has gone on to be one of the most popular Massive Open Online Courses (MOOCs) in the world. While the majority of the students enrolling are in the 25–34 age bracket, school-age students have enrolled too, and the creators have followed up with a book and course designed for younger learners.<sup>44</sup>

In 2019, they wrote a paper explaining how they'd applied Mayer's principles of multimedia learning to the creation of their course. Watching the videos from the course and reading the paper gives an insight into how these principles can be applied. For example, Oakley and Sejnowksi particularly focus on the learning benefits of green screen, as illustrated in the following image.

How a green screen can support learning.<sup>45</sup>

Green screen allows a video of the instructor to be inserted into the learning materials and for everything irrelevant to learning to be cropped out, reducing the extraneous load on working memory. You can also see that the images in this presentation have been chosen carefully to demonstrate the precise point the instructors want to make. They aren't decorative, easy-to-obtain clip art.

The result of all this is an engaging and extremely popular online course that embodies the principles it teaches. It's clear from watching these videos that not all content is created equal. Even reliable online

information may not have been optimized for learning. In order to make sure students get the best learning materials, we have to create them, give them to students, and not rely on them stumbling upon them online by chance.

Oakley and Sejnowski's course doesn't only rely on well-designed content and explanations. In common with many other online courses, it provides frequent end-of-unit quizzes and in-video questions that let students check their understanding. Online quizzes like these have many benefits which we will explore in more detail in the next chapter. What we can see from this chapter is that instead of expecting technology to eliminate the need to build memories, we should instead use technology to make it easier for us to build memories.

### The jobs of the future

Before we look in more detail at quizzes, however, let's deal with one more frequent objection to the idea that we need to know things. This is that, while we may need to memorize facts now, in the future rapid improvements in technology really will make memory obsolete and reduce the need for us to acquire complex skills. Perhaps learning a lot of foreign vocabulary is valuable now, but before long machine translation will improve to such an extent that we'll have *Star Trek*-style language earpieces. Perhaps learning how to map-read is valuable now, but before long we'll wear augmented reality headsets that will direct us to wherever we need to go.

It is true that computers are making rapid improvements in many areas, and we can expect this improvement to have an impact on jobs and the economy. However, while we can continue to expect technology to change the economy, this is not going to have the same impact on education for three reasons.