Young Pupils and Visual-Spatial Ability/Intelligence

Dr Jim Newcomb, University of Wales, Newport, UK

RESEARCH

Abstract

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

This paper provides details of a small scale study centred on the extent to which infant children, as guided learners, are able to utilise a more formalised drawing strategy (orthographic projection) as a means of generating, communicating and recording ideas, thereby supporting young children's ability to visualise objects, or parts of an object from different perspectives, in an appropriately realistic manner. A key rationale for the study was that of identifying 'relatively exceptional performance', in respect of visual-spatial awareness; that is, a recognition of children who display an aptitude for depicting objects (in this case design ideas) by way of utilising appropriate graphical representations/viewpoints as a means of achieving greater 'visual realism'. Here, realism is seen to be reflected by the children's recognition and representation of how their product is to function: a vehicle carrying a chocolate cream egg securely, while it runs down a slope, along their classroom floor and through a finishing line (details below). The study attempts to shed some light on this issue by comparing output from what are termed 'free' and 'taught/guided' drawings. Initial results suggest that, with guidance, young children generally depict design ideas with a sharper focus on elements relevant to the desired functioning of their product, including a move away from what I have termed, 'personal contextualisation': the desire to include components that, whilst indicative of young children's personal experiences, have limited practical bearing in terms of that which will eventually be manufactured.

Key words

visual-spatial ability/intelligence, relatively exceptional performance, orthographic projection, occlusion, visual realism, personal contextualisation

Introduction

Silverman (2005) recognises that visual-spatial ability underlies, among other things, creativity and is an essential feature of 'technological fields', whereby teachers need to engage visual learners in 'spatial exercises' and 'visual imagery'. For Kimbell et al (1996:23) 'imagery' is a key component of design and technology activity, and rephrasing Langer they note that, 'Images are our prime instrument of technological expression. The things we can draw are, in effect, the things we can think.'

If this is accepted, then teachers need to play their part in developing this ability in young children, not least in terms of the activities they provide and manage. As Golomb (2004:123) notes, for example, children's preference for 'canonical' representation, including an avoidance of occluded or partially occluded objects (see below) is, 'Grounded in the graphical logic of the child' and 'highlights the extent to which the nature of the task can affect the outcome and elicit new drawing strategies.' Though her discussion is not centred specifically on 'design' drawings, her identification of children's willingness to overcome their firm preferences in order to adopt unfamiliar orientations supports the call for taught elements to be carefully planned for and delivered as a means of developing children's design drawing skills.

Golomb (2004:107) also references Piaget and the concept of 'intellectual realism', a stage of development, identified between the ages of four and seven. Here, whilst children generally, 'Include more details in [their] drawings and the internal ordering of parts is much improved', they still tend to produce distorted drawings of objects where, instead of drawing what they see, they draw what they know; what they understand of certain objects and the relationship that exists between them.

In the context of this study, set in a Year 1 classroom, 'more detail' and 'drawing what they know' was evidenced, in part, as 'personal contextualisation' – children wishing, to use the opportunity to produce design ideas, as a means of 'telling a story'. Of depicting elements of personal experience that, whilst important to them as individuals, tended to reduce their focus on what the product was to do.

Moreover, a number of common errors were identified within their free drawings, including: transparency, mixed views, fold-out and a failure to indicate that one object may be hidden or partially obstructed (occluded) by another. In the last case,

children, by and large, did not make effective use of hidden-line-elimination. These issues have informed my own criteria for analysing the data collected to date and more detail is provide in the methodology section, below.

Of course, some children were able to respond to the task of drawing in a more formal manner (orthographically) more readily than others and could be judged to have a particular capacity for visualisation which set them apart from their peers. This leads to the notion of 'relatively exceptional performance' and whilst this is considered in the context of examining a very limited field of individual aptitude I believe strongly that children should be provided with opportunities that allow such ability to surface, be recognised and nurtured, in support of personalised learning.

Here, the role of the teacher is crucial. For, as Mathewson (1998:abstract) says, 'Visual-spatial thinking develops from birth, together with language and other specialized abilities, through interactions between inherited capabilities and experience.'

The link to 'experience' can also be identified in the work of Cox (1994) who evaluated the effectiveness of a 'negotiated drawing' approach in Art education, within Key Stage 1 classrooms. In this study results indicated that children's drawing of objects improved, over time, following a programme of structured support. Here, the term 'negotiated' refers to activities through which children, guided by their teacher, come to view objects more effectively, promoting, among other things, both their observational skills and their understanding of the many ways in which an object might be depicted. For her, imaginative work can be undermined by children's inability to draw everyday objects and supporting this aspect of their work can allow them to engage with such objects in more imaginative ways. Of course, it may be argued, as Anning and Ring (2004:18) have acknowledged, that 'spontaneous expressions of art from young children should never be 'interfered' with by adults'. However, I believe that one has to consider the context in which any drawing is being executed and, in terms of developing children's design drawings, would suggest that supporting children's recognition of the advantages of drawing ideas from a particular viewpoint supports their longer term capability of making reasoned decisions about how best to represent a design idea. As Egan (1999:79) notes, 'It is not surprising that drawing episodes in design and technology activities are problematic. Children are not introduced to the genres of drawing that can help them to develop designerly thinking and behaviours.' Similarly, Hope (2005) argues that young children not only need to know when drawing is most relevant, but also when to make best use of their visual representations as a means of supporting their design thinking. Here, she discusses, amongst other things, the possibility of young children having conversations with their drawings, understanding the relationship between drawing and construction details and establishing clear links between that which is drawn and that which is made. Indeed, in this way, children should begin, as Egan (1999:83) says, 'To develop a clear sense of function in drawing for designing.' However, this will require, as she suggests, 'Considerable scaffolding from the teacher.'

At this juncture, it is important to note, as Cox (1994) has done, that teaching drawing techniques does not mean reference to one 'correct' way of drawing, but the encouragement of a greater flexibility in the representations that children become able to employ. Silverman's (2005:1) list of key questions, aimed at the self-identification of visual-spatial learners, appears to be of particular relevance here, for it asks the individual, amongst other things: 'Can you visualise objects from different perspectives?' Relevant, because it is this aspect of visual-spatial ability that is of particular interest here; together with the extent to which young children are provided with opportunities to demonstrate their associated talent in this field.

Relatively Exceptional Performance

The notions of 'giftedness' and 'talent' have taxed scholars over a very long time and, no doubt, deliberations will continue well into the future; not least because gifted individuals come, 'In a tremendous variety of shapes, forms and sizes.' (Sternberg, 2004:9) It is hoped that society has moved on from narrow definitions, generally related only to 'academic' performance', to those that see giftedness as an amalgam of interrelated human traits, one of which is 'creativity'. For example: Clark (1997), Sternberg and Davison (2005) and Treffinger (2004). Creativity is referenced here because, as part of the

RESEARCH

contentious debate surrounding any definition of that particular term, abilities in relation to 'visual form' are often identified as a key component. In the context of this paper the focus is on a specific aptitude/talent – the ability to produce visually realistic representations. Of course, whilst talent in a single field such as this cannot be related readily to the notion of the 'gifted child', in the broadest sense, it can be argued, as Clark (1997:33) has noted, that of the many definitions of talent, some have been used to, 'Designate individuals who were not as accomplished to the level of the gifted individual, but who had better than average potential evident.'

This offers a useful link to 'relatively exceptional performance', particularly in terms of what Gagné (2004) acknowledges as 'spatial talent' and the need to offer chances for children that have this 'talent', to express it. As such, young children need to be operating in educational environments which afford a wide range of educational opportunities, amongst which the teaching of graphical communication techniques will be evident.

Stenberg and Davison (2005:28), also signal the importance of this position when noting that, 'Talent development is important to achieving one's full potential …. and that …. ongoing educational opportunities will be crucial to developing that gift.' This seems to be even more relevant as teachers strive towards the management of 'personalised learning', centred on supporting individual need, interest and aptitude as a means of nurturing the unique talents of all children. As the DfES (2004a:6) have noted, 'Personalised learning means high quality teaching that is responsive to the different ways students achieve their best.' Moreover, it requires a broad and balanced school curriculum that should, 'Encourage children to develop their strengths and to have these strengths acknowledged and celebrated.' DfES (2004b:58)

Visual-Spatial Ability/Intelligence

So what is meant by spatial ability/intelligence? Gardner (1993) identified this as one of seven areas of intelligence (he has since added an eighth – Naturalistic Intelligence) and promoted a view that educational institutions should place equal attention on each area. For him, spatial intelligence is multi-faceted and may combine a number of interrelated capacities. Whilst acknowledging the associated complexities, and the extent to which Gardner's work has been contested, there is a limited focus here on what Gardner saw as a number of key tenets. Not least, an individual's ability:

> 'To perceive the visual world accurately (a form or an object), to perform transformations and modifications upon one's initial perceptions, and to be able to re-create aspects of one's visual experience, even in the absence of visual stimuli.' (Gardner, 1993:173)

For Gardner, children who have a talent in this field of endeavour would have, among other things, the ability to: 'draw, imagine or transform an absent world.' (1993:173) In this study, one could argue that for the children, the world (their product) is not wholly absent, as during taught/guided sessions they will not be drawing, as it were, in a vacuum. Indeed, they will be prompted to respond in a particular way, to draw using specific techniques and with a discussion of an example product, to aid their progress. However, a degree of 'absence' can also be identified because the children will be required to manipulate an idea, an imagined solution that still requires individuals to make concrete, that which is held in their mind's eye. That is, to perceive, transform and represent visual images as a means of demonstrating an ability to 'see' an object when viewed from different positions. As Gardner (1993:174) notes, 'Once one is asked to manipulate the form or object, appreciating how it will be apprehended from another viewing angle, or how it would look or feel were it turned around, one enters fully into the spatial realm.'

Intime (circa 2000) suggest the following characteristics of visual-spatial intelligence, from which I have identified three key components relevant to the focus of this paper. Relevant, in the sense that the children's work was analysed in terms of their willingness/ability to draw in a particular way (orthographically) in order to depict the detail and positioning of task relevant elements in a visually realistic manner:

Young Pupils and Visual-Spatial Ability/Intelligence

- Likes to draw
- Likes to take things apart
- Likes to build things
- Enjoys puzzles
- Likes to doodle
- Has a keen eye for detail
- Has a good sense of parts to the whole
- Is mechanically adept
- Remembers places by descriptions or images
- Can interpret maps
- Enjoys orienteering
- Is good at imagining things, sensing changes, mazes/puzzles, reading maps and charts

This brief overview suggests that individuals who can demonstrate 'relatively exceptional performance' in respect of visual-spatial ability/intelligence should have an aptitude for visualising objects (products) and transforming associated mental images effectively, when these are recorded, in order to communicate developing ideas (possibilities). As such, an ability to design through the use of more formalised drawing techniques (orthographically – side, front and or plan views) should be less problematic, for these children. Indeed, for these children the accurate representation of interrelated images including an ability to see objects from a range of vantage points/perspectives (visual realism – seen here as a focus on key elements and functionality) should be something that they are able to demonstrate, well.

That some of the children who I have witnessed demonstrating this 'relatively exceptional performance/talent' were deemed to fall into the special educational needs category prompted me to consider the extent to which these and other children are provided with opportunities to demonstrate aspects of ability/intelligence which may not always be valued by teachers, to the same degree as others, for example: verbal-linguistic and logical-mathematical intelligence. If learning is to be 'personalised' then teachers will need to value a pedagogy that attempts to facilitate the means by which pupils can demonstrate all of the talents they possess, including the ability to visualise objects from different perspectives.

Indeed, as the DfES indicate:

> Whether or not one subscribes to theories of multiple intelligence, the high standards within a rich and broad curriculum advocated in *Excellence and Enjoyment* encourage provision of all types of learning opportunity. Such a curriculum is personalised to encourage children to develop their strengths and to have these acknowledged and celebrated.' (DfES 2004b:58)

Methodology

An essentially qualitative approach was adopted for this small-scale study, though some simple numerical data did accrue from a comparative examination of young children's 'free' and 'guided/taught' drawings.

Research Instruments:

1. As part of a DT project Year 1 children designed and made a vehicle to safely carry a chocolate cream egg, down a slope, along the floor and through a finishing line. As part of this project they were engaged in two interrelated activities:

   - Firstly, the children were asked to offer an initial response to the task (free-drawing), once requirements had been appropriately clarified.

   - Following this a second representation was produced based on a focused practical task that encouraged them to communicate their idea orthographically (taught/guided drawing), and preferably, in terms of indicating how the chocolate egg was to be securely held, within a plan view.

This provided data, in the form of 42 drawings (21 pupils involved), from which categories of drawing style were developed in order to analyse the children's work. These are discussed in the following section. However, at this stage it is worth noting that this was an evolving process requiring modification to the categories following several failed attempts to reach a workable format.

2. Informal semi-structured interviews with individual children as a means of appreciating their viewpoints in relation to the tasks undertaken. What value do they place on their own ability in this field

RESEARCH

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? To what extent do they feel that the more formalised approach helps them to talk about their ideas?

3. An informal, semi-structured interview with their class teacher that focused on a limited number of key questions – some developing from the children's output. For example, what arrangements are in place to value and record 'talent' of this type (an ability to offer appropriate degrees of realism when representing design ideas)? Do any of the children, identified as relatively exceptional, in relation to the taught drawing activity, 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 study data:
Categorising children's design drawings:
Anning and Ring (2004) reflecting upon 'technical aspects' of children's drawing development, not least the extent to which young children draw what they see or what they know, suggest that an ability to manage representations of objects set behind or within other objects (occlusion), or to represent objects from different viewpoints (spatial orientation) is seen as a challenge to young children. However, Freeman and Cox (1985:9) suggest that, 'young children (below the age of seven) have been underestimated: they have more advanced drawing devices up their sleeves than anyone had suspected.' For example, young children's ability to respond to the notions of 'occlusion' and the adoption of 'hidden line elimination' rather than segregating objects or drawing items as though they were transparent.
When posed with the design problem of how a chocolate cream egg might be securely held within the body of a truck, children might, as Freeman and Cox (1985) suggest: overlap: different objects drawn in their entirety with boundaries crossing; segregate: where each object is depicted in isolation; use bridged segregation: where separate depictions are related to one another by the inclusion of connecting lines or fail to adopt hidden-line-elimination: where parts of an object which cannot be seen in its entirety, have not been deleted. Evidence also indicated preference, in relation to the young children's 'free drawings', for the inclusion of additional objects, such as: a driver, a passenger, car radio, shopping bags etc; that, whilst irrelevant to the functioning of the product, indicate a need for 'personal contextualisation'; to a view of the world that provides, for the child, a connection between what the product is actually to achieve and how it might sit within their own understanding of how it might operate in the world at large. Whilst it is possible to view this as a different/alternative way of representing the world, that has validity in some design settings (e.g. a presentation drawing); this personal contextualisation does not support the notion of 'visual realism', as defined here. These additions, in the context of classroom practice, rarely come to fruition as manufactured elements and, at worst, distract young children from the key elements of their design intentions: in this case, how to securely hold the chocolate cream egg.

As such, taught inputs will provide young children with support that helps them towards a more focused representation. As Freeman and Cox (1985:89) note, 'Young children draw what they know, rather than what they see [should depict], suggesting that children do not pay attention in their drawings to what they see from a particular point of view until a comparatively late age.'

Indeed, part of Freeman and Cox's discussion centres on the contention that, with support, children can focus more effectively upon key aspects of a representation. They question, for example, the degrees of freedom that might underpin a drawing exercise, suggesting that delimiting the number of decisions that an individual drawer might have to take, together with supportive instructions and information should help the individual to focus on relevant aspects of the associated task. Of course, children will vary in relation to how sensitive they are to any instructions provided but, in general, as instructions become more precise, in the context of the purpose that the drawing is to serve, so do the depictions that follow; though they note that children's ability to select and use a particular graphic strategy, in response to verbal cueing, may not arise until they are 6.5 to 7.5 (the age of the children in my study). This position would seem to support the inclusion of taught inputs, when

requiring children to generate and communicate design ideas. In the case of the 'egg truck project', encouraging the children to adopt what might be termed as: a best option viewpoint (plan view), not only relieves them of the partial/total occlusion difficulties that will otherwise materialise, but promotes an awareness of the advantages of using different perspectives as a means of achieving greater visual realism. This seems of particular significance given that, as Cox (1985:194) indicates, 'Even if a child is capable of adopting a particular point of view, s/he may not see the need to do so.'

Categories of Drawing

All of this led to six guiding categories against which the 'free drawings' and 'taught/guided drawings' were judged and associated data recorded (see figure 9):

FAILED REALISM

1. NON DISCERNIBLE (ND)

A red 6 indicates where the depiction(s) failed to show a clearly identifiable representation of the vehicle in terms of the viewpoint/details offered.

2. MISSING CHOCOLATE EGG (MCE)

A red 6 indicates where the depiction(s) failed to clearly identify the inclusion of the chocolate cream egg, as an integral part of the design.

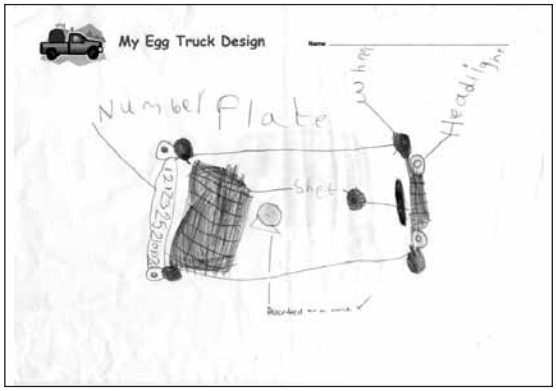
Figure1: is seen to represents an example of failed realism in that the chocolate cream egg is missing and, whilst wheels are shown, the rectangles (windows?) are arranged inappropriately for what is essentially a plan view.

VISUAL REALISM

3. ORTHOGRAPHIC 1 : PLAN VIEW

A green 4 indicates that the chocolate cream egg and other key elements were positioned appropriately.
A green ○ indicates that a means of holding the chocolate cream egg was shown.

Figure 2: This drawing provides an example of a

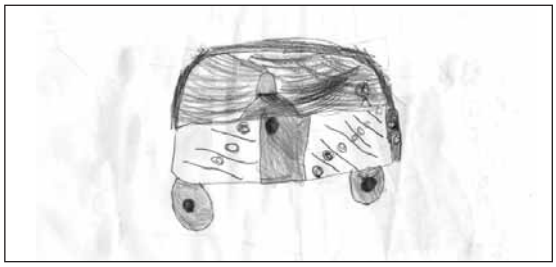


plan view with the egg positioned appropriately. However, the means of holding it was not deemed to be secure (it was later described as a cone) and there are also elements of inappropriate placement (IP – wheels folded out). As such, this drawing provides evidence of some visual realism as well as elements of partial realism. This led to the associated spreadsheet cell being coloured light yellow (see below)

4. ORTHOGRAPHIC 2 : SIDE VIEW

Depictions where the chocolate cream egg was correctly shown, because of the use of hidden line elimination, are denoted as HLE.

Figure 3: Provides an example of hidden line



elimination and a means of securing the egg. There is some inappropriate placement (IP – headlights).

RESEARCH

5. ORTHOGRAPHIC 3 : FRONT VIEW
Depictions where the chocolate egg was correctly shown, because of the use of hidden line elimination, are denoted as HLE.

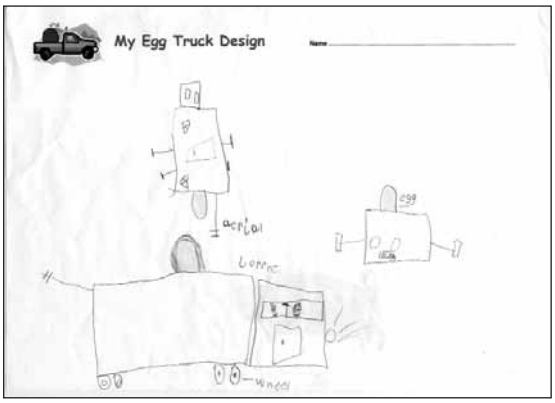


Figure 4: Here, the front and side views clearly demonstrate the use of hidden line elimination, though elsewhere there are elements of inappropriate placement (IP) – wheels, together with some personal contextualisation.

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 was identified but its placement was inappropriate are denoted as a blue 4.
- Depictions where the means of securing the chocolate cream egg were not securely identified are denoted as a blue O.
- Segregation (**S**) –the chocolate cream egg was drawn separately from other elements of the depiction(s).
- Transparency (**T**) – the occluded chocolate cream egg was 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 essentially adopted a mixed media approach with two and three dimensional viewpoints 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.

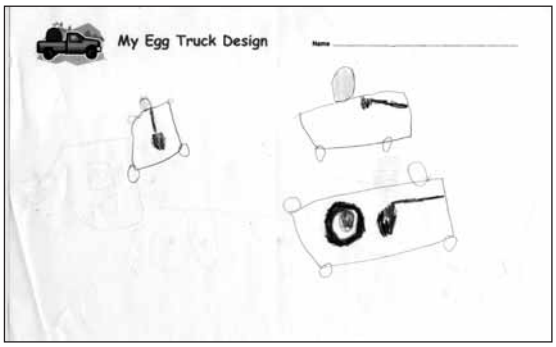


Figure 5: Provides an example of a side view where the egg was deemed to be segregated (**S**).

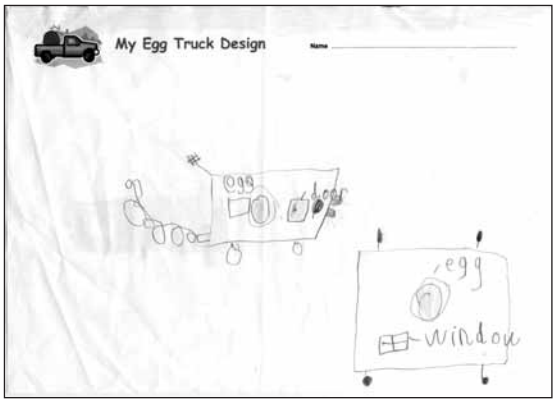


*Figure 6: Has the egg positioned and secured appropriately but also includes Inappropriate Placement (**IP**) – wheels and window on plan view and transparency (**T**) – egg shown in side view.*

6. MIXED MEDIA
To fall into this category the drawing was not presented in terms of a distinct orthographic projection, but as an amalgamation of viewpoints which included one or more of the misrepresentations noted above (**S**, **T**, **IP** or **PC**).

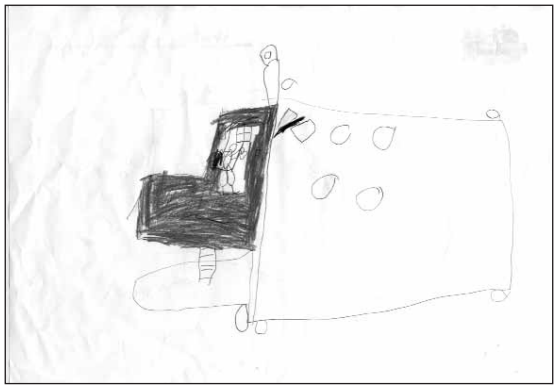


*Figure 7: Provides evidence of a drawing where the egg is visible and a means of securing it noted (though not in a visually realistic manner). This drawing was also deemed to include a mixture of side and plan views (**MM**), together with some personal contextualisation (**PC**).*

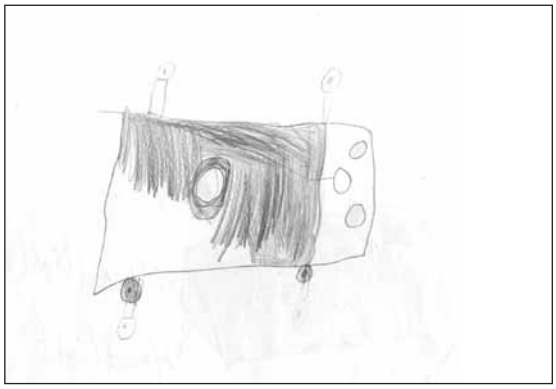


*Figure 8: Another example of inappropriate placement (**IP**) where fold out is evident (wheels and headlights shown). However, the egg is depicted correctly with a means of securing it noted.*

Where Visual Realism was wholly achieved cells on the Excel analysis sheet were shaded dark yellow. Where there is some misrepresentation, alongside elements of Visual Realism, cells were shaded pale yellow.
An example of the recording system is shown below:

		12	13	14	15	16
FREE DRAWING						
ND						✖
MCE					✖	
ORTHO1	PLAN			✔ ● IP		
ORTHO2	SV	✔ ● T IP PC			IP PC	✔ IP PC
ORTHO3	FV					
MM			✔ ● S IP PC			
TAUGHT DRAWING						
ND						
MCE					✖	
ORTHO1	PLAN		✔ ● PC		IP PC	
ORTHO2	SV	✔ ● T IP PC	HLE IP	✔ T IP		✔ T
ORTHO3	FV		HLE IP PC			
MM						

Figure 9 Recording system example

Young Pupils and Visual-Spatial Ability/Intelligence

Initial Findings:
Having examined the children's drawings against the categories noted above two children: Pupil 2 (*see Figures 10 & 11*) and Pupil 13 (*see Figures 12 & 13*), out of the twenty one who undertook the work, were judged to be relatively exceptional, having completed the taught drawing by:

- recording their idea(s) using appropriate orthographic representations;
- utilising hidden line elimination and correctly positioning and depicting the chocolate cream egg within the vehicle (truck).

Even here, however, some limitations were noted: Pupil 2 moved from a mixed media (**MM**) approach that included both inappropriate placement (**IP**) and personal contextualisation (**PC**) (Figure 10), to a plan, side and front view (Figure 11) that are, generally speaking, visually realistic, though some detail is missing from some views (e.g. headlights). This pupil also failed to show the means of securing the egg.

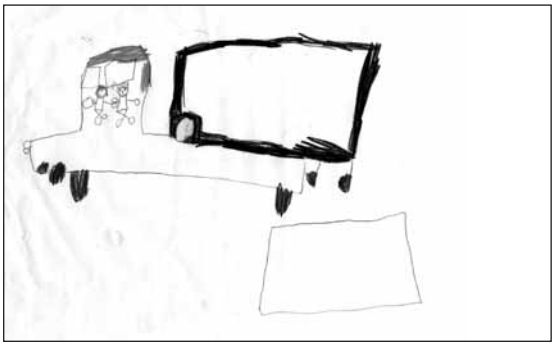


Figure 10: Free Drawing

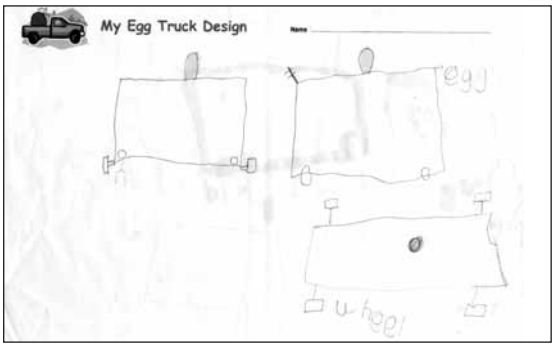


Figure 11: Taught Drawing

Pupil 13 also moved from a mixed media drawing (**MM**) to orthographic representations that included depicted (plan view) the means of securing the chocolate cream egg, effectively. However, this pupil also included elements of personal contextualisation (**PC**) and inappropriate placement (**IP**) in the taught drawing.

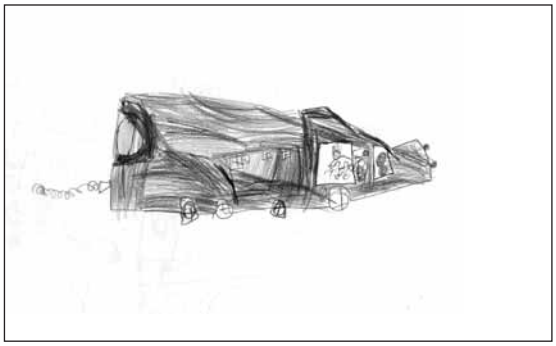


Figure 12: Free Drawing

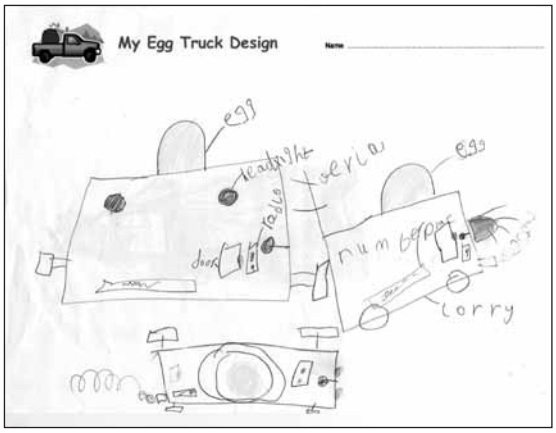


Figure 13: Taught drawing

Nevertheless, these two pupils were judged to have made noticeable progress in relation to the criteria set.

In three other cases (Pupils 14, 17 and 20) a plan view was provided in advance of my taught input, showing the position of the egg, and an indication of how it was to be held in place, in a visually realistically manner. However, in these cases there were also elements of inappropriate perspective/placement (e.g. fold-out) and or personal contextualisation.

A further 8 children (Pupils 1,4,5,6,9,10,19 and 20) 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 7 children (33%) 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 (71%) pupils included an aspect of personal contextualisation, compared to 6 (29%) 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 (29%) children included 9 elements of visual realism, compared to 10 (48%) 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)

Discussions with the class teacher and pupils

Discussion with the class teacher was centred on both the ability levels of those pupils identified above (1, 2, 4, 5, 6, 9, 10, 13, 14, 17, 19 and 20) and her reaction to my analysis of the drawings they had produced. As a result, the following key points emerged:

- She was surprised by the guided drawing of pupil 2, who is identified as being of low ability (SEN) and seen to be weak, academically. She was particularly impressed by the level of retention demonstrated by this pupil who, though one might feel that the completed side, front and plan views draw heavily from the taught input, has nevertheless depicted each viewpoint very accurately. One needs to bear in mind here that all detail was removed from the whiteboard illustrations that underpinned the guidance, and in this context no pupils were able to copy a correct response.
- In relation to pupil 13, the class teacher was not surprised by the results obtained, stating that this pupil is very able and capable of logical thinking.
- Pupil 14 is deemed to be one of the most able children in the class. He told me that he had had help at home when attempting to do a design in advance of the school based input.
- Pupil 17 is deemed to be the most able pupil in this Year 1 class and her ability to draw a plan view in advance of my input was not seen to be surprising. However, as with all other pupils in this group, no work on plan views has been carried out by the class teacher which begs the question: what prior experiences are such children drawing upon, if any? In my discussion with the pupil she explained that she was not sure why she had drawn in this fashion, but that a side view was used in the follow up exercise because she wanted to do a different type of drawing. However, whilst she had depicted the egg and a means of securing it in the free drawing (plan view), following the taught input the egg was viewed as though the vehicle were transparent (side view). She was not bale to explain why she had shown it in this way.
- Pupil 20 drew a plan view in advance of my input and a more detailed, extensively labelled plan view after the guidance was provided (though not with the same level of accuracy as pupils 2 and 14). When asked why she thought that I was very pleased with her drawings, she replied that, 'it's because I can colour right up to the line.' She, along with other pupils in the group, did not seem to recognise the value I was placing on the accuracy of the representation and this begs a further question about the elements of drawing that they may perceive to be of importance in terms of assessable outcome? She also noted that her personal contextualisation was deemed to be of relevance because she wanted to, 'be able to give other people a ride in the truck.'
- Pupils 1, 4, 5, 6, 9, 10, and 19, who demonstrated a very wide range of ability, were not interviewed on an individual basis. However

> the class teacher did note that she was surprised by the output of pupils 9 and 10, who would normally, she felt, produce rather simplified drawings, in other curriculum areas. Of this group, two pupils also said, during a whole class discussion, that they had been given help on drawing at home (Pupils 5 and 6)

There was also a brief discussion with the class teacher about the recording of exceptional performance and this is dealt with in the recommendations section, below.

Conclusion

Though the data analysed in this study is limited it does seem to suggest that, given appropriate support, young children are able to move towards higher levels of visual realism, as defined here. For Edwards and Mercer (1987:142) 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.'

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

- Pupil 2 moved from a mixed media (**MM**) approach that included both inappropriate placement (**IP**) and personal contextualisation (**PC**) to a side, front and plan view incorporating hidden line elimination and an indication of where the egg was to be positioned, if not how it was to be secured. However, detail was not always transferred between views (e.g. headlights - see Figures 10 and 11).
- Pupil 13 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 and a clear indication of how the egg was to be secured, though some elements of personal contextualisation (**PC**) and Inappropriate Placement (**IP**) were still evident in the taught drawing (see Figures 12 and 13).

Elsewhere, a reduction in children's adoption of personal contextualisation was 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, this small-scale 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 may be seen as an inappropriate focus on 'neatness', at the expense of underplaying the content contained within the representations produced (e.g. pupil 20).
- Where can other opportunities for encouraging visually realistic drawing be developed as a means of supporting all pupils, especially those who are 'relatively exceptional' in this sphere?

The final point seems of particular relevance for, in simplified terms, 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 ability/intelligence set in the context of practical problem solving activities (design and technology), and the relatively exceptional performance/talent of young children in relation to visual realism.

j.newcomb@newport.ac.uk

Recommendations

As such, the type of guidance outlined in this paper:

- Should be seen 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 developing 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.

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

References

ACCAC (2000) *Design and Technology in the National Curriculum in Wales*, Cardiff, ACCAC

Anning, A. and Ring, K. (2004) *Making Sense of Children's Drawings*, Maidenhead, Open University Press.

Clark, B. (1997) *Growing Up Gifted* – Fifth Edition, New Jersey, Merrill – Prentice Hall

Cox, M.V. (1985) 'One object behind another; young children's use of array-specific or view-specific representations' in N.H. Freeman and M.V. Cox (eds.) *Visual Order: the nature and development of pictorial representation*, Cambridge, Cambridge University Press.

Cox, M.V. (1994) 'The teaching of drawing in the Infants school: an evaluation of the 'negotiated drawing' approach', *International Journal of Early Years Education*, Vol. 2 No. 3, 68-83

DfES (2004a) *A National Conversation about Personalised Learning*, London, DfES

DfES (2004b) *Excellence and Enjoyment: Learning and Teaching in the Primary Years – Creating a Learning Culture: Classroom Community: Collaboration and Personalised Learning*, London, DfES.

Edwards, D. and Mercer, N. (1987) *Common Knowledge: The Development of Understanding in the Classroom*, London, Methuen.

Egan, B. (1999) *Children talking about designing: how do young children perceive the functions/uses of drawing as part of the design process?* IDATER 99, 79-83, Loughborough.

Freeman, N.H. and Cox, M.V. (Eds.) (1985) *Visual Order: the nature and development of pictorial representation*, Cambridge, Cambridge University Press.

Gagné, F. (2004) Giftedness and Talent: Re-examining a Re-examination of the Definitions, in Sternberg, R. (ed.) *Definitions and Conceptions of Giftedness*, Thousand Oaks, California, Corwin Press.

Gardner, H. (1993) *Frames of Mind*, Second Edition, London, Fontana Books.

Golomb, C. (2004) *The Child's Creation of a Pictorial World*, 2nd Edition, Mahwah, New Jersey, Lawrence Erlbaum Associates.

Hope, G. (2005) 'The Types of Drawing that Young Children Produce in Response to Design Tasks', *Design and Technology Education: An International Journal*, 10.1, 43-53

Intime (circa 2000) http://www.intime.uni.edu/model/teacher/teac1.html [accessed 26/10/05]

Kimbell, R., Stables, K. and Green, R. (1996) *Understanding Practice in Design and Technology*, Buckingham, Open University Press.

Kreger Silverman, L. (2005) *Upside Down Brilliance: The Visual Spatial Learner*, Queensland Association for Gifted and Talented Children, Brisbane, Queensland http://www.qagtc.org.au/conf2005/QAGTC_upside-down.pdf [accessed 18/10/2005]

RESEARCH

Mathewson, J.H. (1998) *Visual-spatial thinking: An aspect of science overlooked by educators*, http://www3.interscience.wiley.com/cgi-bin/abstract/30002307/ABSTRACT [accessed 25/10/05]

Sternberg, R.J, (ed.) (2004) *Definitions and Conceptions of Giftedness*, Thousand Oaks, California, Corwin Press.

Sternberg, R. and Davidson, Janet E. (2005) *Conceptions of Giftedness* (2nd Edition), New York, Cambridge University Press.

Treffinger, Donald J. (Ed.) (2004) *Creativity and Giftedness*, Thousand Oaks, California, Corwin Press