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Embracing the new revolution: How to effectively teach with technology

By Dave Canavan

If you're a teacher who loves technology and are quick to embrace anything new, you have a real advantage in this ever tech-increasing world of education. But there's a big difference between how a program or app functions and how to practically use and apply those programs or apps in your day-to-day teaching. You may have the tools, but do you know how to use them?

Biography

Dave Canavan is an experienced science teacher with a Master of Science in Behavioural Ecology. Having taught for many years in the UK, Australia and in an international school in Thailand, Dave now works for Stile Education, a company founded by Alan Finkel (currently Australia's Chief Scientist) whose mission is to improve STEM literacy and science engagement in students here in Australia and ultimately around the world.

Technology seems to have always been a part of our lives, but only recently has it become so omnipresent that to think of life without computers, mobile phones and other essentials seems unbearable!

The iPad was invented in 2010, which seems incredibly recent (I would have guessed much earlier), yet only in the last few years has the impact of technology really been felt in education. Early adopters of technology in education started with computer rooms, and the overhead projector was quickly phased out by data projectors, interactive whiteboards and TVs. This certainly changed how we presented content and information to students, but it is only in the last few years that technology access for every student is gradually becoming the norm.

In my role as Community Leader for Stile Education in Queensland I visit many schools with vast variations in their methods of accessing technology and what technology is available to their students. From one-to-one, school-supplied laptops to some flavour of bring your own device (BYOD/X/T or some other acronym!), to iPad schools or letting students use phones, the one common theme is that technology is now (or aims to be) in every classroom, in every lesson, with every student.

The computer rooms of old are being phased out by the idea that you shouldn't need to go somewhere to use technology — technology should be readily available to use in the classroom in all subjects and not just reserved for ICT classes or the odd lesson here and there, assuming you can book a time to get into the computer room!

This change is quick and can be scary. It is fraught with many issues, but ultimately the use of technology in the classroom is hard to argue against and, in reality, it's inevitable. If we as teachers are to prepare our students for life in the 'real world', then an ability to use technology in their everyday lives is essential. Whether you like it or not (and I can assure you that you're not alone if you don't like this new revolution), technology is here to stay and will increasingly become part of your day-to-day job.

If you're a teacher who loves technology and are quick to embrace anything new, you have a real advantage in this ever tech-increasing world of education. But there's a big difference between how a program or app functions and how to practically use and apply those programs or apps in your day-to-day teaching. You may have the tools, but do you know how to use them?

What technology *shouldn't* be

There is a school of thought suggesting that technology is creating lazy teaching, and certainly there is a danger of this. Many programs lend themselves to a 'set and forget' mentality where the teachers assign work and their students simply get on with the exercise and receive answers at the end. I'm all for independent learning and reducing teacher time in planning, and this method certainly has its place, but if that's all technology is being used for, it's a disservice to the students.

There always needs to be an element of reflection or consolidation for work that the students complete using technology because if this isn't the case, it can become meaningless for the students if they are doing things their teacher appears not to care about.

There's also the thought that technology can replace books verbatim, and function in the same way. Aside from this being a waste of the power of technology, if it's a straight swap for a physical textbook to a PDF on a screen, the benefits are little, if any. And no book has ever run out of batteries, so the temptation to simply use technology as a reading device is a waste.

To *only* use technology as a 'Googling' machine is also wasteful in terms of time and resources and does not maximise the power of technology. And to assume that students don't need a base knowledge of information for a subject because they can Google it, is not correct. Ultimately, you need content from which you can then produce and relate ideas (Hattie 2018).

Finally, on what technology shouldn't be is that it should never be the only thing you

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do, and the only thing you use. Variation in all of your teaching is key because different strategies will be relevant at different stages of learning. To use technology all the time for every lesson is not a good use of technology.

What technology *should* be

It seems obvious to say, but technology should be a *tool* to help in your teaching and learning. Programs or apps should save you time, should engage students, should be relevant and should be useful. Ideally, they should fit seamlessly into what you're already doing, although it may require a shift in pedagogy to ensure effectiveness.

Programs should be reliable, regardless of the device used by the students. This is a big thing as time is the enemy of the teacher. If you plan a lesson with technology and that technology fails you, the time wasted and learning potential lost is infuriating.

It should be educationally rigorous and easy to use. No one should have to be an IT teacher in order to use an app or program in the classroom. And it should do things no book ever could, like involve engaging simulations, give feedback, provide insights for teachers and give more transparency and clarity to teaching and learning. So, assuming all of the above, and assuming you've chosen a program to use that works for you, how do you then teach effectively using that program?

The problem for teachers

When I was at university studying a double degree in science and teaching, students using technology simply wasn't a thing in the classrooms. My first teaching position had me using a roll-around chalkboard and, if I was lucky, chalk of varying colours! How times have changed.

Even recently graduated teachers would find their knowledge of teaching with technology out of date by now, given the speed of change in the current climate. Whether you're an early adopter school and have had computers or other technology for a few years, or whether you're just embarking on a BYOD program, there's no denying we're at a fundamental change in education and one which we are figuring out as we go.

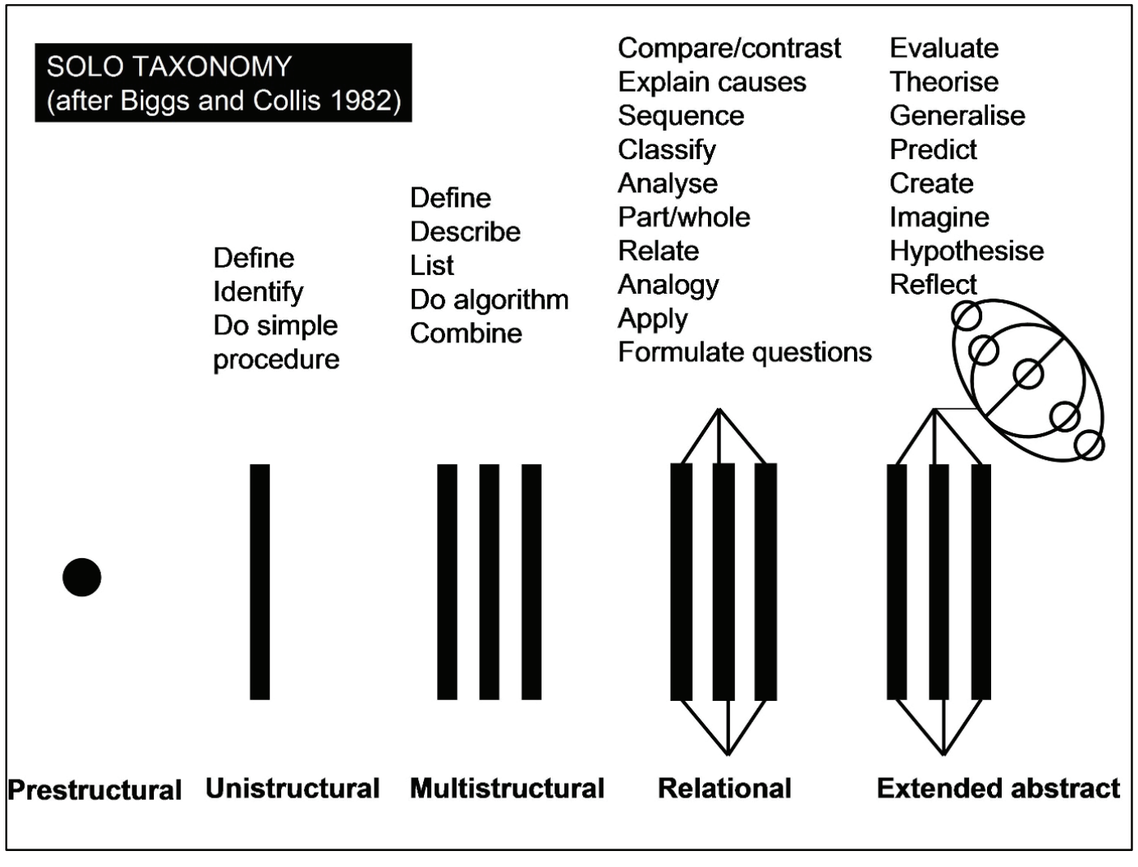
Teaching is a collection of skills and abilities which, when applied correctly, can have huge impacts on student learning. From direct instruction, facilitating discussions to hands-off guidance allowing independent or collaborative learning, employing various tactics at the right time is key to effective teaching and learning. Therefore, integrating these pedagogies with technology is the key to successful teaching and is essential in preparing students for the future.

SOLO Taxonomy

In 1986, Biggs and Collins came up with a structure of learning outcomes called SOLO (Structure of Observed Learning Outcomes) Taxonomy. SOLO Taxonomy has gained popularity and has been adopted by John Hattie and others and applied to the understanding of surface learning, deep learning and the transfer of understanding to other areas of learning, which is key when talking about which teaching strategies to use when teaching with technology.

The structure of SOLO Taxonomy has five levels, moving from students having no knowledge, to gaining knowledge in a *unistructural* or *multistructural* way, which reflects surface learning. This is a gathering of terms, definitions and facts about a concept for a fundamental understanding and a foundation from which to build upon.

From this foundation, ideas can then be created and applied in the *relational* and eventually *extended abstract* levels, which is where deep learning occurs, and ultimately the transfer of understanding to other, often unrelated areas.



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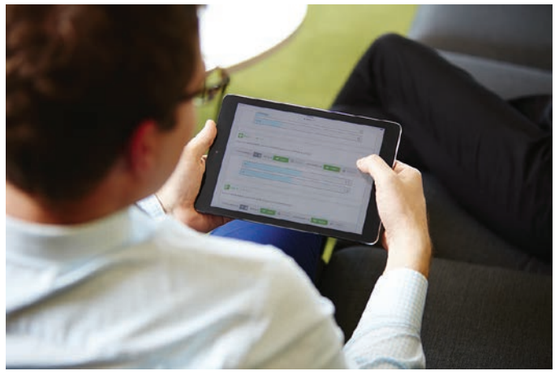


Although the idea is to move from surface learning, to deep learning and ultimately to transfer learning, the process isn't linear because even in the deep learning areas, surface learning is still required. Ultimately, if you can determine where your students are in the SOLO Taxonomy model, you can modify your teaching to enable students to progress from one stage to the next.

According to research by Hattie and others, more than 90% of 'testing' in schools relies on surface knowledge, but for students to be employable and able to apply their learning to everyday life, deep learning and the ability to transfer skills and understanding are essential. Knowledge and basic information of a concept is a necessary foundation for moving onto deep learning, but it can't be the only function and outcome of education.

Let's be honest (and as sad as it is to think about), students will forget the vast majority of content you'll ever teach them but if they can analyse, apply, formulate questions, hypothesise, imagine and reflect, you've armed them with lifelong skills. It's about teaching them how to think, not what to think.

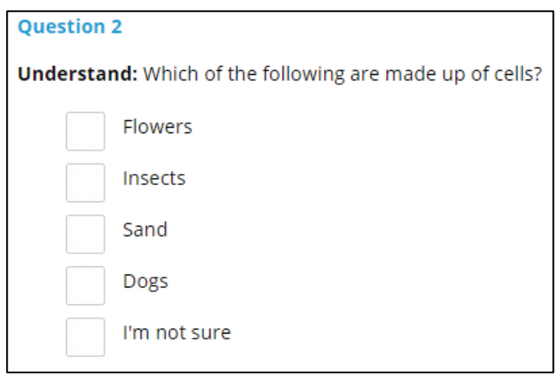
As professor of psychology at Kent State University John Dunlosky noted in 2013:

Teaching students how to learn is as important as teaching them content, because acquiring both the right learning strategies and background knowledge is important — if not essential — for promoting lifelong learning.

An example of SOLO Taxonomy questions whilst utilising technology

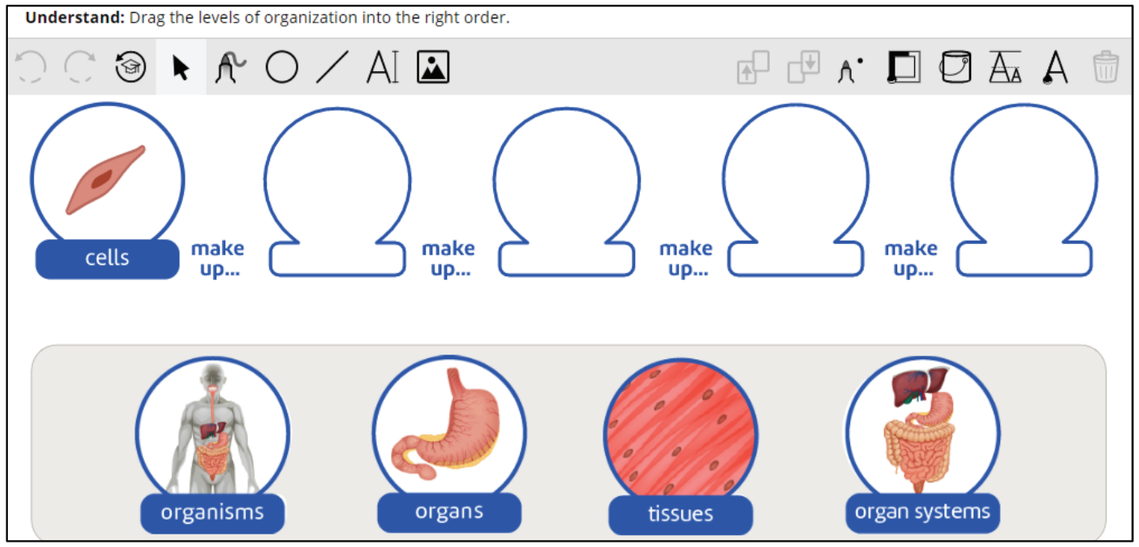
When planning lessons, think about the key verbs associated with SOLO Taxonomy at each stage and what questions apply, and then consider how these could be used in conjunction with technology. I will provide examples of each question type from Stile Education's latest Cells unit for Year 8 to show how these questions can be presented through technology. Bear in mind that it isn't so much the question type that matches each SOLO stage (multiple choice, short answer, cloze and so on), but the question content. You can have deep learning, extended abstract multiple-choice questions, although they're much harder to write!

Unistructural: Surface Learning



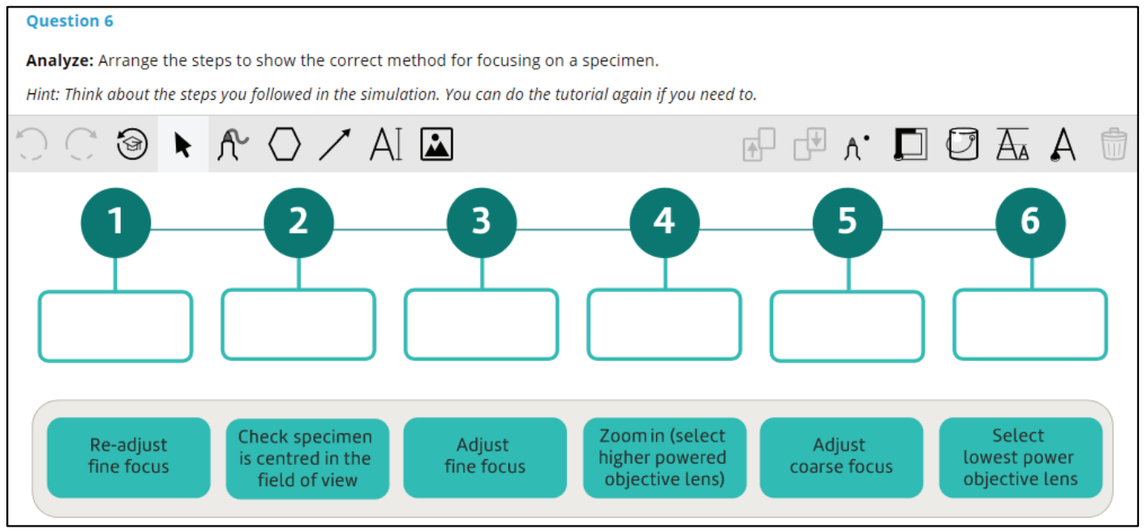
This requires the students to understand one concept: that living things are made up of cells.

Multistructural: Surface Learning

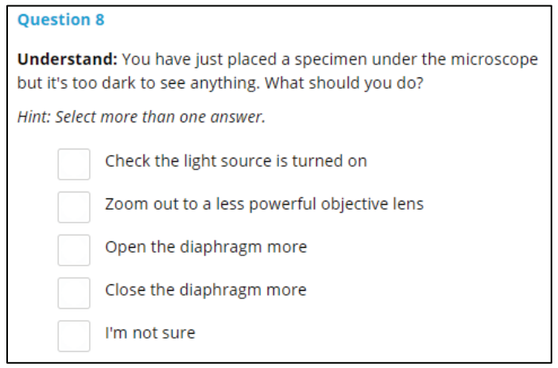


This requires students to understand multiple concepts: how components of living things are linked, and in what order they are built upon.

Relational: Deep Learning

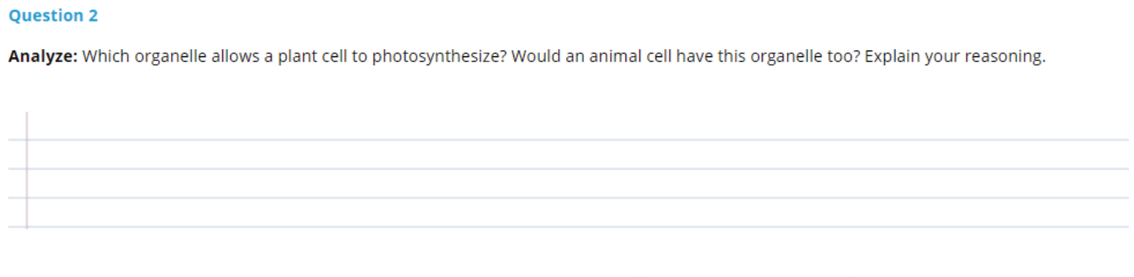


Here the students are asked to analyse and apply their understanding of how microscopes work and construct a logical order to enable them to use a microscope correctly.

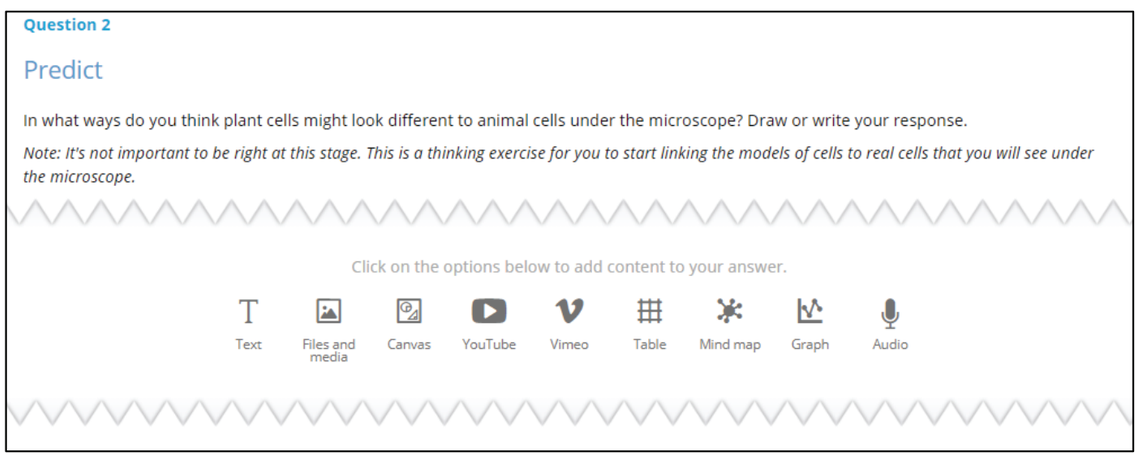


Here is another example of this concept in the form of a multiple-choice question:

Extended Abstract: Deep Learning and Transfer



This is asking the students to recall information (surface learning) and then theorise as to why animal cells would not have this organelle based on their understanding of the differences between plants and animals.



This example requires students to complete a more complex task: reflecting on prior knowledge of animal and plant cells, understanding the similarities and differences and hypothesising. It also allows creativity where students can respond in a variety of different ways.

A model for the classroom

Think of a scale from 0 to 10, where 10 is your classic 'chalk-and-talk', lecture-style teacher who is at the front of the class the whole time. I have taught with many of these teachers and they'd be better suited to higher education, in my opinion. High school teaching is more about inspiring and engaging students than it is about imparting knowledge.

On the scale, 0 is a teacher who is never at the front of the class undertaking direct instruction. These are your FLIP teachers of whom I know many. They're effective but very specialised and this technique is certainly not for everyone.

So, from 0 to 10, where are you on this scale? I imagine it varies, depending on what you are teaching (which is a good thing) but on average, when I was teaching, I would put myself as a 6 or 7. I was never a lecture-style teacher — more a discussion-style facilitator — but, more often than not, I was at the front of the class.

I vividly remember a conversation with my principal at a school in Melbourne, where I was Head of Science. She explained that while science was going well and the uptake into VCE was great, '*try to be less the font at the front, and more the guide at the side*'. In hindsight she was right, of course, but it wasn't necessarily an easy thing for me to do — to be a facilitator rather than a deliverer of content.

However, this is what technology allows teachers to be. On the whole, if you can spend less time delivering content and more time letting students work independently or in groups, then you're on the right track. It's not quite as clear cut as that, but for me, if I were to go back into the classroom now, I'd want my average to be more a 3 or 4 on the scale. And I'd achieve that by using technology in a way that textbooks just don't cut the mustard.

To get more specific here, we need to reflect on where students' learning is positioned within the SOLO Taxonomy. Before every topic you embark upon, key *high impact learning strategies* must be taken into account: What skills do the students already have? What prior knowledge do they come in with? And do they have the confidence to succeed? This last point is critical as students need to know they can succeed, otherwise they never will.

Other basic techniques which are incredibly impactful in teaching and learning include having learning goals or learning intentions and, more importantly, success criteria. The students need to know *what success looks like* and not simply what needs to be done; what they need to *do* or be able to *demonstrate* in order to succeed. Once learning goals and success criteria are established, then consider your practice.

At the beginning of a unit, it is likely that the majority of what you are teaching is surface learning. Memorising, rehearsing, summarising and outlining are all part of knowledge acquisition and from a teacher-directed perspective, you may be delivering content at a 6 or 7 on the scale. This is where you can use technology to reinforce surface learning and have students grasp new content, but with guidance from you to 'keep them on track'. Quizzes, practice tests, simple homework and classwork tasks that help students acquire knowledge are good ways to utilise technology as this is predominantly surface learning and laying the foundations for deeper understanding.

As you progress through the unit, the surface learning should begin to transfer into deep learning where you plan, evaluate, self-question and peer review. This teaching should have you being more of a 2 or 3 on the scale, leaving students to work more independently as opposed to you delivering content.

The content itself should allow more creativity and imagination, giving students the opportunity to make mistakes and learn from those mistakes. Failing is a critical part of the learning process that should never be discouraged and this is another area where technology can really play its part. If students are receiving feedback in a timely and regular fashion, they can easily learn from their mistakes and correct their learning. This can be difficult for a teacher to do alone in a class of 25+ students, so whatever technology you use, ensure its ability to give feedback is effective.

Other key verbs to describe the classroom climate in a deep learning state should be reflection (as a part of feedback), hypothesising, and questioning through demonstrating a deep understanding of the concepts involved.

With you being much more 'hands-off' and more of a facilitator of the students' learning as the unit progresses, you can utilise technology to deepen their understanding with various styles of more complex questioning, enabling students to self-question and verbalise their understanding. It's important to allow for classroom discussion, for peers to seek help from one another. If your students start to recognise similarities and differences within concepts and see patterns with what they are learning that they can apply to new situations, then you are nailing it!

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A summary

The main takeaway here is: don't be rigid. Be flexible, based on surface versus deep learning. Utilise the fact that technology *should* allow you to easily differentiate content, so students can work at their own level and progress accordingly.

Effective technology use should allow independent or collaborative learning to happen in a more interesting and engaging way than teaching in the pre-technology era ever could. This should also remove the need for an overemphasis on direct teaching and should allow you to facilitate within the classroom more than you ever would normally have done in the past. When students take ownership of their learning, their focus and effort increase enormously, so effective technology should allow students to work independently and enable you to provide support and guidance easily and regularly.

When planning, think about the 0–10 scale and where you should be to enable maximum effectiveness. If you're starting out on a topic you may be a 6 or 7, so utilise the non-direct time with good technology, which reinforces concepts and allows practice and revision of key facts. As the topic progresses, move down the scale to allow more student-centred learning to happen. Ensure technology enables peer discussion, creativity and reflective questioning to consolidate the surface, foundational knowledge into deep learning and complex understanding of the concepts involved.

Stile (and other programs) have live analytics which help teachers to see where misconceptions are made and get the students back on track. It also presents student answers to facilitate discussion and peer review. This type of technological tool also allows for effective consolidation after students have completed work, to embed ideas for growth.

Whatever technology you use, make sure it saves you time and engages students. Review the content to confirm appropriateness, curriculum alignment and, overall, insist that it contains a blend of surface and deep learning questions. Oh — and be sure it's easy to use!

If you're a teacher of science, be sure to check out Stile Education's Y5–10 Australian Curriculum aligned, interactive and incredibly engaging content as I promise it'll make your life easier!