Young, able (talented) pupils and visual-spatial intelligence

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Abstract
At Key Stage 1, the programme of study for Design and Technology in the National Curriculum in Wales, in relation to ‘Designing Skills’, simply states that:
‘Pupils should be taught to record their ideas, e.g. using words, pictures, sketches and ICT’ (ACCAC 2000 p.8)

This paper provides details of a pilot research study, focused on the extent to which young children (infants), as guided learners, can develop competent sketches, as a means of generating, communicating and recording ideas. Here, the emphasis is on young children’s management of more formalised drawing formats (orthographic projections) and how these might support the development of pupils’ visual-spatial awareness; not least, the ability to visualise objects, or parts of an object, from different perspectives, in a realistic way.

One of my aims was to try and distinguish children whose work demonstrated ‘relatively exceptional performance’, that is, an aptitude for ‘visual realism’ and the importance of valuing and nurturing such aptitude across the curriculum.

As such the teaching of design drawing skills is seen as an important element of classroom practice because it can help children to move beyond a pre-schematic stage (4-7 years of age), where their drawings usually demonstrate ‘failed-realism’ or ‘visually unrealistic’ depictions of objects (Anning and Ring (2004 p.17), citing the work of Lucquet).

Moreover, as Golomb’s (2004) has noted, if teachers structure tasks effectively, then children will adopt unfamiliar orientations and instead of drawing what they know/understand about certain objects, will draw what they see. This may help children to avoid common misrepresentations including: segregation, transparency, mixed views, fold-out and a failure to indicate that one object may be hidden or partially obstructed (occluded) by another; that is, to use hidden line elimination.

Past experiences have indicated that very young children (six years old and above) are able to secure a sound correlation between two and three dimensional images of an object (product) and to utilise these representations, together with associated talk, to move ideas forward. Mechanisms to support/scaffold children’s design drawing output, that I have previously used, include:

• **Drawing like a photograph**: discussing and labelling photographs as a means of supporting children’s three dimensional representations and associated annotation.

• **The use of clip art**: to support children’s recognition of differing viewpoints.

• **Exemplar models**: allowing children to view a product from a range of perspectives.

• **Part-drawings and exemplar drawings**: to help children think orthographically, about the relationship between front, side and plan views.

Of these support mechanisms an exemplar model, clip art and photographs were utilised during the pilot study.

Key words
visual-spatial intelligence, relatively exceptional performance, talent/giftedness, orthographic projection, occlusion, visual realism

An overview
The pilot study was based in a Year 1 classroom where a comparison was made between ‘free drawing’ and ‘taught/guided drawing’. This approach was guided by the work of, for example, Maureen Cox’s (1994): ‘negotiated drawing’ techniques; Kreger Silverman’s (2005) focus on children showing as well as telling by way of visualising objects from different perspectives; Egan’s (1999) concern about a failure to introduce children to ‘genres of drawing that can help them to develop designerly thinking and behaviours.’ (p.79) and Hope’s (2005) call for the explicit teaching of the role of
drawing'; for young children to know not only when drawing is most relevant, but also when to make best use of their visual representations as a means of supporting their design thinking.

All of this has led me to see 'taught/guided drawing' as a scaffolding framework within which the responsibility for issues such as proportion, scale, orthographic representation, visualising in three dimensions etc, are partly removed from the child who can then think creatively about what to do with the basic pictorial forms that s/he is encouraged to focus on.

Giftedness/Talent
Space does not permit a detailed discussion of these notions but it is hoped that society has moved on from narrow definitions, generally related to ‘academic’ performance, to those that see giftedness as an amalgam of interrelated human traits, one of which is ‘creativity’, which I would wish to associate with ‘visual form’. Moreover, these notions are contentious and, in the context of this paper, I recognise that attempting to correlate an ability to depict a design idea, in a visually realistic manner (talent/gift in a very specific field), with the notion of ‘giftedness’, in the broadest sense, is problematic.

However, an identification of ‘relatively exceptional performance’, in terms of spatial/visual awareness, and the extent to which such aptitude is valued and nurtured at the level of the individual child, remains significant. Indeed, I am wishing to argue that where any relatively exceptional performance is identified it needs to be provided with opportunities through which it can ‘surface’, be valued and, thereafter, nurtured, not least as a means of supporting children achieving their full potential. This argument can be related to, ‘personalised learning’ and in DIES (2004 p.6) terms, ‘high quality’ teaching that is responsive to the different ways students achieve their best.

Spatial Intelligence
Some, for example, the Harvard Project Zero and President and Fellows Harvard College (1999) have suggested that spatial intelligence relates to accurate mental visualization and the mental transformation of images. Others have linked it to aptitude for drawing, a keen eye for detail and or a good sense of the parts to the whole. Gardner (1993) identified it as one of areas of multiple intelligences (Gardner, 1999); promoting a view that educational institutions should place equal attention on all of these ‘multiple intelligences’. For Gardner (1993), albeit his theories have been contested (see Mark Smith 2002), spatial intelligence (more often referred to as visual-spatial intelligence) can be linked to a number of key tenets. In the context of this study his identification of an individual’s ability to, ‘perceive the visual world accurately’ and ‘to perform transformations and modifications upon one’s initial perceptions’ (p.173) are of most significance.

The question is, to what extent do children who have aptitudes in this area have opportunities to demonstrate this aspect of intelligence and are such gifts/talents valued or celebrated, by teachers, to the same degree as others, for example: verbal-linguistic.

The question is posed because, if learning is to be ‘personalised’ then teachers will need to work towards a pedagogy that attempts to facilitate the means by which pupils can demonstrate all of the talents they possess, including the ability to, among many other things, visualise objects from different perspectives.

Methodology
An overview
An essentially qualitative approach was adopted for the pilot study, together with the development of some simple numerical data. I had three research instruments in mind, though in the context of this paper, it is the former that provides a focus for the discussion which follows.

I. Children will be engaged in two interrelated drawing activities. In the pilot study the DT project was based upon the design and manufacture of an ‘Egg Truck’ that had to be able to carry a chocolate cream egg safely down a ramp, along the floor and through a finishing line, without the egg rolling out of position. The children’s design work was structured, in line with the overview provided above, to allow them to:
- Produce a ‘free drawing’, once requirements had been appropriately clarified;
- Produce a ‘guided drawing’ based on a focused practical task that encouraged them to communicate
their idea orthographically, and preferably, in terms of indicating how the chocolate egg would be securely held, as a plan view.

This provided data in the form of 42 drawings (21 pupils involved) from which categories of drawing style were developed (see analysis section below) and supported a comparative analysis of children’s output.

II. A semi-structured interview with individual children/whole class as a means of appreciating their interpretation of the tasks undertaken and the work produced. For example, what value do they place on their own ability in this field of endeavour? Why did they draw in the way that they did, during the free drawing session? What do they see as the advantages/disadvantages of drawing in a more formalised manner?

III. A semi-structured interview with class teacher(s) focusing on a limited number of key questions. For example, what is your response to the central findings? What arrangements are in place to value and record ‘talent’ of this type? Do any of the children, identified as relatively exceptional, normally fall into the most/least able category? To what extent are other opportunities available, as part of current provision, for this particular ‘talent’ to be demonstrated?

Analysis of pilot study data
Categorising children’s drawing

The analysis of children’s drawings is based on a set of categories (see below) largely based on the previous work of others (e.g. Baret et al, Cox, Selfe and Willats, all cited in Freeman and Cox 1985). These categories (six in number) evolved from repeated reflection on the data (42 drawings) alluded to above. Guiding me in the initial stages of categorisation was a statement from Freeman and Cox (1985) that, ‘young children (under 7) have been underestimated: they have more advanced drawing devices up their sleeves than anyone has suspected.’ (p.9) The guiding categories are as follows:

1. **Non discernible (ND)**
   The depiction(s) fail(s) to offer a clearly identifiable representation of the vehicle in terms of the viewpoint/details offered (failed realism); denoted by ✗.

2. **Missing chocolate egg (MCE)**
   The depiction(s) fail(s) to clearly identify the inclusion of the chocolate cream egg as an integral part of the design (failed realism); denoted by ✗.

**Visual realism**

3. **Orthographic 1: Plan view**
   Depictions positioning the chocolate cream egg and other key elements appropriately will be denoted as: ✔. Where an appropriate indication is also provided of the means by which the chocolate egg is to be held, this will be denoted as: ☐.

4. **Orthographic 2: Side view**
   Depictions where the chocolate cream egg is correctly shown, because of the use of hidden line elimination, will be denoted as: HLE.

5. **Orthographic 3: Front view**
   Depictions where the chocolate egg is correctly shown, because of the use of hidden line elimination, will be denoted as: HLE.

**Partial realism**

Partial realism relates to orthographic depictions which are not wholly correct due to one or more of the following misrepresentations:

- Depictions where the chocolate cream egg is identified but its placement is inappropriate will be denoted as: ✗.
- Depictions where the means of securing the chocolate cream egg are not securely identified will be denoted as: ☐.
- Segregation (S) – the chocolate cream egg is drawn separately from other elements of the depiction(s).
- Transparency (T) – the occluded chocolate cream egg is drawn in part or full, as though behind glass.
- Inappropriate perspective or placement (IP), for example, elements contained in a plan view which should not be seen – vehicle doors, headlights, number plates etc. This has been referred to by Golomb (2004 p.108), for example, as fold-out.
Here, children will essentially be adopting a mixed media approach where two and three dimensional viewpoints are merged.

- Personal contextualisation (PC) denotes a focus on elements within the design drawing which are not directly relevant to the functioning of the product, e.g. depiction of a driver, passenger, shopping etc.

6. Mixed media
To fall into this category the drawing will not be presented in terms of a distinct orthographic projection but an amalgamation of viewpoints which may include one or more of the misrepresentations noted above (S, T, IP or PC).

Where Visual Realism is wholly achieved cells are shaded: 
Where there is some misrepresentation, alongside elements of Visual Realism, cells are shaded: 

Initial findings
I have examined the children’s drawings in an attempt to identify relatively exceptional performance on the basis, at this stage, of placing their work into one or more of the categories identified above.

In this context, two children (Child 2 and Child 13) were identified as being relatively exceptional given that they had:
- recorded their idea(s) using appropriate orthographic representations;
- had utilised hidden line elimination and had correctly positioned the chocolate cream egg within the vehicle (truck);
- and, in the case of Child 13, the means of securing the egg was also depicted effectively.

Child 13’s work is shown below:

![Figure 1: Child 13’s free drawing](image)
In three other cases (Pupils 14, 17 and 20) a plan view was drawn in advance of my taught input but it was unclear from discussions with children or pupils where any prior experience, in this respect, was gained. Some individuals indicated that they had had some further guidance from a parent when doing a design at home, in advance of the work undertaken at school.

A further 7 children (Pupils 1, 4, 5, 6, 9, 10, and 19) were identified as having offered elements of visual realism, though their taught/guided drawings also exhibited some aspects of misrepresentation. This represents a total of 10 children (48%) exhibiting aspects of visual realism compared with only 6 children (29%) in the free drawing session, where none of them depicted the egg truck in a wholly, visually realistic manner. If separate entities are considered (all visually realistic elements) then in the free drawing session 9 such entities were noted, compared to 22, following the guidance provided (see also below).

Elsewhere, the following key issues were identified:

- In the ‘free drawing’ exercise 15(21) pupils included an aspect of personal contextualisation, compared to 6(21) following the teaching input. It would seem, therefore, that scaffolding the children’s progress does help them to focus on relevant aspects of the task in hand (see below).

- In the ‘free drawing’ exercise 6 children included 9 elements of visual realism, compared to 10 children and 22 elements following the taught input. These included:
  - More appropriate representations of the chocolate cream egg 8(4).
  - Greater use of hidden line elimination 9(2).
  - More frequent indications of how the egg would be secured 5(3).
Feedback from class teacher and pupils

In general, the feedback from the teacher indicated that no clear associations could be made between children’s ability, linked to their performance in English and mathematics, and the output from the drawing activities. In terms of the two pupils seen to be ‘relatively exceptional’ one is deemed to be very able, the other designated Special Educational Needs (SEN). Elsewhere, some children who might normally produce what were described as ‘simple drawings’ across curriculum subjects, performed at a higher level here. Discussions with the children produced little of significance. Most were unable to explain why they had produced their drawings in the way that they had and none, where applicable, were able to suggest what prior activities supported their ability to draw a plan view in advance of my input; though some referenced parental support (as noted above). One child suggested that I was viewing her drawing as ‘very good’ because she was able to colour between lines, accurately. This led me to reflect on what young children perceive to be ‘valued’ aspects of drawing activities – indeed; I felt that the majority seemed to underplay visual realism, placing greater emphasis on appearance, at the expense of recognising the significance of the content included in their representations.

Conclusion

Though the data analysed in this pilot study is limited it does seem to suggest that, given appropriate support, young children are able to move towards higher levels of visual realism. For Edwards and Mercer (1987) it’s about inculcating pupils into what can be described as a ‘shared discourse’, whereby a teacher’s questions, clues and prompts help children to achieve insights that they may seem incapable of when working independently. For them, it’s about pupils participating in, ‘the creation of shared knowledge.’ (p.142)

For the two children identified as having demonstrated ‘relatively exceptional performance’, there was very clear progression:

- Pupil 2 moved from a mixed media approach, together with personal contextualisation, to a drawing that utilised side, front and plan views effectively, including the use of hidden line elimination.

- Pupil 13 moved from a mixed media approach that included both segregation and personal contextualisation to a side, front and plan view incorporating hidden line elimination and a clear indication of how the egg was to be secured.

Elsewhere, improvements in terms of a more ‘designerly approach’, for example, less personal contextualisation, were also identified to be of significance and the guidance does seem to have been successful in terms of focusing the children on the most relevant aspects of the task in hand.

However, the pilot study has also thrown up some, as of yet, unanswered questions:

- How was it that some children produced visually realistic plan views in advance of the taught input, given that the class teacher has confirmed that no such teaching has taken place within the class and only some of the children suggested that support might have come from home?

- How can the children be encouraged to value levels of accuracy (visual realism) and use this valuation as a means of supporting their self-confidence – a willingness to draw from different viewpoints in the context of future design based, drawing activities? To move beyond what for one, seemed to be an inappropriate focus on ‘neatness’, at the expense of underplaying the content contained within of her representations.

- Where can other opportunities for encouraging visually realistic drawing be developed as a means of supporting all pupils, and especially those who are ‘relatively exceptional’ in this sphere?

Of course, questions remain in terms of what ‘gifted’ and ‘talented’ might mean. However, if the problems of finding acceptable definitions can be put temporarily to one side, then the key argument here, in simplified terms, is that if a child is able to do something well, if performance is deemed exceptional, relative to that of their peers, then that ability needs to be given opportunities to flourish, as part of any personalised educational provision. This requires, of course, recognition of achievement across a very wide spectrum of possible classroom activities. Here, as discussed previously, the focus is on an aspect of visual-spatial...
intelligence, in the context of practical problem solving activities (Design and Technology), and the ability (gift/talent) of young children, with guidance from their teacher, to depict their design ideas in a more visually realistic manner.

As such, I would argue that the type of guidance outlined in this paper:

- needs to form part of a range of teaching and learning strategies that are utilised by teachers within both design and technology and other curriculum areas;
- will support children’s recognition and use of a wide range of drawing techniques, particularly where children’s ability to achieve visual realism are rewarded explicitly;
- will be important in terms of seeking to help young children develop a growing range of communication skills, in the hope that these can gradually be internalised and utilised independently.

In sharing the initial findings of this pilot study I would hope to generate further debate around the notions of spatial-awareness, visual realism and relatively exceptional performance.

My next step is to return to the school to in order to track the children in this Year 1 class as they move through their primary education. This might help to answer some further research questions. For example:

- To what extent are other opportunities afforded to children as a means of consolidating/developing their visual spatial awareness/intelligence?
- To what extent is the relatively exceptional performance noted here, identified elsewhere in the curriculum?
- To what extent is the type of relatively exceptional performance noted here, valued in assessment procedures?
- To what extent does the relatively exceptional performance noted here continue to be demonstrated by the children who have shown evidence of this as Year 1 pupils?

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