## Patricia Murphy

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# Gender & pedagogy

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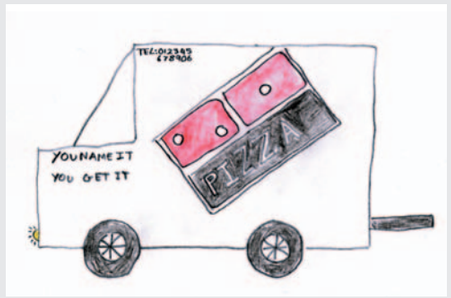
### Introduction

It is claimed that design & technology in the National Curriculum for England and Wales makes a unique contribution to the development of all young people by preparing them to participate in the rapidly changing technologies of the futures. The national curriculum made design & technology compulsory for all five - sixteen year olds; this extended access to primary children and to pupils, post fourteen. However, post fourteen pupil choices remained in terms of which aspect of the subject students could study. Look at the table below, which shows entry trends across design & technology subjects for boys and girls. Is this familiar to you and is it replicated in your educational context? Clearly the extent to which we prepare pupils to participate in future technologies varies considerably depending on whether they are a male or female.

| Subject | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Electronics | 18 | 2 | 17.8 | 1.5 | 17.1 | 1.4 |
| Food technology | 27 | 75 | 28.9 | 74.9 | 28.9 | 74.1 |
| Graphics | 61 | 47 | 59.5 | 45.9 | 57.5 | 44.4 |
| Resistant materials | 89 | 27 | 87.8 | 24 | 85.9 | 21.3 |
| Systems control | 13 | 1 | 13.5 | 1.1 | 12.5 | 1.1 |
| Textiles technology | 2 | 46 | 1.6 | 48.5 | 1.7 | 50.8 |
| Other D&T | 5 | 3 | 9 | 6.7 | 11.4 | 8.1 |

01 01 Entry by thousands of male and female students in design & technology GCSE subjects. (Source: www.dfes.gov.uk/rsgateway)

Yolande Brooks (2003) commenting on pupils' design & technology option choices observed that *'there are still many areas of life where boys will be boys and girls will be girls'* (p. 4). How you respond to this comment could be *'This is just what pupils are like'*. Or you might believe that pupils' choices reflect something about the subjects or something about how we, and others, represent the subjects to pupils. Sue Eaton (2003) observed that the use of CAD/CAM in textile product courses for 11-14 year olds encouraged boys to take the subject further as it showed that it *'was not a "posy" subject but one which uses machinery and precision to a strong degree'* (p. 2). Do you associate the use of machinery and precision with things that boys do particularly well





02 03

02 Examples of girls' - (aged 10 - 11)
03 vehicle designs.



04 05 06

04 Examples of boys' - (aged 10 - 11)
06 vehicle designs.

and like, as opposed to girls? Sue also noted that pupils were aware that *'most famous dress designers are men'*, and the small number of boys choosing to study textiles were influenced by career aspirations.

There is significant gender stereotyping in students' career choices evident in the different vocational pathways taken by girls and boys. Angela Roger and Jill Duffield (2000) identified two influences underlying girls' persistent opting out of science and technology courses: students' view of themselves and future possibilities; and career awareness. They described the relationship between self-concept and career awareness as the *'interaction between the way pupils see themselves and the opportunities they perceive are open to them'* (p. 374). Self-concept shapes the attitudes to subjects of boys and girls alike and is a predictor of subject choices.

> Do you in your choice of tasks and in talking about practices tend to reinforce traditional views of how technology is used in the workplace? In your mind's eye who are the successful pupils in your subject, are they typically boys or girls? Why do you think that might be?

Consider these quotes from teachers about their views of what girls and boys are like in relation to design & technology.

- *'Electronics in the end isn't a girls' thing.'*
- *'You have your high technological boy… he's a very technological kiddo and he is able to work at very high level, logical, technical, mathematics etc. The girls are more artistic in their approach. They're far more quality-conscious than the boys.'*
- *'The lads who are really good scientists, mathematicians, they tend to go for the electronics side of it.'*
- *'They're [girls] neat about what they do. Their attention to detail is often better than the boys, so the chances of their products working are great.'*

(Murphy, 2006, p. 225)

How did you react to the quotes? Are girls innately more artistic than boys and is this the case for all girls? Are boys logical and therefore does it follow that girls are illogical? If you think of any common myths about gender they typically treat all males and all females as the same.
One teacher commenting about primary girls' and boys' designs observed, *'the boys will want to make it move and the girls will colour it'*.
Have a look at the initial drawings of Y6 pupils in the illustrations above; what do you notice about them?

Look at the purposes the designs serve. The girls' examples are for transporting food, people and animals whereas the boys are for getting places fast, safely or for defence. Brunner, Bennett and Honey (2000) reported similar findings and described girls' vehicles as household helpers or improvements to technologies that solved real life problems. Boys' vehicles were characterised as having the capacity to take them wherever they wanted to go instantly.
Are you aware of differences in girls' and boys' approaches to designing and making? How would you characterise these differences? How do you explain them?
To begin to unpack why gender differences emerge in what teachers say, and what pupils do, you need to consider how thinking about gender and learning has developed.

## Understanding learning and gender

Talking about the way that 'boys' and 'girls' are reduces gender to biological sex, i.e. a fixed attribute of an individual. It implies that as groups, females and males experience the world in similar ways. However, any view that assumes meanings and experiences are stable across populations of people is inconsistent with thinking about how human understanding develops. Susan Greenfield, the neuroscientist, describes how understanding of the world develops through a process of associations between characteristics of objects, people and experience. These associations lead to objects and people gradually acquiring *'ever more eccentric and intense degrees of significance'* (Greenfield, 2000, p. 52).
Several ideas follow from this:

- people and events acquire differential degrees of importance for individuals;
- the world as we experience it is personal; it is what we make of it;
- meaning is not pre-existing, rather being a human is to engage constantly in a process of negotiation of meaning.

If we think of learning as a process of meaning-making then teaching is not a simple process of transmission (input) and reception (output) mediated only by the innate characteristics of the pupils. The personal way of knowing described by Greenfield determines our interpretations of, and responses to, new situations. Teaching and learning is a dynamic process; meanings shift and evolve as activity develops and evolves. Think about some recent lessons, each represents a new situation where new meanings have to be created between you and your pupils as they engage in activity with the tools made available. These tools include the physical equipment and the ways of acting, talking and being, that are valued - in the subject. Your practices cue what it is appropriate to do, say and produce in the design & technology setting and therefore have a major influence on the meanings that pupils create. Similarly what pupils bring into learning situations influences what is available for them to learn. This includes how pupils see themselves in relation to the subject, both in the present and in the future.

Jean Lave and Etienne Wenger describe how, in this view, learning and knowing is better understood as relations among people in activity: *'in, with and arising from the socially and culturally structured world'* (Lave and Wenger, 1991, p. 51). Gender is central to the way life is organised and construed and is embedded in our thinking and routines. It is, therefore, a significant influence on the process of learning both in terms of how you represent your subject and who can do it and how pupils feel positioned in relation to it. So how does this influence operate? In trying to represent masculinity and femininity we tend to place them in opposition; what one is the other is not, and this becomes part of what we take to be 'normal', the common sense way of understanding the world.

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Look at the following words that teachers used in interviews to describe girls and boys:
- independent/dependent,
- conformist/risk-takers,
- diligent/slapdash,
- neat/careless,
- circumspect/opinionated,
- motivated/disaffected.

These too work on oppositions and represent gender categories. Which do you associate more with boys than with girls and vice versa?

Putting these words together creates identities that we extend to our pupils that are gendered and constrained. We all know opinionated girls and motivated boys so can challenge these stereotypes. How often though do we allow that girls can be risk-takers and what impact might that have on what they feel able to do in design & technology?

Through our language we talk into being the categorisations we use to identify what it is to be masculine and what it is to be feminine. These ways of representing gender change over time and continue to be influenced by the vestiges of previous world views. Gender is, therefore, better understood as a social construction, which sets up expectations of what it is to be identifiably masculine or feminine that are more or less stable factors of a culture. Children are aware of the need to be identifiably male or female and locate themselves within and through these social gender categories as they learn to make sense of the world and of themselves. Bronwyn Davies (2003) talks of children's need to *'get it right'* and to do this students have to know the ways in which cultural practices can be varied. Gender is not, therefore, a static identity but a learned capacity of pupils to provide and read depictions of masculinity and femininity



(McDermott, 1996, citing Goffman).

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Think of a girl and a boy as they engage in different aspects of design & technology that are typical of their experience from age 11-14. Imagine them entering a textiles classroom and then a resistant materials workshop. How might they read gender in these settings?
In which setting would you anticipate they each would feel a greater sense of belonging and therefore a better chance of 'getting it right'?

## Working with gender

**Design & technology - a masculine domain?**
The notion of the living 'female' universe to be nurtured and protected emerged in Greek and early pagan philosophies. In the nurturing organic framework those who mined mother earth were portrayed as uncivilised brutes. This imagery was no longer tenable when the industrial revolution in the 18th and 19th centuries necessitated unprecedented access to the earth's resources and the means to shape them. To sanction this change in societal behaviours and the right of 'man' to have dominion over the earth required a shift in the language. Joan Rothschild (1983) describes how the emerging discourse, which sanctioned technological activity, placed aesthetics in opposition to the technical and characterised femininity as passive and masculinity as dynamic. The female role was to stabilise by holding, protecting and preserving. Males were portrayed as the manipulators, the doers assaulting nature and *'the inventor, the user, the thinker about and reactor to technology'* was male (1983 xix). In this way ideas about gender and ideas about technology became associated in industrial society.

*'They [society] all agreed that there was some natural and necessary connection between working with your hands, being skilled, being independent, and being a good man.'*
(Schwartz Cowan, 1997, p. 218).

This construction of masculinity affected the practice of technology; men could invent machines and women and children could operate them. However, when there was a struggle to maintain control over access to machinery, men appropriated skilled work and 'women's work' was restricted to the unskilled and routinised (Wajcman, 1991). Consequently 'technical competence' was seen as integral to masculinities and women were positioned as the technically incompetent.

The design & technology curriculum specification for England and Wales drew together subjects that had deeply gendered



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histories, which reflected these practices. The two main contributors were craft, design and technology (CDT) and home economics (HE) which traditionally were taught to boys and girls as separate groups. HE was to train girls into the domestic roles they were destined for. CDT, which was a subject taught to boys, drew on the workshop skills traditionally associated with male working class occupations and crafts.

Both subjects tended to be aimed at non-academic students and were viewed as lower status than academic subjects like science and maths. This historical legacy is important as it can continue to influence how subjects are represented and how children relate to technical activity.

## Excerpt 1 - the boys only group

**Teacher:** The idea of joining materials together goes way back. Man held together spears, joined flint to doweling with twine. Now we use more sophisticated joins. If you want a bridge to go over a river you need joins that are strong and permanent, or the surface of a road, you can't have something temporary. Can you give some examples of joins that can be taken apart?
**Boy 1:** Nut and bolt.
**Boy 2:** Nail.
**Boy 3:** Staples.
**Teacher:** What about permanent?
**Boy 4:** Welding.
**Teacher:** Welding makes one piece, you can't unjoin it.
**Boy 5:** Glue

A boy started to talk about rafts and how they were joined.

**Teacher:** In the high seas you might want your raft to be springy and flexible so that it does not come to harm…That kind of join goes back possibly 3000 years.

The teacher explained that early man learned the technique of splitting logs to make wedges and sketched a 3D drawing of two wooden batons overlapping and bound and wrote string, leather, bark next to it. The boys copied the sketch into their books. One boy observed that the Tudors and Victorians probably would have used wedge joins.

**Teacher:** The Tudors probably would have, because most of their roofs were thatch, but by the time we get to the Victorians most of the roofs were not. They used nails. The teacher sketched a nail with a right angle in it.

**Teacher:** A blacksmith would have made that. Why was it shaped like that?
**Boy:** It's a tent peg?
**Teacher:** Right area. Think about the ground and a house.

The teacher referred to metal nails used in the Iron Age and the mass produced ones of today then drew a French nail.

**Teacher:** …could be bought in B&Q and a French nail is made of wire. Imagine a machine hits the top of the nail, it spreads out. The technique is called 'upsetting'.
**Boy:** Whacking
**Teacher:** Yes, it is basically whacking. We don't use much iron these days but an alloy of iron and carbon, steel, makes the metal harder.

The teacher went on to refer to several male inventors and inventions such as the Philips screw, etc., and discussed glue and how it was initially made from animal gut. He talked at length about the different chemicals used to make adhesives.



Look at the excerpts and observations below, from the beginning of two resistant materials lessons to introduce pupils to a range of joins made from different materials. The teacher was trained as a CDT teacher and the pupils were in Y9 (aged 13-14) and taught in single-sex groups although the school was co-educational.

## Excerpt 2 - the girls only group

**Teacher:** The posh name for glue is adhesive. Wood is a traditional material. It is old-fashioned. There are two things to worry about with wood. There are frames and carcasses. An example of a frame is what you are resting on at the moment, a table. What do you think a carcass is?

He spelt out the word carcass on the board.

**Girl 1:** A box.
**Teacher:** Yes.
**Girl 2:** What about a chest?
**Teacher:** Yes a chest of drawers would be a very good example. Notice when I start my drawing I start a little further down from the top.

He sketched a 3D drawing of a table and a carcass.

**Teacher:** The trouble is you have to hold that together with something [points to a join in the drawing] What would you use?
**Girl 3:** Glue.
**Teacher:** Yes…I know you are not very happy with 3D drawings I suggest you do it lightly [to erase mistakes more readily].

As the lesson went on the teacher referred to other domestic items such as shelves, mirror frames and jewellery boxes. He talked of the girls doing something only if they 'couldn't persuade your husband to fix it'.

Another time in discussing a particular joint he commented:
**Teacher:** Have you seen your Dad doing that?

He continued to comment about the girls and their drawing skills:
**Teacher:** If you think you can handle the drawing…I would like to think you could draw…

He often took over the drawing for some pupils.

(See Ivinson and Murphy, 2007)

These two excerpts are very different. Notice how with the 'boys' group it is assumed that knowledge is shared; with the 'girls' the opposite is the case. Is there a possibility that this could happen in your practice or that of your colleagues?
The teacher covered a wider range of materials with the boys and assumed they could cope with scientific information, which he excluded from the girls' lesson. Look at the historical references, which gave the boys a context to understand the link between joins and structures over time. This along with the reference to male inventors gave them both a sense of history and an identity they could associate with. For the girls they are the passive users of technology not the doers. Their role was to look after home furnishings. The teacher saw his subject as troublesome for the girls. In his practice he acted as though drawing skills was something girls were not capable of achieving, i.e. an innate deficiency. Hence rather than seeing the need to open up practice to enable the girls' participation by modelling drawing he did the drawing for them or let them flounder.

? Do you, in linking your lessons to technological action in the world, represent the achievements and roles of both males and females? Do you consider that girls or boys might feel a different sense of belonging in your subject and do you attempt to change your practice to give them access?

Does this seem an extreme example exacerbated by the separation of girls and boys and the teacher's background? Another teacher, in the same school teaching the same age pupils, who was more recently trained, made a point of situating resistant materials in the domestic realm for both boys and girls. He made a very successful change in his practice to engage girls with the machinery. The girls talked of being *'trusted to use the machinery'* and *'knowing how to work it [the machine]'*. This teacher opened up access to the tools of the subject, extending girls' agency, i.e. the realised capacity to act upon their world (Holland et al., 1998). However, this same teacher made no such change in the 'all boys' group, assuming boys were not only competent, but felt competent, to participate. Yet as one boy, who was anxious to drop the subject, commented: *'I am just afraid of hurting myself'*. The teacher's practice confronted this boy with an identity he did not share but to ask for help would reveal this.

? Try observing how different pupils engage with activities and the equipment routinely used in your subject. What differences between boys and between girls did you notice and what insights does this give you into what they feel able to do?

Look at the table below and the pass rates for the GCSE subjects in 2005.

| GCSE D&T subject | Entry in thousands | | % achieving A*- C grades of students attempting the subject | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| Electronic products | 15.9 | 1.1 | 58 | 73 |
| Food technology | 27.2 | 66.7 | 44 | 63 |
| Graphic products | 49.2 | 37.4 | 47 | 65 |
| Resistant materials | 80.4 | 18.0 | 49 | 65 |
| Systems control | 11.1 | 0.9 | 57 | 76 |
| Textiles technology | 1.6 | 46.6 | 37 | 69 |
| Other D&T | 13.3 | 8.5 | 51 | 68 |

07 % male and females at the end of KS4 gaining a pass or higher (A*- C) by subject in 2005. (Source: www.dfes.gov.uk/rsgateway)

This table shows that many girls and boys achieve well across the subjects in design & technology, which challenges assumptions about incompetence or innate differences, attributed either to girls or to boys.
Where there is a major imbalance between girls' and boys' entry the minority group is considered to be the more highly selected i.e. representing more able and committed pupils. It is, therefore, expected that their performance would be higher than the majority group. The figures indicate that this may be the case with girls but not for those boys choosing to study textiles and food technology.

## What pupils pay attention to

Children learn what is important for them to pay attention to in managing a gender identity, and what is not, and from an early age are observed to engage in different activities and roles even when using the same resource. As they learn from what they do real differences emerge in what they become familiar with, and in what they understand is purposeful activity. For example when playing with construction kits young boys were observed to focus on making structures that moved whereas girls were more likely to use structures as part of their social play. These differences in what girls and boys tend to pay attention to influence what they focus on in design & technology tasks. Girls' concern with the social context



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dominates their designs and they are more likely than boys to consider aesthetics and user needs. Boys are more likely to include detail about mechanisms and structures focusing on the physical aspect of needs and wants. This can result in certain girls facing complex problems and solutions that teachers do not anticipate in the support and resources they make available.

In a study involving secondary pupils given the opportunity to generate authentic designs it tended to be girls who situated their response in the context of the person's needs and the circumstances in which the product would be used. Moisture sensors were used to create a bath alarm for a grandmother and housed in a water drop shape. A rain alarm for a mother's wash line was in a sock-shaped housing (Murphy 1999). If you reconsider the drawings on pages 236 and 237 you can see this concern with people and the social world in the girls' examples. Also if you remind yourself of the way technology became associated with gender (noted on page 236) notice how what boys and girls have learned to pay attention to reflects very closely the way that masculinity and femininity, in relation to technology, was characterised.

'Design and make' activities often start with a brainstorm of needs and wants. The needs and wants that pupils identify reflect their values and commitments, and this is influenced by gender. The needs and wants that emerge define the problem space in which pupils work on their design and make skills. Pupils' commitments, therefore, influence the learning opportunities available to them. For example in a study that evaluated the Nuffield Primary Design & Technology resources for teachers (Barlex, 2001) one activity had children designing a bus. Most boys began their making task with the moving parts whereas girls generally focused on the interior features for the passengers and the exterior appearance. At the end many girls' buses looked like buses but lacked wheels or had rather inefficient wheels. Many boys' buses looked like moving cardboard boxes (Murphy and Davidson, 1997). Leonie Rennie (2003) working with elementary pupils making pirate boats also noted this effect referring to the different levels of construction skills as well as differences in how the boats were designed and furnished. Only boys made boats from wood and girls made all the boats that were less well constructed. It was perhaps not surprising that the national Assessment of Performance Unit's survey of 15 year olds in design & technology found that girls did better than boys as a group on tasks that involved identifying underlying issues and empathising with users' needs. Boys did somewhat better in generating ideas and in modelling working solutions (Kimbell et al., 1991).

Pupils and teachers are often unaware of how gender influences learning outcomes in design & technology.





Why not look at initial design ideas to see what pupils appear to prioritise? Or use peer review at the initial design stage to engage pupils in reflecting on the nature of their priorities in relation to physical, social, and emotional and market needs before they commit to their design solution.

Product analysis tasks involving a range of products can also open up pupils' thinking about different emphases to meet different needs.

## Pupils' perceptions of relevance

The tendency for girls to focus on appearance and boys to consider structures first is evident in the emphasis they give to design and to making in their design & technology activities. In a study with 13-14 year-old pupils (Ivinson and Murphy, 2007) one activity observed was to design and make a vehicle with four wheels to carry a kilogram weight five metres. All the boys worked first on the structure to meet the criteria of stability, strength and movement. Appearance was a secondary consideration: *'it's the capability of the designs that's key'*. The girls gave priority to presentation and appearance so one chose to work with plastic and used vacuum-forming. Another girl, Julie, aware that the value she placed on design might prevent her meeting the brief was prepared to take the risk: *'I'm just hoping that the design mark is really good and it will make the five metres'*. Another pupil was well aware of the gendered nature of design & technology practices describing them as things *'girls don't normally do'* but had an interest in pursuing her study of resistant materials in spite of this.

*'When they [girls] grow up they're just beauticians or working on computers and all things like that and when something goes wrong, like, my Mum, she can never do [fix] it…When I get older I just want to be able to do it all myself instead of relying on everyone else.'*

For the teacher the skills acquired through the design and making of artefacts such as a model car have an obvious relevance to life. In interview he described how measurement in relation to where to drill the holes for the model car axles could be linked to the context of putting up a shelf and buying a microwave to fit a given space. Creating joins was another feature of the activity and for the teacher this knowledge would enable pupils to *'do those little jobs around the house'*. For Julie the importance of the making for her learning was not clear, as the teacher did not articulate it. Nor could the teacher know, unless he spoke with the girls, that their design decisions were constraining their opportunities to develop the making skills he valued. The teacher could

**Girl:** How do you put the times?
**Teacher:** Where would you put the three waits?
**Girl:** Three waits?
**Teacher:** Yes, there are three of them.
**Girl:** What, large?
**Teacher:** Well, one of the three ones will be determined, say, by road conditions or by the amount of traffic. You've pressed the button; this automatic would link; amber appears; so, wait there then.
**Girl:** Where?
**Teacher:** There's a timed wait. You put it in between the commands. So, you just put a little arrow there, and say: here we'll wait. We don't know how long the wait is at the moment, but there is a specific wait time band between you pressing the button and the system operating, and there are two more. It might be a wide road. Say, a wide road?
**Girl:** Longer for an old person.
**Teacher:** Yes, for granny pushing a trolley, easy to hit.
**Girl:** We put that in there?
**Teacher:** OK, when the people are crossing. It goes, yes, there.
**Girl:** Wait's put in it or…?
**Teacher:** Yes, put a wait there. OK, we're stopping the traffic here…What are the people doing? They're going. The wait light is on, so you actually have to tell them to wait all the time…
(Murphy et al., 2004)

Notice how the teacher emphasises physical issues to do with traffic and road conditions as well as the people who might be using the crossing. Another important feature of his practice that pupils commented on was the support he gave them to be autonomous and make decisions for themselves.



make quite inaccurate judgements about pupils' achievements and capabilities without access to what they prioritise.

The relevance of what it is possible to learn through design & technology activities cannot be assumed. I have pointed out how boys and girls become familiar with different aspects of their environment and what they consider relevant follows from these differences in experience. Pupils need teachers' explicit help to make bridges to what is unfamiliar to them in design & technology subjects so that they can understand their relevance. If this had happened with Julie and the other girls you could imagine that they might have made very different design decisions.

In many interventions to change participation for girls and boys products are selected that we know girls and/or boys find relevant and therefore engaging. For example, Yolande Brookes (2003) reported on a school that was encouraging girls in their study of systems & control by focusing on textile products such as children's play mats. An emphasis on industrial applications is often used to engage boys. This is a useful short-term strategy but can reinforce the influence of gender rather than challenging it in the long term. What is important is to use tasks that are authentic and relate to the real world but to provide bridges where you anticipate girls and boys may lack relevant experience. This may be more likely for boys in food and textiles and for girls in systems & control and resistant materials. You can only find this out though if you ask pupils about what they perceive to be of interest and relevance in the activities you select or why they may lack this in their view.

In a study of electronics in schools a teacher who was very successful in engaging girls used a task of programming a pelican crossing with Y10 pupils. The design decisions involved giving thought to the context of use and to the users. The teacher in setting up the task made continual references to where PICs might have been experienced by pupils. Look at the excerpt above and how the teacher bridged between the task and the pupil's experience to create and maintain relevance in learning.

## Ways of working

Pupils value having autonomy and responsibility for their own learning and this is an essential aspect of pedagogy that engages girls and boys. In many studies differences in how boys and girls work have, however, been noted. Girls state a preference for working together and boys for working alone.

? Think about the way teachers characterised boys and girls as independent/dependent.

? Do you consider collaboration as indicating dependency? Do you associate independence in working with ability and intellectual flair? Some teachers discourage collaborative work in design & technology as they see it as an opportunity for students to 'freewheel'. Have you noticed which pupils tend to engage in discussion and which tend to work alone?

Girls are described as facilitators giving lots of support to others in discussing strengths and weaknesses in designs. Girls are more likely to do this than boys even when they are working on individual products as they often talk out loud their problems and potential solutions keeping track of their own and others' designs and product issues. We described how learning was a process of negotiating meaning. Collaboration with peers provides pupils with alternative ways of seeing the world and thinking about it. Successful collaboration involves verbally explicit planning, negotiation about alternatives, equitable involvement in shared decision-making and opportunities to resolve conflict through dialogue. The ability to negotiate the shared endeavour in activities is a fundamental prerequisite of participation and collaboration is key to this. Some boys may however struggle to see the value in collaborating and need support to engage in it effectively. One problem for girls is if their collaborative approach is interpreted as them being less able or deficit.

The "Young Foresight" (Barlex, 2002) approach to designing uses group work, as a means of engaging pupils in authentic practices and as a means for learning. It provides guidance about group tasks and support that enable collaboration. Both boys and girls in the evaluation of "Young Foresight" valued the opportunity to collaborate: *'It works better when we're in groups, more ideas than if you work as an individual. You can see things from different perspectives'*. Industrial mentors supported teachers in enabling collaboration: *'the other thing we teach them is to work as a team. At the end of the day it's not just one person siting there with all the ideas. There is a huge team process going on and they have to learn to work with other projects, make decisions, sort problems, all those sort of things'*.

Another difference in ways of working is that girls appear more willing to consult the teacher whilst for some boys this is the last resort. However how teachers respond to girls seeking help can limit their learning.

For example some teachers, instead of modelling possible solutions and offering alternatives, identify the problem and solve it without discussion, removing girls' independence and undermining their agency. Some boys, as we have noted, who feel unable to ask for help, either from other boys or the teacher, struggle and often fail to progress. To encourage these boys there needs to be a shift in emphasis on to the learning process away from the product and value given to learning how things work *'even if you don't get it right'*.

## Summary

Technological practices and design & technology subjects have a deeply gendered history and the discourses that relate gender and technological activity reflect this. If we view gender as a social construction that emerges as pupils commit to meanings and positions as they participate in activities in subject contexts then we can change its influence on pupils. The difficulty is that much of its effects are invisible to both teachers and pupils. The discussion has shown how gender can emerge in teachers' practices and in pupils' expectations of themselves in relation to the subject. What teachers do can alter how pupils are positioned in relation to design & technology subjects and extend to them an identity of participation and belonging. To achieve this, attention has to be paid to:

- how we talk about subjects and who is included and excluded by this;
- the assumptions we hold about what girls and boys can do;
- what tasks are selected and how the relevance of what they offer pupils and their learning is made explicit;
- treating girls and boys as individuals and not homogeneous groups;
- what girls and boys bring to their design & technology lessons, i.e. their learned priorities and ways of working;
- strategies that make visible to pupils their commitments and the consequences of these for their design decisions and solutions and therefore what is available for them to learn;
- the support needed for pupils to develop new learning habits;
- extending subjects to include a broader view of technological practices which embrace a wider future-orientated conception of technological activity and careers.



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