Design Technology

A conversation with Amanda Britton

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What does success look like at the end of Year 9 in terms of what students know, understand, and can do if you have taught them a rich, challenging curriculum?

The ideal Year 9 design and technology student is socially aware and environmentally aware. They are essentially problem solvers. They have a sense and understanding of function and aesthetics. They know the importance of function alongside what looks good, they know what technologies we use to make certain components, and they have a cradle-to-grave understanding of the products they design and construct.

We want students to have the confidence and capacity to be able to intervene and solve design problems. We want them to be alert thinkers who look around themselves and think, 'There's a problem which I could solve creatively.' And in designing a solution to a problem, they would have some concept of how their design would have an impact on the

environment and how it would improve the stakeholder's life. We want them to be able to design products that are useful, functional and aesthetically pleasing. They will have thought about big concepts like the inclusivity and usability of the product. They will have thought about the whole life cycle of the product they design, from the time they design it, from the materials they choose, their sources and origins, what sort of technologies they are going to use, the type of labour that is required, how it is going to be made, and how it is going to be marketed. They would also consider what is going to happen to the product at the end of its functional life. Is it going to be recycled, is it going to be upcycled, could it be repaired or could it be upgraded? They would ensure that it is not going to be a landfill product and that it is made sustainably, without impacting upon future generations.

Sustainability has become a central element of our curriculum. Materials such as timbers and metals are becoming more expensive. We are always considering how much plastic we use and how we can recycle it or look for materials that are recycled and sustainably sourced. For example, Gum-tec is a plastic made from chewing gum. Smile Plastics are made from washing up bottles and other waste plastic items; Pinatex leather made from pineapple leaves. These materials make us think differently. Products no longer have to be made from plastic, wood or metal; there are many other sustainable materials out there to choose from.

How do you build the DT curriculum from Year 7 at Twynham?

We are ambitious for all students and committed to mixed prior attainment teaching. Our curriculum is relevant and modern while embracing tradition, therefore it is relevant to the students and relevant to the design world. It attempts to move with the time; we are continually reflective. We always evaluate the curriculum, unit by unit. When we come to the end of a unit or a term, we decide what worked and what needs improving or updating. We are always iterating and tweaking something to make it better. We do this naturally, even on a daily basis with a resource or a scheme of work through teacher conversations. Our curriculum is always evolving. As soon as it hits the paper, it is outdated. We are forever asking the question, 'How could it be better?'

In Years 7 and 8, we want students to experience all areas of Design Technology: Food and Nutrition; Graphics and Computer-aided

Design; Product Design and Textiles. In each of these areas, we have an introductory project to build the overarching skills in each area. We have designed projects within each area that develop very specific skills. In Graphics and Computer-aided design, we include robotics work and computer-based design work. In Product Design, we emphasise the realisation of a design in a workshop. In Textiles, we focus upon surface decoration. We still have a carousel in Years 7 and 8 as this makes best use of our facilities and specialist teachers, although we continually look at how to remove material boundaries. In Year 9, students specialise in one of those areas for the whole of the year as part of the school creative arts option system. Year 9 students become specialists in their area, preparing them for the GCSE. We develop their expertise over the course of the year through a range of higher-level activities. Year 9 have three lessons each fortnight for the whole year: approximately 56 hours of contact time. And in Years 7 and 8, we try to ensure, where possible, that a teacher can take their class through both years and into Year 9, so that deep, trustful working relationships are established. Moving from discipline areas with students through Years 7 and 8 helps illustrate their similarities and differences and supports students in making links between materials and processes when designing new products. Teachers can see the whole key stage 3 Design journey and emphasise to students that designers do not sit in distinct material areas: they mix materials all the time.

As a Design Technology teacher, you may have trained in a specialism; as a team, we use our expertise to support each other to become highly proficient in teaching a wide variety of processes, techniques and material knowledge. Technologies change endlessly. Ten years ago, 3D printing had not made it through the classroom door. 3D printing has changed hugely just in the last five years and we now have 3D printers in all our workshops. Robotics and Coding is another area we have collectively embraced and upskilled ourselves to be able to give our students an up-to-date educational experience that resembles real-world practice. As teachers, we are continually learning new skills and knowledge that we apply and adapt to different situations and materials. Design and Technology teachers are highly collaborative, creative and adaptable.

Design crosses over into lots of other subjects such as mathematics or science or business studies. It is not always possible to align the

teaching of related topics across different curriculum areas. Deep curricular thinking at a school level emerges over time, when you spot these opportunities; they cannot all be planned for in advance. However, acknowledging these overlaps as they arise can increase student understanding of the real application of subjects such as maths. Curriculum development is a never-ending story; it is never going to be finished. As we discuss our curriculum, we discover more connections, and these then become incorporated at some point into our planning process. This is the real richness of the fabric of curriculum thinking when you are doing it collectively as a school, because it is deeply satisfying for the children to be able to make these connections. We are a pattern-seeking species, and so when rich curriculum connections are made, it is a beautiful professional phenomenon.

The fundamental design process

In the real world, you begin a project with a design brief that stems from a design problem. At key stage 4, students need to come up with their own brief and are given three contexts to choose from. This year for our students, the given contexts are: home exercise, educational play and eating outside. Students explore the contexts and look for design problems. With outside eating, we would brainstorm collectively and look at all the ways of eating outside, from picnicking to going to a festival, to carrying food, keeping food cold, considering a wealth of range of problems. This part of the process is difficult and requires open-mindedness; it can be uncomfortable for students and teachers. Once focused on one selected area, students clarify the following:

- A brief statement of the specific problem the student is looking to solve through their design project;
- A description of the target 'stakeholder' and their needs and wants;
- A broader list of wider stakeholders involved in the problem and their relevant needs and wants.

These pieces of information shape the students' entire design journey. They work throughout the process with a target or primary stakeholder who helps them make key decisions from the brief to final artefact. The next step is to research into the problem in more detail. Students

explore existing solutions to their design problem. They undertake market research and compile a list of requirements that their design would need to meet. We call it the 'Master List of Requirements', which is essentially specific performance criteria or a product specification their designs should meet.

The idea creation stage can take many forms. It could be modelling. It could be listing words, or drawing. Once ideas have been formulated, an iterative process of designing, modelling, consulting the stakeholder, looking at materials, looking at trends, exploring the current market for ideas, analysing stakeholder needs and wants and testing all happen while students are shaping and refining their ideas. Once this intense process has expired, students focus their decision making by evaluating against their 'Master List of Requirements' and with the help of their target stakeholder. They emerge with a single solution to their brief and make a plan to construct that product.

Once they have made a first iteration of the product, they go back to the stakeholder and test and evaluate it to see if it successfully meets what was identified in the 'Master List of Requirements' to suggest possible improvements. Iteration is the key. They keep answering three questions: 'Is it fit for purpose?'; 'Have I produced an artefact that does what it intended to do for the stakeholder?'; and, if I have not, 'Why not?' It is a cyclical process which is underpinned throughout by thinking about environmental issues and what happens to the product at the end of the life cycle.

The creative core of the design process: generating ideas

It is important that we create an environment where students 'loosen up' to ideas. We give them a structure which, paradoxically, helps them come up with ideas to solve their design problem. We use the acronym 'SCAMPER':

- Substitute
- Combine
- Adapt
- Modify (also Magnify and Minify)
- Put to another use
- Eliminate
- Rearrange

It helps students ask questions of each idea they might have. So, what would happen if you took that bit of the design away or if you added something to it? What parts could you change? What if you did not have that material? Could you make it with fewer materials? Could it be smaller? We want them to question their own thinking rather than settle on a single idea immediately, which is the major mistake so many students make.

SCAMPER is a shortcut for the thought processes that the students ingrain in their brain. We might not use all of it; we might use just some of the terms. You could use just three of them and begin quickfire idea generations, where students pass their design to the next person. Could they modify an aspect of it? Pass it to the next person and ask whether they can eliminate something from it. Or it might just be word generation, extending vocabulary to describe the design. We do not want students to draw neatly or artistically at this stage. We insist on quickfire solutions. We might ask for a front view, or a top view. It doesn't have to be three dimensional. What would it look like from the back? Tell me what it would look like from above. You are trying to extract what is in their head, so you can begin exploring their ideas with them whilst building their confidence in communicating.

Another element we emphasise is simplicity, because so many design solutions are simple. And finally we look at instances when designs have gone wrong. Why have they gone wrong? What happened there?

We talk about innovation and about how creativity does not have to be about reinventing the wheel. It might be improving a small part of something, or it might be taking inspiration from something. We look at lots of different designs, where people have made a very small change, but that minor tweak has had a big impact on the effectiveness of the artefact. We explain that failure is an integral part of the process and how the first design is not going to be perfect; it is a prototype. We talk about what a prototype is, how it is not a working fully functioning object and what the expectations are, that we are not expecting a crafted, beautiful product, we are expecting an idea that is going to grow and, as a prototype, that might lead to something else unplanned.

There is something deeply creative that we are tapping into when we talk to the pupils about how their design solution is going to be

useful and functional, look good and have a life cycle which is based upon the principle of sustainability. These are big human ideas. It is a deeply humanistic process in terms of imagination, of practicality, of literally making the world a better place, with the items and the products that are in it. There are not many opportunities for pupils in schools to create something worthwhile that has got that physical element, beyond possibly the creative arts. There is a deep satisfaction that comes from taking raw materials and producing something with them. Providing our pupils and students with those opportunities is a magnificent thing to do.

Year 7

When planning, we think about what we want our students to know, understand and do by the end of Year 7, and then we break that down to several outcomes:

- Searching for design problems;
- Sourcing information;
- Selecting materials;
- Scrutinising plans;
- Skilfully constructing the artefact;
- Scrutinising and evaluating the artefact against the design problem;
- Safeguarding the future.

These are the 6 Ss to success (credit Dave Bausor @topbrum). We then think about how, and in what sequence, we would teach each of those outcomes. Crucially, the students do not have to create a take-home made product. We focus on how to teach the knowledge, understanding and skills most effectively, and that can be through a product or via an activity. It might be a group task or a single person activity. Throughout the year, the students will have had an experience of a range of different types of activities. Crucially, they will not have made a product in all the four areas of design. We are gradually weaning them off consumerism, of having to take something away with them. It is essentially about how we want to teach them to use a certain piece of machinery or develop understanding of a concept and not always about what they want to take home.

We have a unit called 'Mobile Communication' where the students are given a brief to design a mobile concept device. It begins with us talking about how to come up with creative ideas and the students learning how to communicate their ideas through hand drawing and CAD drawing. We talk a lot about thought showers, getting them to crash down on the page what sort of mobile devices there are. We talk about fitness devices and health devices and where and how you could wear these devices. And then we talk about how we could present our ideas. How would we draw them? What are the advantages of doing it on a computer? We introduce Computer-Aided Design, analysing the benefits of CAD. How would CAD make it better to communicate their ideas? Or how would using CAD be more difficult? What would be the problems with it? We focus on choosing the appropriate method of communication, rather than listing what we want them to do. We asked them, 'How would you communicate your ideas and who is the audience?' And then we would teach them the skills they need to present their ideas, whether that be CAD or hand drawing.

In the digital world, the analogue is still important: pen and paper remain a fundamental element of sophisticated thinking before we can go on to CAD or other ways of designing things. If you think of fashion, it is impossible to imagine a fashion designer beginning the design process with a computer. They would have a piece of paper and a pencil and they would sketch their ideas. At Ferrari, they use a pen and paper to work things out or to show something quickly. You have got to begin somewhere. You have to put that pencil on the paper and have a go. Building the courage to record ideas is key.

The challenge is to help the students go beyond what they already know. Everything is derivative, of course, but in this project, it is too easy for students to just draw versions of an iPhone. We use lots of questioning, based upon SCAMPER. We are always reframing things, showing students different pictures, different styles, introducing them to things they have never seen, historical design that still stands up. We look at key designers that have had an impact, that they would be interested in, and then research different areas of design and even look at history – for example, Roman design. We always go back to the problem that is being solved by the designer. We use the BBC series *The Big Life Fix*, where they profile a stakeholder with a problem and

designers like Jude Pullen find a solution. The most profound example was one stakeholder, a young man, who wanted to be a hairdresser, who was born with a hand that did not have fingers, and therefore he could not hold a pair of scissors. Jude Pullen designed scissors that would fit like a prosthetic, and this profoundly changed the future and life chances of the young man. We use this clip in our very first Year 7 lesson. We look at 'out of the box' designers and also introduce the students to more mainstream designers like James Dyson or Vivienne Westwood. We also look at artefacts, such as the design of the paperclip or the design of the zip or the escalator and other products that are in the daily lives of our students.

What would you like to be asked by your senior leader line manager to help you develop the curriculum?

A senior leader line manager needs to understand the key concepts of the subject. Beyond that, they need to know what misconceptions students have and understand the barriers to learning in Design. They need to know your basic lexicon because without this it is hard to engage in discussion with you. They need to understand what good progress looks like in the subject. That does not have to be a made product. What makes a successful student in Design and Technology? How do you support lower prior attainment students? There is an academic rigour to our subject that needs illustrating. There is a whole raft of skills involved that are quite complex. It is not about knowing everything, but it is about having done some preparation, so you can have an intelligent conversation.

A non-specialist senior leader needs to approach the conversation from a place of humility. They need to accept that they cannot possibly know everything about your subject; they owe it to the process and to the professional they are talking to to have done some reading, so at least you can open up a conversation. Presenting to governors is helpful because how will the governors know what that subject entails and what standards might look like unless they see some examples of work? When this is done well, in a culture of appropriate challenge and low threat, although it might be nerve-wracking beforehand, you come away appreciating having had the chance to talk about your subject and to have been an advocate. It is highly developmental. The more you talk to

people, the more it actually consolidates your own understanding of the worth, the virtue and the contribution that design makes to the lives of your young people.

When you are talking to your line manager, it is important that you do not want to feel your subject is in competition with another subject. You have to have the freedom to talk about your subject. You want to know that if that senior leader is making big decisions about your subject, then they have some good grounding in the subject to make a decision that might affect curriculum time, funding or resourcing.

It is important that Design and Technology remains on the curriculum. If it disappears, there would be a real hole in the curriculum. It is something fundamental to a good education; we need it to be valued as a hugely useful subject. We are a nation of designers. The only thing that is going to keep us internationally competitive in the next 50 years is our initiative to solve a whole list of different design problems: how to rethink how we are going to travel; how we are going to find sustainable resources; how we are going to combat climate change; how we are going to provide energy.

Design and Technology: background

Before 1989, subjects such as CDT (Craft, design and technology, which was often called woodwork, metalwork, and technical drawing in schools), home economics, textiles (or needlework) and electronics were all separate subjects in secondary schools. Since the introduction of the first national curriculum in 1989, these subjects have been taught under the single heading of design and technology, with the common requirement to develop skills in designing and making alongside a materials-technology knowledge base.

It is worth referring to the purpose of design and technology in the national curriculum programme of study:

> Design and technology is an inspiring, rigorous and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines

> such as mathematics, science, engineering, computing, and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth and well-being of the nation.

And the aims for Design and Technology are to ensure that:

> All pupils develop the creative, technical and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world; build and apply a repertoire of knowledge, understanding and skills in order to design and make high-quality prototypes and products for a wide range of users; critique, evaluate and test their ideas and products and the work of others; understand and apply the principles of nutrition and learn how to cook.

Once the importance statements have been revisited, it is helpful for subject leaders and coordinators to discuss and agree with colleagues the reason why their subject, in this case design and technology, is important for the pupils in their school. One way of doing this is to draw on a quote, in this case from Stephen Gardiner: 'Good buildings come from good people, and all problems are solved by good design.' This kind of prompt allows us to formulate our way of stating the importance of the subject. We might agree or disagree with such a statement and, in doing so, come to a form of words which expresses our view of the importance of this subject, in this school. This moves us away from the territory of 'We teach this subject because of the SATs or GCSEs.' While the external tests and exams are important, they are not the totality of the subject.

Professional communities

Subject associations are important because at the heart of their work is curriculum thinking, development and resources. The subject association for design and technology is the Design and Technology Association and any member of staff with responsibility for a subject should be a member of the relevant subject association, and this should be paid for by the school.

Twitter subject communities are important for the development of subject knowledge because it is here that there are lively debates about what to teach, how to teach and the kinds of resources that are helpful. For design and technology, it is worth following the D&T Association on Twitter and the hashtags #dtchat, #designtech, #DandT and #supportDT.

LINKS AND ADDITION READING

Design and Technology Association
Teaching Design and Technology Creatively
Food A Fact of Life
BBC Bitesize Design and Technology
BBC Teach
How Stuff Works
STEM
STEM Engineering
Talking D&T – www.apple.co/3seVHDH
Designed for life – www.buzzsprout.com/1225046
Fix Ed – www.fixing.education/fixperts
Big Life Fix – www.bbc.co.uk/programmes/b09g5hwf
STEM learning – www.stem.org.uk
Ellen McArthur Foundations – www.bit.ly/2Xp5jAx
James Dyson Foundation – www.jamesdysonfoundation.co.uk/who-we-are.html
Tomorrow's Engineers – www.tomorrowsengineers.org.uk
Design Council – www.bit.ly/3AGhRSg
Design Museum – www.bit.ly/3sbUv49
Royal Academy of Engineering – www.raeng.org.uk/education

An overview of the Twynham School key stage 3 design technology curriculum

	Year 7	Year 8
Autumn	Introduction Health: Food & Nutrition Unit 1 • Producing products for a healthy diet • Food groups • Vitamins and minerals • Skills: Shaping and oven use	Provenance: Food & Nutrition Unit 2 • Source of food & environmental issues • Cross contamination • Finishing and presentation • Combining ingredients and hob use
Spring	Learning & play: Product Design Unit 1 • Exploring contexts • Stakeholder needs • Generating ideas and design strategies • Materials knowledge: Polymers	Dispensing: Product Design Unit 2: • Sustainability • Quality control in batch production • Designer and consumer responsibility • Materials knowledge: Timbers
Spring	Organisation & storage: Textiles Unit 1 • Planning for manufacturing • Manufacture and quality control • Evaluating products and processes • Materials knowledge: Fabrics and fibres	Travel: Textiles Unit 2: • Research into solutions • Surface decoration and finishes • Mechanical fixings • Responsible design: Fairtrade
Summer	CAD New technologies: Graphics Unit 1 • Communicating ideas in 2D Design • New technologies: microcontrollers • Material knowledge: Papers and boards • Branding and marketing	CAD New technologies: Graphics Unit 2: • Communicating ideas in 3D • Onshape© • Robotics: VEX© • Effects of new technologies

School creative options system				
	Year 9 Product design	Year 9 Graphics	Year 9 Textiles	Year 9 Food
Autumn	Working from home: Product Design Unit 3 • User centred design and inclusivity • Selecting materials • Joining materials • Materials knowledge: Metals and alloys	Design Ventura: Graphics Unit 3 • National competition to design a problem-solving product to be sold at the Design Museum for a specified user group for under £10 using sustainable materials	The home: Textiles Unit 3: • User centred design and inclusivity • Use of patterns • Selecting materials • Material smart and sustainable	Food & nutrition Unit 3: • Dietary needs • Functional and chemical properties of food • Food processing and production • Health and food production
Spring	Entertainment: Product Design Unit 4: • Circuit construction • Design movements • Planning manufacture • Material knowledge: Smart and modern	Mobile communication: Graphics unit 4 • Lifestyle and trends • Communication of ideas using CAD and hand sketching • User centred design and inclusivity	Holiday: Textiles Unit 4: • Lifestyle and trends • Adapting patterns • Fabric construction • Fair trade and environmental issues	Food and nutrition Unit 4: • Special dietary requirements • Food spoilage and contamination • Factors affecting food choice • Environmental impact and sustainability of food
Summer	Open ended context: The beach Unit 5 • Exploring the context • Stakeholder needs • Existing solutions research • Generating design ideas • Modelling prototypes • Planning manufacture • Feasibility and evaluation			Food and nutrition Unit 5: Designing for context • Plan, prepare, cook and present two dishes from context • Scientific investigation of the working characteristics, functional and chemical properties of ingredients.

Three documents for your senior leader line manager to read about design technology

1. Learning to Teach Design and Technology in the Secondary School: A Companion to School Experience. Hardy, A. (2020). (4th ed.). Routledge. Chapter 1: Design and technology in the Secondary School
2. D&T for the Next Generation www.bit.ly/3xNt8hQ
3. Justifying Design and Technology, David Barlex www.bit.ly/3iI0jiv

Five questions for your senior leader line manager to ask you about design technology

1. What is design and technology? Why is it on the curriculum?
2. What are the key concepts or big ideas in design and technology?
3. What does a high-quality lesson look like in design and technology in key stage 3?
4. Talk me through how design and technology learning is structured and sequenced over key stage 3?
5. Can you show me examples of an expected year of learning evidence for Year 7?