What makes a good technology teacher?

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WHAT MAKES A GOOD TECHNOLOGY TEACHER?

Nigel Zanker and Gwyneth Owen-Jackson

INTRODUCTION

‘Teaching is a highly complex activity, which requires intellectual sophistication in a dynamic space’

(Howard and Aleman 2008: 161)

There has been much debate, spanning many decades and across many countries, about what constitutes teachers’ professional knowledge and what makes teachers effective, and how to define ‘effective’ teaching. This chapter considers these debates and how they might impact on D&T teachers. It also looks at the different routes into teaching and the influence that these might have on the debates.

TEACHERS’ PROFESSIONAL KNOWLEDGE

Across Europe, education has its history in the churches and mosques as it was intended for those entering religious life and for children of the wealthy. It wasn’t until the emergence of industrialisation and urbanisation, in the mid-nineteenth century, that education was made available to the majority. At that time it was easy to define the purpose of education and the role of the teacher, as Dickens (1854) observed, through Gradgrind, all teachers needed to know were ‘facts’:

‘Now what I want is facts. Teach these boys and girls nothing but facts. Facts alone are wanted in life……nothing else will ever be of service to them……Stick to Facts sir!

(Dickens 1854)

The teacher had to know his or her subject and then impart it to the pupils, who wrote it down and learnt it. It’s a very different story today. As societies have become more complex, and as our understanding of learning has grown, the purpose of education is not so straightforward and the teacher’s role is more demanding, as Howard and Aleman’s quote at the head of this chapter indicates. There are now shelves of books and journal articles discussing the nature and form of teachers’ knowledge, this chapter can do no more than provide a brief summary.

Over 20 years ago, Shulman (1987) suggested a typology of seven categories of knowledge needed by teachers and this work still has value today. The categories he identified are:

- content knowledge
- general pedagogical knowledge
What make a good technology teacher?

- curriculum knowledge
- pedagogical content knowledge
- knowledge of learners and their characteristics
- knowledge of educational contexts
- knowledge of educational ends, purposes and values and their philosophical and historical grounds.

These categories indicate that teachers need to know something about their subject and how to teach it, knowledge of their pupils and schools, and knowledge about the value of education.

Building on the work done by Shulman, and others, Leach and Banks (1996) suggested teachers’ knowledge comprised subject knowledge, pedagogical knowledge and school knowledge, all informed by an individual’s personal constructs (see Figure 1). Personal constructs are built on the teacher’s own past experience of learning technology, their own belief in the purpose of the subject and their own view of what makes a ‘good’ teacher. Banks et al (2006) were keen to stress the ‘dynamic relationship’ between the different elements in their model, changes in one sphere would have impact on other spheres of knowledge.

Bransford et al (2005: 11) drew up a similar framework, highlighting teacher knowledge as encompassing:

- Knowledge of learners and how they learn and develop within social contexts
- Conceptions of curriculum content and goals: an understanding of subject matter …
- An understanding of teaching [related to content and learners], informed by assessment and supported by classroom environments.

They also noted that teaching has a moral purpose, and ‘must serve the purposes of a democracy’ (ibid).

The Training and Development Agency in the UK developed a model similar to Leach and Banks as a way of identifying what student teachers needed to learn, see Figure 2.

Figure 1 – a visual tool for describing teachers’ professional knowledge (Leach and Banks 1996)
Debates about design and technology

Figure 1 – a visual tool for describing teachers’ professional knowledge (Leach and Banks 1996)

Figure 2: Knowledge for Teaching (Adapted from TDA 2007)
All of these models recognise that teachers’ professional knowledge is comprised their subject knowledge, knowledge of appropriate pedagogy and knowledge and understanding of their pupils and the schools in which they work. However, this list of things that teachers need to know is only a part of their professional knowledge, it is what they do with what they know that makes a difference. As Luntley (2011: 27) points out, ‘…propositional knowledge does not suffice to capture the knowledge that informs practice’.

As Howard and Aleman (2008) identified, these elements of knowledge that teachers have are constantly interacting in different ways in the classroom and teachers are constantly reconfiguring the knowledge they draw on and use in the classroom. Bransford et al (2005: 1) noted that teachers ‘must be aware of the many ways in which student learning can unfold in the context of development, learning differences, language and cultural influences, and individual temperaments, interest and approaches to learning …’. Bondi et al (2011: 18) recognise that in teaching, and other similar professions, the general knowledge that is acquired then has to be selected for its relevance, appropriateness or sensitivity to each new context; they refer to this as ‘professional wisdom’. Teachers draw on their professional wisdom in each new encounter with a pupil or class, in each new lesson. Research has shown that teachers who do this well, those with a deeper knowledge of how to teach, as well as what to teach, have a positive impact on pupil learning (Hill et al 2005).

However, this complexity is often not recognised. Shulman’s work led, in America, to the introduction of national standards for teacher performance, a move emulated in the UK in 1992 and across other countries. These standards are then used as a way of defining teacher knowledge, and a way of measuring it.

Since 1992 the UK government have used standards, or competence statements, to define their expectations of what teachers should know and do, from initial training through to senior positions. The standards, however, tend to be a reflection of the prevailing political agenda rather than an informed consideration of what really constitutes teachers’ professional knowledge. The standards in England were updated in 2012 and in these teaching is identified as requiring teachers to have high expectations of pupils, promote progress in learning, have good subject and curriculum knowledge, plan and teach lessons in which they ‘impart knowledge’, adapt their teaching to suit all pupils, assess pupils, manage pupil behaviour and ‘fulfil wider professional responsibilities’. Personal and professional conduct defines the ‘behaviour and attitudes’ expected of teachers and includes the requirement to ‘not undermine fundamental British values’ (Department for Education 2011).

So what does this mean for D&T teachers? The requirement to know their subject is discussed below, but what is appropriate pedagogic knowledge in the subject? And how do pupils learn in D&T?

In the UK, as in other countries in Europe, the theory underlying pupil learning has moved from the behaviourist approach through constructivism and social constructivism to
situated cognition. There are also theories of constructionism and embodied cognition which are useful to D&T as they assert that there is a strong correlation between doing and thinking. How do teachers use these theories to guide their classroom practice? Do they use these theories?

Teachers classroom practice is often guided less by their theoretical understanding of how pupils learn and more by their use of curricula, programmes or resources – which may themselves have been developed using learning theory. For example, D&T learning has moved on from the ‘dem and do’ model, where teachers demonstrated a particular skill and pupils copied and practiced it, to engaging pupils in a range of activities. D&T classroom practice across the UK often now includes analysing products, focus tasks in which pupils learn specific skills or knowledge, design and make assignments, working individually and in teams.

Designing in D&T is still often taught in a linear way, whether for ease or convenience or to meet examination requirements is not known. It is, though, widely acknowledged that this is not the way in which designers and over 10 years ago Barlex and Welch (2000) showed through their research work that pupils prefer to develop design ideas through 3D modelling rather than sketching. Why then do so many teachers continue to ask pupils to sketch several design ideas, annotate them, choose one, develop and justify it? Are examination requirements driving ineffective classroom practice?

One of the criticisms made of D&T is that it is under-researched (Ofsted 2011). This may be the case, but the criticism can also be made that much of the research work that is being undertaken is not permeating down to impact on classroom practice. And whilst the research evidence is growing, can it yet be claimed that there is an agreed appropriate, effective pedagogy? And is there sufficient evidence of how pupils learn in D&T to support pedagogy?

TEACHERS’ SUBJECT KNOWLEDGE

One element of teachers’ knowledge on which all are agreed is the need to know the subject they teach. How do we define subject knowledge in D&T? Banks (2009: 376), in looking at a number of technology curricula, concludes that ‘there is as yet little common agreement as to the subject domain of technology …and to what is valid content’. Should its focus be on technological concepts? If so, which ones, and who decides? Should the focus be on practical skills? (See Chapter 5 for a discussion on this).

The initial National Curriculum in the UK emphasised the procedural aspects of D&T, as Wakefield and Owen-Jackson point out in Chapter 1, the DES affirmed that ‘capability’ in D&T processes was as important as ‘the acquisition of knowledge’ (DES 1989 :1). There were aspects of knowledge listed in the curriculum orders but these were not emphasised in the attainment targets, which specified what pupils should know at different stages of their education. National guidance has continued to focus on the processes of designing and making rather than the knowledge required. Where there is reference to the knowledge
pupils should acquire this is often vaguely-defined, for example, when studying food pupils’ learning should include ‘a broad range of practical skills, techniques, equipment and standard recipes’ (QCA 2007: 55), which gives no indication of which skills, techniques or equipment they should learn to use.

As Wakefield and Owen-Jackson also highlight (see Chapter 1), when D&T was first introduced onto the curriculum, those teaching it were teachers who the previous year had been teachers of art, business studies, CDT and home economics. Those teachers were unsure of the subject knowledge required, and the NC provided little guidance. As a result, the subject association for D&T teachers drew up a guidance document which identified the propositional and procedural knowledge that new teachers should be expected to have. Despite criticism from some (Martin 2011) this guidance has undergone two revisions and is still used widely across England and Wales for identifying the required subject knowledge (DATA 1995, 2003, 2010). However, as Ginestie (2009) points out, how subject knowledge is defined for technology teachers various across Europe.

Although D&T is comprised of different material areas, UK secondary teachers usually specialise in just one or two. In the early years of the National Curriculum in England there was discussion about D&T teachers being ‘generalists’, being able to teach in all the areas, but it was soon realised that teachers could not gain the required depth of knowledge across such a broad range of areas.

Primary teachers, of course, have to develop subject knowledge across a number of subjects and few of them choose to specialise in D&T. In primary schools, therefore, teachers’ D&T subject knowledge is often limited and pupils’ experiences constrained. This is not true of all primary schools, there are some in which excellent practice can be found which provides pupils with a sound foundation on which to build, but this is not the case in all primary schools.

One of the difficulties in defining what teachers need to know is that it is not a constant concept, as we can see with the example of Gradgrind above. Grant (2008: 129) also identified that ‘what teachers need to know, including their skills and dispositions, change and evolve in response to changing social, economic, and political agendas’ and Bransford et al (2005: 3) noted ‘that teachers continually construct new knowledge and skills in practice throughout their careers rather than acquiring a finite set of knowledge and skills in their totality before entering the classroom’. This particularly applies to D&T teachers, who have to continually reappraise and update their subject knowledge as new materials and new equipment become available and new processes emerge. Keirl (2007: 45) goes further, saying that ‘…design and technology’s identity is about its capacity to remain dynamic (not a fixed pedagogy or body of knowledge)’.

There is also a question to be asked about who decides? Who decides what is appropriate subject knowledge for pupils learning design and technology? Is it the government, who prescribe the curriculum? Is it the commercial companies, who produce the textbooks and learning resources? Is it the examination bodies, who set examination specifications which
guide pupil learning? Or is it the teacher and the D&T educational community? When new technologies and new materials emerge, who decides whether or not these should be on the curriculum for pupils? Curriculum content is not value-free, as Briant and Doherty (2012: 53) noted ‘the questions of ‘which’ and ‘whose’ knowledge, skills and values are to be legitimated in any curriculum become a subject of social and political debate’

Despite the importance given to subject knowledge, and acknowledging that teachers do need to know their subject, there has been some suggestion that this is not necessarily the most important knowledge they need. Research by Goldhaber and Brewer (2000) found that there is not a direct co-relation between a teacher’s level of subject knowledge and their effectiveness. Hattie (2012) argues that the amount of subject knowledge a teacher has is less important than how they understand, integrate, organize and present the knowledge to pupils. A practising teacher also provides some evidence to support this. In an article in The Guardian newspaper (19 January 2010) one teacher, recounting experiences from his own school, writes:

Cameron’s [UK Prime Minister] cardinal mistake is to think qualifications make a good teacher. They don’t. When you’re faced with 30 truculent children after lunch on a Friday afternoon, qualifications don’t count for much. Take Lesley, a high-powered business executive who I mentored as she trained to be a teacher. She had everything: a great degree, excellent organisational skills and good communication skills. Yet she crumbled in the classroom because she was so impatient with her pupils, nothing they did was good enough. Whereas her employ had tolerated her endless nit-picking, her pupils became demotivated and disaffected.
If you don’t have the right personality, you’ll suffer in the bearpit of today’s classrooms. In my experience there are four types of teacher who are effective: the despot, the carer, the charmer, and the rebel. And none of them, in my experience, requires an upper-class degree.

TEACHER EFFECTIVENESS – SO WHAT IS A GOOD TEACHER?

The article above identifies, anecdotally, four types of effective teacher. But what do we mean by an ‘effective’ teacher? Pupils generally judge their teachers on whether they are ‘good’ or not and their judgements are based on a wide range of factors, including personal relationships, a teacher’s enthusiasm, lessons that are interesting and fun, and which involved them (Younger and Warrington 2002).

However, in the ‘performativity’ culture in which schools and teachers now operate, ‘effective’ teachers are those whose pupils perform well in measures of academic attainment and less attention is now paid to teacher qualities (Stronge at al 2011).

Bransford et al (2005: 5) acknowledged that ‘…there is no single “cookie cutter” formula for being successful’ but they also go on to say that there are practices and strategies which have been identified as being common to teachers generally regarded as effective in that they are able to support and promote pupil learning. These practices included:
What make a good technology teacher?

- Clearly stating what they expected of pupils
- Providing models and examplars of the work they expected
- Moving around all of the classroom whilst teaching, and monitoring pupils’ activities
- Many used small group activities
- Classroom talk focused on pupils asking questions, sharing ideas and discussing the work
- Lessons were well-organized with resources prepared and readily accessible.

Many of these elements can be found within the competence statements so presumably all teachers work this way to some degree. So what is it that makes some teachers more effective than others?

Hattie (2009, 2012), after conducting a meta-analysis of hundreds of research reports, found that what makes teachers most effective, that is improve pupil attainment, was good pupil-teacher interactions and teacher ‘credibility’. Teacher credibility, according to Hattie, is when pupils believe that a teacher knows their subject, cares about the pupils and wants them to do well; this leads them to trust and respect the teacher and so improves their learning and attainment. This does, of course, mean that teachers need to have well-planned lessons and be well-organised but it also requires the ability to be in control of the classroom, good communication skills and confidence. Some of these can be taught and practiced, others teachers have to develop for themselves. Hattie also claims that it is important for teachers to be ‘passionate and inspired’ (2012: 23), where in the lists of competences used across the world is that phrase?

So what would ‘effective’ D&T teaching look like? The nature of D&T work means that it would not be difficult for teachers to institute the practices described above, indeed many already do so. There are many D&T departments in which the learning environment is rich in examples of pupils’ work and displays of products and material to provide ideas and inspiration. The best lessons are those which appear effortless but which have been well-organised, with the resources ready and accessible, and activities well-prepared. The best teachers are those who move purposefully around the room, just happening to be in the right place at the right time, interacting with pupils as they work. It is a joy to be in classrooms like this, when it is clear that both the teacher and the pupils are enjoying the experience.

PREPARING EFFECTIVE TEACHERS

Like teaching, teacher education programmes are grounded in their temporal and political context. Programmes vary from country to country, both in structure and in content. This is to be expected as teachers are prepared to work in the different education systems and, as Banks and Williams show in Chapter x, for the different forms of technology education that exist.
Despite these differences, most teacher education programmes consist of ensuring that teachers have sufficient subject knowledge, know the accepted pedagogy for teaching that knowledge, how to manage the classroom and know how the school and education system operates.

Currently in the UK, whilst there appears to be a wide and diverse range of routes into teaching, in reality there are three main routes: higher education institutions (HEI), school-centred (SCITT) or employment based (EBITT). Higher education routes include undergraduate and postgraduate, although the undergraduate route is most common for primary teachers. Undergraduate courses are of three to four years and this allows time for students to study all the subjects required at primary level. Some students choose to specialise in D&T, but these numbers are small and even specialists do not have time for extensive study of the subject.

For secondary teachers, the most common route is to take a first degree in their subject followed by a one-year postgraduate degree in education (PGCE) with Qualified Teacher Status (QTS). All HEI programmes have close partnerships with schools in which the student teachers undertake placements or practicum.

School-centred programmes, as the name suggests, are run by consortia of schools and only open to graduates. They are available for both primary and secondary teachers, take one-year and lead to Qualified Teacher Status. Some, but not all, also work with local universities and offer PGCE in addition to QTS. The UK government is also developing ‘Teaching Schools’ to expand the provision of school-based teacher education, a situation common to other counties as Williams (2009: 535) notes that many are moving their teacher education programmes away from the universities and to a more ‘school-based apprenticeship model’.

Employment-based routes are also only open to graduates, take one-year and are school-based. The difference is that the student is employed by the school and is paid a salary whilst undertaking on-the-job training. As the school-based route is expanding, this route is likely to decline.

As Maandag et al (2007) have shown, research into the different models of teacher education is limited and it is difficult to say which produces the most effective teachers. However, it could be argued that the HEI route into teaching gives student teachers a broader understanding of the theoretical knowledge which underpins practice and encourages them to reflect on their own developing practice against this theory. School-based programmes, on the other hand, tend to be based on an ‘apprenticeship’ model in which students observe other teachers and mimic their practice. The debate hinges, therefore, on whether teaching is, as Howard and Aleman (2008) noted, complex and intellectual or whether it is a trade or craft in which students need to learn only a series of procedures.
CONCLUSION

This chapter has shown that teacher knowledge is multi-faceted and much of it is often unacknowledged. Good or effective teachers make the task look simple, but as Howard and Aleman (2008: 161) said ‘it requires intellectual sophistication’. This applies even more so in D&T where subject knowledge is fluid and dynamic, the pedagogy develops as subject knowledge and learning theories develop, teaching has to take account of wider changes in industry, society and the economy. Debate has to continue to discuss what is appropriate subject knowledge, how can we best teach that knowledge and how can we ensure that teachers are effective? But as Bransford et al (2005: 5) recognised ‘Specifying what successful teachers need to know and be able to do is not a simple task.’

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