Weaving the specialist material strands of design and technology together

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Abstract

The design and technology curriculum in England has gone through various policy changes since its introduction in the Education Reform Act of 1988. The 2014 policy revised the content to make it slimmer and outlining the essential core knowledge for Key Stage 1 to 3. Schools need to consider wider aspects of design and technology not included in the National Curriculum which they would like to teach as part of their own school curriculum (DATA n.d.). Previous research into D&T explored the challenges of adapting established ways of working and the issues involved in sub-cultural retreat by teachers. This research paper sets out to understand how teachers coped with the 2014 curriculum change and the factors influencing teachers' capacity to implement assessment changes that impacted the need to teach more broadly. The larger investigation followed a qualitative methodology and collected interview data during the first round of teaching the new upper-secondary examination courses in English secondary schools. An interpretive approach to the analysis suggests two ways the teachers conceptualised the change as "coming off the circus of specialist rotations" and "teaching inside a specialism". Challenges for the teachers included the issue of specialist knowledge, traditions of curriculum organisation, opportunities to share expertise, and attitudes towards the policy shift. Teaching outside a specialism is a way to think about supporting pre-service and in-service teachers with the current policy change and ways to modernise the subject in school.

Keywords

Introduction

Design and technology teaching has traditionally developed within schools to cover a range of short projects taught by individual specialist teachers that provide expert teaching in one (or two) material areas, comprising electronics, food, graphics, resistant materials (RM), textiles, or systems and control (S&C). During initial teacher education (ITE), design and technology teachers typically specialise in one or two material areas related to their first degree (Design and Technology Association, 2010). This pattern of teaching and training was challenged in 2014, through a new Key Stage Three (KS3) curriculum, which introduced a single design and technology examination (DfE, 2013; DfE, 2015) and a Subject Knowledge Enhancement Course (SKE) to support pre-ITE training (DfE, 2021).

Whilst the timescale of the policy change did not affect examination teaching until 2016, secondary teachers faced an unprecedented challenge to their established practice (Davies, 2022). The discontinuation of all but one specialist pathway (Food Nutrition and Preparation) and the shift to a single design and technology examination in upper-secondary – Key Stage Four (KS4) - led to a steep learning curve and disruption of curriculum plans for teachers working in English design and technology departments. Teachers needed to move away from

their traditional teaching practice within specialist material areas and embrace a combined way of teaching and thinking about the subject. Not an easy task, due to a climate where most schools continued to advertise for new teachers with a specialism, and whilst in post, teachers take on the role of an expert within that material strand.

Currently, lower-secondary curriculum - KS3 - is typically organised into four to six project rotations that develop pupils' knowledge and skills associated with a specialism. Within the traditional context, technical and process skills are developed through design and make activities that focus on one material area. Specialist workshops and classrooms provide the environment for each teacher to deliver their bespoke specialist design and make projects which are timetabled to repeat through the year with different groups of pupils. The policy change to a single General Certificate of Education (GCSE) for design and technology disrupts the established practice of project rotations and the view that design and technology knowledge should be taught through material specialisms (Ashbee, 2021). As design and technology departments attempt to move forward and change, the issue of shifting teachers' established practice from material expert to design and technology generalist requires special attention and planning. Teachers with experience of delivering design and technology through a rotation model know that effective policy developments depend on their capacity to adapt to the changes. The following study is placed at the mid-point of the educational change. It focuses on the stories of two teachers to provide insights into how these different teachers started to question and adapt established practices in response to the change.

Literature Review

Changes to the design and technology examination and National Curriculum (NC) arose from a review instigated by a change in government. A desire to compete internationally with high-performing countries led to a review of perceived weaknesses with the previous curriculum iteration, and recommendations to revise curriculum policy to focus on essential knowledge within key subject disciplines (DfE, 2010). The review led to a new policy for design and technology that emphasised technical knowledge and contextual understanding over practical knowledge and skills (DfE, 2013; DfE, 2015). The move to teaching through contexts rather than material specialism, for example textiles, shifted the nature of curriculum design within the subject. Fullan (2015) highlighted the implication of policy change that reduced or removed aspects of curriculum that teachers valued when he recommended the importance of alignment. More recently Van Deventer & Steyn's (2022) research into design teachers' attitudes towards a modified curriculum in South Africa claimed that clear identification of problems associated with change supported implementation success. In addition, the research observed the way teachers were likely to disengage with the process of change if not consulted from the outset. However, the scope of this work remains focused on understanding the English context and the specific challenges that teachers encountered during the phase of policy change that impacted KS4 assessments and the move away from specialisms at KS3.

In the English secondary school, it is typical to witness design and technology lessons organised through a rotation system (also called a circus or carousel) despite pedagogical criticism (McGimpsey, 2011; Miller & McGimpsey, 2011). A rotation system characteristically involves KS3 pupils moving from one material specialism and specialist teacher to another, generally four to six times a year. The system was initially set up in the 1990s to accommodate the new NC subject, combining the study of Home Economics and Craft Design and Technology (CDT).

Rotation systems allowed each teacher time to deliver subject content in specialist teaching spaces (Penfold, 1988). However, the cyclical nature of teaching through a rotation promotes a narrow focus on each material specialism and the potential for the repetition of general design principles (Hardy, 2020). Therefore, department teachers need to share information about their pupil's attainment to support the transition from one teacher to another so that each teacher can build upon the pupil's strengths and areas for development (Pollard et al., 2019). Something that findings from Ofsted (2008; 2011) identified as the best way to ensure design and technology rotations are successful.

Design and technology teachers are generally trained to teach one to two specialisms within the subject unless trained through a pre-training SKE course. The nature of design and technology teacher education separates specialist knowledge and experiences and prepares student teachers to take up specialist roles. Specialist roles that, according to Bell (2015) encompass Computer Aided Manufacture (CAM), Computer Aided Design (CAD), Technological Textiles, S&C, Engineering, Electronics, Food Technology, RM, Product Design (PD), Apparel Textiles and Graphic Design. Early research into the policy implementation identified a lack of alignment between teachers' practice and the policy's aim to combine specialist material areas into a single design and technology examination (Choulerton, 2016). Within this research, design and technology teaching continued the notion of specialist pathways associated with the old General Certificate of Education (GCSE) across KS3, and teachers appeared to not engage with the shared forms of knowledge and general design principles that the new policy advocated. Shared forms of knowledge are defined by Reinsfield & Williams (2018) as technological knowledge that is general to all aspects of the subject and different from technical knowledge that is specialist.

Teacher agency and Boundary crossing
In addition to showing the challenges teachers faced when adapting established practices in response to the policy change, this research sought to identify past activities that influenced intentional actions in the present. Teacher agency has been used to theorise the shift to teaching more broadly and shed light on the factors that support a change in practice. The theory of teacher agency defines teachers' actions as intentional and socially dependent because what teachers' do and who they do it with, shapes and is shaped by the social context within which the actions occur (Priestley et al., 2013; Scott, 2007). Teachers' capacity to purposely adapt their practice to align with the new policy is, therefore, time related and informed by the social world of policy documents, departmental ideas, and teaching habits (Emirbayer & Mische, 1998, Hardy & Davies, 2021).

The previous idea of specialist examination pathways and specialist material area KS3 projects created the social habit of separating aspects of design and technology into discrete mini subjects. Separate aspects of the subject with their boundaries of unique min subject knowledge, pedagogy, and ideas. Subject boundaries encapsulate how teachers practice and make sense of a subject (Goodson, 2013) - informing the shape of teachers' work and influencing the activities teachers take within their role. In this case, they identify with a material area specialism and define their role within a subject department as a specialist (Britzman, 1992). The shift to teaching more broadly requires teachers' future action to focus on the intentional crossing over into other subject boundaries. When this was historically required of home economics and CDT teachers at the start of NC design and technology,

research from Paechter's (1995) identified the practice of sub-cultural retreat where some teachers chose to withdraw from the subject.

Research Design

This research aimed to generate knowledge about the qualitatively different ways teachers, who completed their ITE with one university provider, responded to and implemented the subject policy changes introduced in 2014. In addition, the research investigated the factors influencing design and technology teachers' capacity to implement change. The overarching question to be considered was:

- In what qualitatively different ways have design and technology teachers translated policy development into practice?

A qualitative study explored 12 teachers' day-to-day experiences of subject change through in-depth interviews. A qualitative and interpretative methodology was chosen for this research because it allowed for collecting rich data in a natural setting (Robson & McCartan, 2016). Qualitative research allows for both inductive and deductive methods of interpretation that use theory to frame the research problem (Creswell & Poth, 2018). This approach supports the generation of data that includes descriptions and interpretations of the problem reported in ways that capture the voice of participants and contribute to ideas for change.

Aspects of the phenomenographic approach informed the strategy for exploring how teachers made sense of policy development (Barnard et al., 1999). Phenomenography is a qualitative research method built on the phenomenological approach to answering questions about a collective experience (Bowden, 2000; Marton, 1981; Marton, 1986; Trigwell, 2006). Although this approach does not usually promote the richness of individual experiences, Ashworth and Lucas (2000) argue for including rich individual descriptions that aim to conceptualise detailed accounts of the lifeworld of participants, leading to individual profiles that can be cross-referenced as part of the interpretative process.

Using in-depth interviews, allows for thick descriptions of research participants' experiences through a conversation between researcher and participant that offers maximum freedom (Creswell & Poth, 2018; Robson & McCartan, 2016; Silverman, 2015). Validity can be achieved in a range of ways, including collecting data within the participants' natural setting, researcher reflexivity, and participant transcription checking. As a qualitative phenomenographic methodology guides the study, the primary sources of data came from in-depth interviews with the secondary design and technology teachers during the academic year 2018 - 2019.

Data Analysis

Data analysis followed a creative approach (Kara, 2015) where data was collected with supporting field notes and visual sketches, leading to a set of composite individual teacher descriptions (Ashworth & Lucas, 2000; Checkland & Poulter, 2006). Findings were recorded and coded, leading to researcher themes (Gibbs, 2018; Saldaña, 2013). The choice of a qualitative approach generated subjective knowledge and experiences that, although not universal, offered individual truths about insights into the problem. For ethical reasons, the participants' real names have not been used.

The research context

This paper will present the findings from two teachers in two secondary schools. The first teacher is Judith, a food and textile technology trained teacher, who had learnt to teach outside her specialism across two schools. In contrast, Mary had only taught textiles technology despite completing her training in all aspects of design and technology. In addition, she has been nationally recognised as an outstanding newcomer by the subject association for her work in curriculum development.

Judith

Judith was in her 11th year of teaching design and technology at her current secondary school and worked with a small team of supportive teachers. She had transferred her practice of what she described as "coming of the circus" to her current school, which had welcomed the chance to move away from the rotation model. Judith believed that pupils needed to experience all aspects of the subject, including the different material specialisms and that young people should develop solutions to real-world problems rather than only learning to make existing products. She explained that she felt this way because of her background in the fashion industry, where she saw that design was not just about making products but understanding technical data and ergonomics. So, she was enthusiastic about the aims of the new design and technology GCSE qualification. In Judith's school, KS3 was taught through four material-focused short projects and one multi-material end-of-year project in Years 7 and 8 (11 - 13 years). At KS4 pupils were grouped in relation to the specialist technical knowledge material option they chose. In turn, their choice led to additional specialist questions within the written aspects of the GCE examination, and Judith taught a textile focused group. Judith recognised that the shift to teaching an integrated KS3 curriculum would rely on the willingness of the department team to share expertise and respond to the challenge of teaching through contexts rather than short, mainly making projects.

Mary

Mary was in her third year of teaching textiles lessons within a creative arts department comprising art, design, and technology teachers. She worked in isolation on the planning, teaching, and assessment of KS3 textiles and a GCSE group made up of pupils that specialised in textiles. Mary talked about a lack of time or appetite for collaboration on planning despite her involvement in national courses that advocated a team approach to planning. Mary described how she networked with other enthusiastic colleagues outside her department through her involvement in a school-level assessment group. She had started to see her ideas trickle into the department's teaching but generally described a lone approach to teaching design and technology. Mary expressed an initial frustration when she started at the school that pupils achieved in the artistic side of drawing their design ideas, but they struggled to demonstrate a knowledge of the materials and processes involved in manufacturing their products. She believed pupils required this technical knowledge and adapted her teaching plans accordingly.

Findings

Mary and Judith were enthusiastic about how teaching pupils for more extended periods in the academic year led to stronger pupil achievement and engagement with the subject. Mary claimed the move to teaching pupils for longer had a more substantial impact on pupils' progress than the previous iteration of the short six-week regime when she states:

> *Their knowledge and understanding of design and technology seem to be a lot better embedded than the year nine's when I started at the school (Mary).*

In Judith's school, the timetable allowed teachers to work with the same pupils over two years. She explained that:

> *To track the progress, we felt it helped to keep the kids for the year, and we even tried to keep them for two years. I've got one group who I have had since year seven who are now doing their options in year eight - everyone in my class is taking design and technology (Judith).*

Mary emphasised how each colleague in the department had a separate role from the other. She stated:

> *I'm the only person doing textiles. So, I've had full accountability for what I've written for the textiles scheme of work, and the food teacher has had full accountability for her [area], and the robotics and the RM staff have had the same for theirs (Mary).*

Both teachers emphasised the need to learn the new knowledge required to understand the new elements they needed to teach. Judith highlighted the practice at her school of prioritising departmental time for professional development. She stated:

> *We have two staff meetings a week - one on a Monday and then on a Wednesday. As a department, we knew, obviously, we wanted to be flexible and be trained in all these different areas, so we decided, right, we are going to use that Wednesday [to teach each other].*

In contrast, Mary focused on her experience of making decisions about how the lesson content would be shaped by the non-specialist teacher and the compromises she would make to ensure future lessons could be taught by all team members. She stated:

> *Sometimes I'll plan a really hands-on lesson, which has lots of like handling kits, tips, bits and pieces that I have in and around your classroom, and you can quite easily pull together. So, when I have planned these lessons, I can't do that, so, I've held back from doing perhaps more exciting lessons, because I've thought about resourcing and practising with them. I suppose the nature of the lesson you've got, to give to somebody else, you want to make it quite easy for them to pick up. So, something that you might not naturally do in your teaching style.*

Judith and Mary drew attention to the teaching spaces for design and technology. Highlighting the link between workshops, equipment, and making specialist products. Judith was enthused about the need to help pupils appreciate that workshops did not have to be associated with one specialism. She asserts that:

> *Even though we might be in the textiles room, we might be working on polymers, or we might be working on, you know, doing moulds for pewter casting. So, we've tried to break the kind of attitude from the kids really that just because they're in this room that they'll be doing this?*

Both Mary and Judith emphasised the need to teach the pupils about the breadth of the subject and not to focus on previous GCSE pathway strands. However, as Judith worked in a school that had already embraced the shift to teaching all aspects of design and technology, she talked less about issues associated with subject content. Whereas Mary enthused about the need to broaden the teaching of textiles from a vocational fashion viewpoint to a more general view of textile applications when she stated:

> *I didn't ever consider textiles as being part of the automotive industry or being part of medicine, or all the other wonderful things that it's part of in the world. In a much bigger spectrum than I perhaps understood when I was at school. So, I think it is quite important at that age to have that open… Yeah, to have that openness about it. Because I think I only ever understood it as "fashion and interior design". I didn't ever really think about the other places it could take you. I think that that's really important for children to understand.*

The experiences that emerged from these findings centred upon a teacher's understanding of what a transformed design and technology might look like and what they needed to do to achieve this. The research findings suggest that a teacher's approach to the planning and teaching of design and technology is influenced by their ideas about the subject and how lessons are organised in the school. The dimensions of " Coming off the circus of specialist rotation" and "Teaching inside a specialism" are a means to elaborate on factors that influence the teachers' capacity to implement change.

Coming off the circus of specialist rotation

"Coming off the circus of specialist rotation" was represented by Judith when she described the department's approach to organising teaching to ensure one teacher worked with the same group of pupils over the whole teaching year (DfE, 2013; DfE, 2015). In addition, she explained how the department judged the practice to support pupils' progress by allocating one teacher to one group and described how the decision had led to more robust engagement in the subject as more pupils chose to study the subject at a higher level. Mary represented the theme of "coming off the circus of specialist rotations" when she described her school's approach to extending the length of specialist projects, thereby reducing the number of rotations a pupil went through in one year (Ofsted, 2008; Ofsted, 2011). She reflected positively on her observations related to the shift to longer rotations when she described how the new practice led to higher progress and attainment for her learners as they engaged with essential knowledge in the discipline (DfE, 2010).

For Judith, the move to teaching all aspects of design and technology was influenced by her previous school experience and in matching her hopes for the subject to develop technological knowledge in pupils (Reinsfield & Williams, 2018). The shared knowledge and understanding of the subject that pupils could draw upon when engaged in learning through contexts, like the one multi-material end-of-year project delivered in Years 7 and 8. Both Judith and Mary represented the issues associated with "coming off the circus of specialist rotation" in relation to non-specialist teachers developing new knowledge and skills that were motivated by a need to adapt. They described how their colleagues needed to learn the specialist elements that were not their own specialisms, and vice versa. Judith described the move to using meeting time to undertake professional learning, whilst Mary described the production of resources

that needed to be practiced with her non-specialist colleagues. For Mary, the role of sharing expert knowledge was focused on preparing simplified teaching resources that potentially limited the specialist content and pedagogical approaches that in Mary's view, only a specialist could deliver (Goodson, 2013).

Judith's idea that the textile classroom could be used for more than teaching textiles was motivated by her aspiration to change how the subject was perceived. For Mary, her experience of learning textiles at school was questioned when she described how she had started to recognise the breadth of the subject and ways to view textile teaching beyond a narrow focus. She could imagine a future for her learners that looked different to her own and offered broader pathways than the vocational aspirations of the previous policy iteration. The key here is that both Judith and Mary were starting to see how specialist knowledge might entwine with other specialisms to broaden the subject, colleagues' skills, and teaching environments.

Teaching Inside a Specialism

The theme of "teaching inside a specialism" was reinforced by both Mary and Judith when they described the design of the single-subject GCSE into specialisms that mirrored the previous iteration of specialist examination courses and created textile groups (McGimpsey, 2011; Miller & McGimpsey, 2011). In Mary's school, this was repeated in KS3, and she articulated how this established a concentration of specialist knowledge and teaching rooms within her department (Penfold, 1988) as each teacher focused on a singular specialist material aspect of the curriculum (Bell, 2015). When describing the planned shift away from rotations Mary admitted apprehension about the capacity of her non-textile specialist colleagues to teach lessons in the way she would. Her textile specialist knowledge was not easy to "pick up" because she believed that teachers operating outside their subject boundary would struggle to make learning as engaging (Goodson, 2013). If departments choose to continue to adopt GCSE organisation that keeps the specialist strands apart, then it will be more challenging to break the established cycle of rotations at KS3. If teachers do not see inside each other's subject boundaries, they are more likely to retreat (Paechter, 1995) and miss opportunities to share the collective expert knowledge that makes design and technology a rich subject to study.

Discussion

The current study found that these teachers either taught or planned to teach outside a specialism by designing the curriculum to allow teachers to work with the same pupils over one academic year. However, the two cases show that design and technology teachers continue to adopt a specialist role by planning the aspects of the curriculum that relate to the knowledge associated with each material strand. In addition, Judith describes meeting times within and after the school day to share expertise across the team. The use of in-house professional development limits the teachers' capacity to develop specialism expertise if that knowledge is missing from within the team or school. For example, a school that lacked a teacher with S&C expertise might remove that aspect from the curriculum. The shift to sharing expertise and teaching specialist content indicates that teachers are starting to teach more broadly (Choulerton, 2016). Teaching the full spectrum of what design and technology offers allows teachers to build on pupils' strengths and areas for development across the year rather than over a short unit of specialist material learning. However, the results do not show how teachers map the shared technological knowledge and general design principles across the specialist

projects (Ashbee, 2021; Hardy, 2020; Reinsfield & Williams, 2018), or share information about pupil's attainment (Pollard et al., 2019).

These results further support the idea from Emirbayer & Mische (1998), who identified how the social world of agents influences the actions they are prepared to take in the present. Mary and Judith observed the pupils in their social world struggling with an understanding, in Mary's case, and a desire to develop design and technology capability through weaving material specialisms together. This is consistent with Van Deventer & Steyn's (2022) observation that in problematising the situation, a change can be implemented successfully through intentional actions (Priestley et al., 2013; Scott, 2007). When Mary saw that her pupils were struggling with technical knowledge and wanted to pursue careers and futures beyond vocational pathways in design and technology, she questioned the subject's purpose and the divisions that specialist material areas offer, aligning her values with the curriculum change (Fullan, 2015). However, she also expressed fear about the watering down of her teaching materials confirming Goodson's (2013) idea that practices and ideas shape individual subjects' boundaries.

The implications for ITE are questions around how to support trainee students who do not experience departments that have opted to "come off the circus of specialist rotations". For example, if a trainee teacher's school training experience is limited to specialist projects, then they are less likely to understand and envisage a future curriculum that embraces the full range of design and technology, and a likely consequence is that they would see their role as limited to specialist teaching (Britzman, 1992). In addition, implications for school departments centre around how to utilise newer teachers who come into the profession that might come into a school with broader aspirations and expertise. The reluctance of Mary's department to work as a team and map the curriculum from a holistic viewpoint demonstrates the factors within a teacher's school that separate subjects and create barriers despite the teachers past experiences of learning about the various specialisms during a pre-ITE training course (DfE, 2021).

Despite the results that show how these two teachers have moved the established teaching model from specialist rotations towards a coherent curriculum model that all design and technology teachers deliver, there are still questions about how to shift each projects content from specialist to shared knowledge that each department of teachers can agree on. In addition, it seems possible that these results were caused by the importance that GCSE examinations have within a school and how these create an imperative for teachers to adapt practice in relation to a policy reform. For those departments that have not yet moved to a shared delivery model at KS3 it is likely that they will not feel the need to question traditional rotation models until the next policy shift and alternations to GCSE examinations.

Conclusion
The purpose of this paper was to understand how teachers coped with a recent policy change and to determine the factors influencing teachers' capacity to implement assessment changes related to the shift to a single design and technology examination. This research indicates that teachers manage a policy change by adapting established practices in ways that both support and conflict with traditional ideas about how to design curriculum delivery. It is evident that some teachers have the capacity to draw on past experiences and align the actions of "coming off the circus of specialist rotations" with their hopes for the subject, whilst others continue

"teaching inside a specialism", despite experiences during pre-service training. Such a response sems appears counter to developing a subject that has universal appeal and a role to play inn general education. The identification of these different approaches to practice within design and technology highlight the role of past experiences and departmental contexts in the quest to challenge the tradition of "teaching inside a specialism" and move towards a curriculum experience that reflects the modern intentions of the current English design and technology curriculum policy. The priority for future research is to find out if these teacher's experiences are unique or representative on a wider scale across different ITE providers and geographical locations.

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