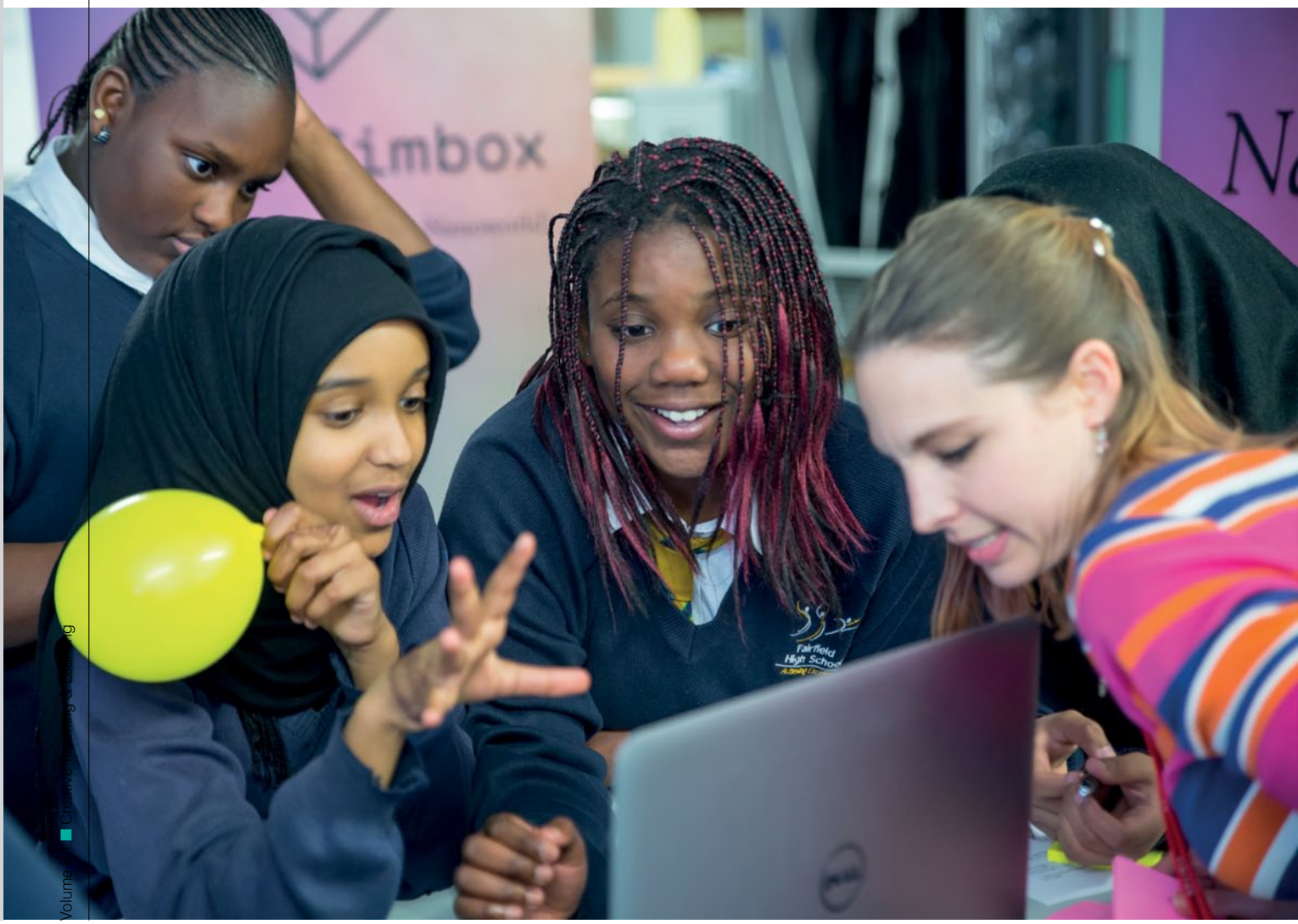
Opening Doorways to STEAM Learning

Traditional approaches to science, technology, engineering and maths seem to be missing the crucial element of arts and imagination. **Becky Sage** shows how some new technology is bringing interdisciplinary and creative thinking to the science classroom.



STEAM = Science, Technology, Engineering, Arts and Maths

STEAM learning is a phrase that we hear a lot, and over the last year I have heard it referred to in many different contexts. While the broad definition stays the same, the *meaning* seems to get confused. Based on the panels, discussions, research and interactions I have had with teachers and education professionals I think that STEAM means an interdisciplinary approach to learning, which gives a more holistic, skills-based learning opportunity than when the subjects are taught in isolation. To me it seems that STEAM is essentially STEM with 21st-century skills thrown in.

While a more interdisciplinary approach to learning is becoming more widespread and accepted as an approach that is helpful, the majority of secondary schools still have to teach towards exams in a very specific and subject-focused way. So, how do we prepare our students with the skills they need to thrive in our fast moving digital world AND give them the specific knowledge to pass their exams and receive the qualifications they need? Good use of edtech is a hopeful solution, which allows both students and teachers to have more fun in their approach. The combination of technology with digital and education design affords fresh approaches to learning. If done well, edtech can enable a broader range of people to have meaningful learning experiences, connecting them to communities and opportunities for exploration around the world (and beyond).

At Interactive Scientific, our starting point is science (as the name suggests). We know that creative, collaborative, scientific exploration is at the heart of finding the solutions to so many global challenges. We are driven to be inclusive as we bring scientific adventure to everyone.

No one can directly interact with the amazing scientific underpinnings which surround us – atoms and molecules are a billion times smaller than the world we are used to experiencing! In order to overcome this visualisation challenge, we have created Nano Simbox, which takes complex scientific information and transforms it into an immersive environment, enabling people to step into the nano-world in a totally new way, giving them the insights and skills to be the innovators our future needs.

This article will not describe Nano Simbox in full detail, but instead I will use it as an example of how edtech can enable STEAM learning to be possible in the classroom.

Blending analogue and digital approaches to STEAM exploration can give learners inside and outside the classroom 'light bulb moments'. Digital tools can open doors to worlds that we can't even imagine – I invite you to step inside:

Opening the door to understanding

Nano Simbox takes all the complexity of research science and makes it visual, showing students only the parts they need. We use data from science labs all over the world to reconstruct the nano world so students can visualise atoms and molecules.

"Working with Nano Simbox Education I want to aid students, in particular, the lower ability students, to be able to visualise things often they wouldn't see. I teach a lot of chemistry even though it's not my specialism and I find teaching molecules, in particular, challenging. Being able to make the invisible visible is a really key thing – especially at KS3 both for those with lower ability and for improving the aspirations of those with higher ability."

Alyssia Fiander, Teacher, Beaufort Academy.

One of the biggest barriers to understanding science concepts is the misconceptions that students develop by creating unhelpful mental models. We can help them to create dynamic pictures of atoms and molecules, which they can use throughout their science learning. Once a student has helpful mental models in their head, they can draw on them throughout their leaning. The Nano Simbox technology enables students to counter their misconceptions about invisible scientific behaviour. Investing time to integrate this into a programme of work early on will save significant time and misunderstanding in the long run.

"It shows them the 3-dimensional structures of atoms and molecules, which I think they don't really have much comprehension of. They show that there's order and there's pattern. It shows the huge variety and number of different compounds that you can make by just simply adjusting the number of different elements and proportions of different elements in a compound. I think that for many of them it's a big 'Wow! I didn't realise this!'"

Phil Brook, Teacher, Selwood Academy.

Opening the door to future opportunities

NESTA and the Creative Learning Alliance have published a report on the value of science education:

"The case for STEAM has been made. We now need a cross-disciplinary STEAM approach embedded in our schools to provide children with the knowledge, essential skills and attributes required to play an active and successful role in our highly competitive, fast-changing digital world." Ian Livingstone, CBE.

As the NESTA/Cultural Alliance report states: In the 2016 CBI/Pearson Education and Skills Survey, 87% of businesses said that the right attitudes and aptitudes were among their top considerations when recruiting graduates, ahead of subject studied. This is why it is so important that we teach students WHY science concepts matter and not just deliver the knowledge of specific abstract concepts, out of context. We must progress towards more interdisciplinary approaches.

I think that digital technology is at the core of approaching this interdisciplinary position.

Using interactive, immersive, task- or project-based learning, we can now help learners to develop curiosity, creativity and collaboration while working towards learning the content that students require to pass exams.

Ultimately, I would like to work with exam boards to determine how we can use edtech in new ways to assess progress, which I think is ultimately how we free up teachers and institutions to align learning with the development of skills that learners will need to thrive in their careers and their lives.

Nano Simbox allows students to learn science differently. It exposes them to abstract science concepts, digital technology and self-guided exploration. We contextualise the science in a web of content, with major global challenges as a starting point, to enable students to develop a sense of responsibility and possibility with regard to the challenges they can be part of solving. Although the opportunity is there for free exploration, many teachers need to focus on working towards exams, so we link all our learning experiences to the curriculum, allowing the users to find new media to help explain tricky concepts.

"Particularly around the virtual reality, augmented reality side of things, to actually go in and see molecules in the full round and climb inside a nanotube was just mind blowing."

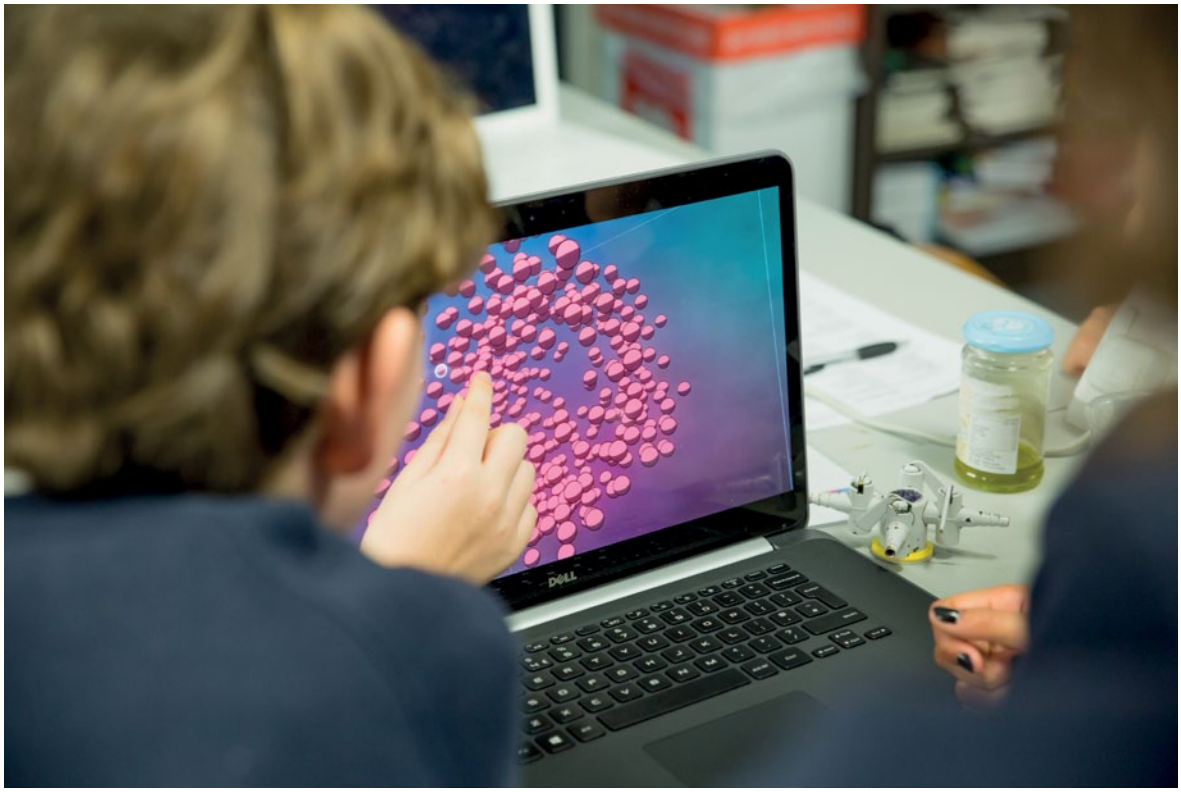
Ian Major, Clevedon School.

Opening the door to inclusivity

Science is often only accessible to those who have a high aptitude in their school science subjects or those who have role models working within in the science industry and so it can seem scary to many students. The science industry still has some problems to overcome with regard to creating gender balance and attracting employees from a broad socio-economic background, but edtech can help find ways to overcome some of the barriers to entry.

In the review of SES and Science Learning in Formal Educational Settings an attainment gap between students from different socio-economic backgrounds has been highlighted.

"Unfortunately, existing research on pupils' attainment in science in U.K. schools has consistently shown an uneven spread of



scientific knowledge. There is a consistent link between pupils' socio-economic status (SES) and their attainment and participation in science learning at school."

There are a number of hypotheses suggested in the report, as to why the current paradigm for science learning is not effective for low SES students, including:

- Lack of learning opportunities
- Lack of interest in science
- Lack of specific cognitive skills: literacy, scientific reasoning and meta-cognition

All these hypotheses come down to one thing – learners don't have the opportunity to develop confidence in tackling science or related subjects. They are too afraid or demotivated to even open the door to scientific exploration.

By making science learning engaging, exploratory and creative, we begin to open the door to a wider range of learners being inspired through STEAM learning.

"It was very apparent that [Nano Simbox] was extremely immersive and that was helping students to break down this barrier of feeling like 'science is scary and I don't get it'."
Dr David Glowacki, Royal Society Fellow.

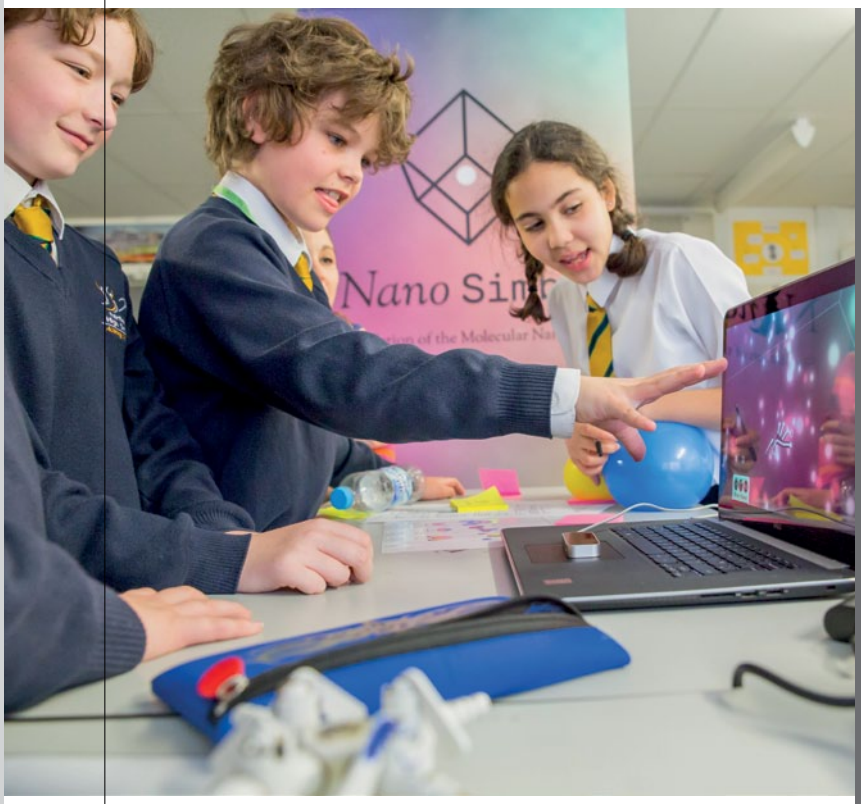
This is just the first step to inclusivity, as we make more plans to make science accessible and attractive to anyone.

Opening the door to connecting with other people

It is important that learners can connect with role models who are working within the science industry so that they can create a connection between what they are learning and potential careers in science. We are building a community of science researchers, communicators, learners and educators to enable students to connect with science research that is taking place all over the world.

For some children scientists are seen as people who are locked in a room with lots of chemicals swilling test tubes and that's not right. We really need to show children what real scientists do – they're real people every day using their knowledge, their intelligence, their thoughts and their research to develop new and exciting things."
Phil Brook, Teacher Selwood Academy.

Many students feel that STEM practitioners come from a different species and this is because they are missing out on role models. Through our work at Integrative Scientific we connect them in several ways:



1. Give them the same tools as science researchers use – Nano Simbox is also used in universities and research labs around the world.
2. Show them that science is a way of exploring and connecting to the world, rather than simply consisting of a bunch of facts to be learned. We believe that innately humans are all creative, curious and progressive – we are all scientists.
3. Make a direct connection. We are working on different ways to directly connect science problems in research with people who are learning science. I can't think of a better way of showing someone that they can solve scientific challenges than giving them real world problems to get their hands on.
4. Build a community. We bring together teachers, learners and researchers from all across the scientific ecosystem.

Through this interdisciplinary approach to scientific learning, we believe that innovative technology has the power to change students' lives. By opening doorways to students so they can develop accurate scientific models and an advanced understanding of science, we hope to also help open the doors to careers and future opportunities students of all backgrounds and interests.

Becky Sage is CEO of Nano Simbox.

Let's get practical – Top tips for using digital technology to open doors for your learners

How can teachers offer these mind-blowing experiences to students in a practical way?

Use the devices that you already have:

At Nano Simbox we develop for mobile and desktop first and adapt to VR second. Many edtech products are similarly being built to be hardware agnostic. While there are some interactive tasks that are easier to carry out in VR, we know that we can reach more learners if we develop virtual scientific worlds for mobile and desktop.

Ask industry to support your learning:

Companies like ours want to spend time in the classroom and we are always looking for opportunities to expose students to our software. Schools can partner with a range of organisations to bring benefits of digital technology into the curriculum. Although sometimes patience is required in working with industry (particularly with start-ups that have fewer resources, but which are often the companies working on the most innovative technology), these connections can also provide an opportunity for you, as a teacher, to get in early and get your ideas heard.

Take it a bit at a time:

Some edtech has per-learner pricing so it becomes possible to try various activities with one or two classes, making some of the more complex technology more affordable.

Invest in infrastructure:

Good basic infrastructure such as good connectivity will be worth the investment as cloud-based edtech tools become the norm. The better the connectivity the more likely your students will be able to collaborate, communicate and get creative with learners and professionals around the world, as we all develop our skills and overcome the global challenges we face together.