

An investigation into the use of cognitive ability tests in the identification of gifted students in design and technology

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Abstract

This study examines whether MidYIS and YELLIS cognitive ability tests (CATs) are appropriate methods for the identification of giftedness in Design and Technology. A key rationale for the study was whether CATs are able to identify those students with the aptitudes considered of importance to identifying giftedness in Design and Technology and their use in connection with target setting. A review of the literature on CATs in relation to giftedness reveals support for their use in the Science, Technology, Engineering and Maths (STEM) fields. A review of the general literature on giftedness suggests methods other than CATs should be used for identification purposes in D&T. The study recommends greater use of Design and Technology specific assessments for the identification of giftedness and target setting. Consideration is given to the use of creativity and the nonverbal element of CATs as alternative methods of identification.

Key words

giftedness, general intelligence, ability, creativity, cognition, design and technology

Introduction

Ask any Design and Technology (hereafter D&T) teacher what giftedness might look like in their classrooms and you may get responses relating to one of the Qualification and Curriculum Development Agency (QCDA) (2009) guidance criterion which include to 'demonstrate high levels of technological understanding and application', or 'display high-quality making and precise practical skills'. These were the two most commonly cited attributes for use as gifted and talented identifiers by teachers during a recent study (discussed below) surrounding gifted and talented identification in D&T. The terms 'gifted' and 'talented' are apparently often used synonymously (Heller, 2004) however the term gifted will be used in this paper to describe high ability in a domain, rather than imply any connection with subjects perceived as traditionally 'academic'.

The DfES (2006: 01) defines giftedness as 'Children and young people with one or more abilities developed to a level significantly ahead of their year group (or with the potential to develop those abilities)'. The DfES state that

around 10% of a school population will normally be identified and should be placed on a gifted and talented register with identification based upon ability, rather than achievement (DfES, 2006). The definition based around ability reflects a need to take account of indicators about future potential, as achievement measures may miss underachievers and only indicate those students who have the opportunity for practice and performance.

One method used by schools to predict future achievement is the Cognitive Ability Test (CAT), usually involving questions based around mathematical, verbal and spatial reasoning ability. In many schools in the United Kingdom, this takes the form of CEM Centre's (Centre for Evaluation and Monitoring) MidYIS (Middle Years Information System) and YELLIS (Year 11 Information System) tests. Of interest to this study is the extent to which achievement on these tests can be used to indicate giftedness in D&T. Recent support for this method of identification can be found in the work of Lubinski, Benbow, Webb and Bleske-Rechek (2006) and their Study of Mathematically Precocious Youth (SMPY) in the USA. These researchers maintain the Scholastic Assessment Tests (SAT), a test similar to the CEM Centre tests, used routinely in the USA to identify gifted students as part of talent search programmes, are good indicators of future academic success in STEM (Science, Technology, Engineering and Maths) fields. If this is true, we as D&T teachers may be able to use the results of CATs to identify those students with potential for excellence in D&T and the associated STEM Fields. There is also some debate in the literature about whether giftedness can generally be identified using CATs. Borland (1997) for example discusses the development of the intelligence test and charts its use as a sole measure of giftedness in the 1920s through to more recent developments which take account of a much wider range of indicators, such as Gardner's (1993) Multiple Intelligences. Borland (1997), also argues against the use of CATs as a sole method of identification, pointing out that testing has fuelled the conceptual development of giftedness as a 'social construction' (7). Further debate surrounds whether a single score outcome on a test is an appropriate method of identifying giftedness in applied skills areas of the curriculum for example Mansell, 2008 and Renzulli, 2005.

The Qualifications and Curriculum Development Agency (QCDA) have produced a comprehensive list of attributes,

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such as 'demonstrate high levels of technological understanding and application' and 'be capable of rigorous analysis and interpretation of products' (QCDA, 2009) to name just two that gifted individuals may demonstrate in D&T using achievement measures. Central to the rationale for this study is the question of whether identification can take place in D&T using standardised tests, in particular the Middle Years Information System (MidYIS) and therefore the extent to which ability related measures, rather than measures based upon achievement are useful. The central question to be answered in this study was "Can teachers use the results of cognitive ability tests to identify giftedness in D&T?"

Rationale

The rationale for this study evolved out of the need to develop a better understanding about the relationship between MidYIS and YELLIS test scores and students' abilities in D&T. The data from these tests is widely used within the author's school, particularly for target setting at both Key Stage 3 (Years 7 to 9) and 4 (Years 10 and 11). However D&T teachers have found the relationship between the test data and subject specific ability tenuous. The MidYIS and YELLIS test scores are derived mainly from a combination of a student's mathematical and verbal reasoning abilities. Gardner (1993) refers to these as logical-mathematical and linguistic intelligences. An investigation of the literature indicates that CATs only show the extent to which a candidate can perform on the measures included on any particular test (Tilsley, 1995) and that in preference multidimensional methods should be used (Heller, 2004). In D&T a much wider range of intelligences than those mentioned above are drawn upon by students and therefore it is unclear whether the use of MidYIS or YELLIS test data is justified as a starting point for target setting or measuring ability within D&T.

Specifically it was hypothesised that if a relationship exists between the test scores and students identified as gifted within D&T, those gifted students would appear at the top of the CAT achievement continuum. This would represent identification of giftedness using ability measures and may provide teachers with improved validity when using the test data as a baseline to aid target setting. Conversely if it was found that a poor relationship exists between CAT scores and students identified as gifted, we might infer that the MidYIS or YELLIS scores do not represent aptitude for D&T specific tasks and therefore that alternative methods should be sought as the basis for target setting and monitoring progress.

The study was carried out in a Grammar school in the South East of England. The D&T department comprises

four teachers with all students studying food and nutrition (since 2009), resistant materials and systems and control in Key Stage 3. In Key Stage 4 food and nutrition, graphics, resistant materials and systems and control are taught. The product design subjects graphics and resistant materials are taught at A level. The research context is considered atypical of education in England as there is a high concentration of Grammar schools locally and the DfES (2007) identify the Local Education Authority as second highest in England, based on their identification of gifted and talented students in the top 10% of schools nationally.

A conception of giftedness in D&T

It is noted that a limited range of literature is available in relation to both D&T and testing, and giftedness in D&T and the applied skills generally. However three perspectives will be explored; aptitude versus achievement, general intelligence and creativity.

The DCSF (2009) define gifted learners as those with exceptional academic abilities in subjects such as mathematics and science and talented learners as those who excel with applied skills such as leadership, art or sport. CEM Centre, the administrators of the MidYIS and YELLIS tests also apply this definition, adding that they believe the identification of gifted learners should be through tests and talented learners through school or teacher assessment (CEM Centre, 2008). This conception is oversimplified in relation to D&T, however, as it does not take into account the multidimensional characteristics of the subject. For example, Smithers and Robinson (1994) have described the subject as different to all of the other curriculum areas and see the balance of subject matter as a combination of knowledge and skill development and solving practical problems. Therefore in D&T, an alternative conception is required to take account of subject diversity and support identification.

At variance with the definition used by DCSF (2009) and CEM Centre (2008), some authors make an alternative distinction between gifts and talents and relate giftedness to general ability and talent to the practice of those gifts in the production of something useful, or a performance in a domain. This affects the way in which students may be identified as highly able, as it implies a focus upon achievement, rather than aptitude.

Gagne (2005) for example, presents the Differentiated Model of Giftedness and Talent (DMGT). Central to this is the concept that natural giftedness in a domain leads to developed talent in that domain. In Gagne's view, you can have general ability and therefore be gifted, but perhaps

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through underachievement or lack of opportunity, not yet talented. Gagne's model is domain specific and takes account of four elements; individual ability, environmental factors, the extent of learning and practicing and chance (chance associated with an individual's heritability and future life opportunities). Gagne (2005) notes the importance of heritability, the environment and the opportunity for practice within a domain as important 'catalysts' for talent development. The model is helpful in reaching a consensus about identification in D&T as it suggests that achievement factors, as well as data from CATs, play an important role in the identification of giftedness in D&T, a conclusion reached by Arthington (2009) in a similar study.

Mayer (2005) contributes to the aptitude versus achievement argument positing a three stage age-related viewpoint; an early stage (precocity) reflecting potential, an intermediate stage, reflecting achievement and an advanced stage reflecting eminence in a specific domain. For Mayer (2005) giftedness relates to achievement within specific domains, particularly those domains represented by school subjects. Mayer (2005) recognises the importance of 'task commitment' as an element in the development of gifted individuals and sees extraordinary performance on authentic tasks as the most appropriate method of identifying gifted individuals, which can lead to the development of objective measures, perhaps in the UK a focus on the use of National Curriculum Attainment Targets. The ideas of Mayer (2005) support a conception of giftedness for D&T based around skills, visual spatial ability and performance. This suggests methods other than CATs should be developed to identify giftedness and set targets in D&T.

The work of Van Tassell-Baska (2005) provides an alternative to traditional testing techniques. Van Tassell-Baska presents a domain specific conception based around aptitudes, interests and the real world. It is suggested that this interconnected approach provides greater opportunities to 'intervene' and offer provision more suited to gifted individuals and their likely future aspirations. Central to this domain specific conception is the use of 'portfolio' and 'performance-based' methods of assessment. It is posited that a dual benefit exists; that of domain specificity and that of evidence based methods of identification.

Elements of Van Tassell-Baska's conception are useful for the development of a definition of giftedness and an identification method in D&T. The portfolio assessment approach matches the methods already used to record and develop design work across the Key Stages. For

example, portfolio assessment typically accounts for 50% of GCSE (General Certificate of Secondary Education) and GCE assessment in D&T, reflecting both elements of task commitment and performance-based assessment. However, there is some discord with the nature of task commitment. Van Tassell-Baska believes this may exist as a process based element, something encouraged and supported by the educator, rather than an aptitude presented within the giftedness profile of an individual.

The element of task commitment is however widely recognised. Gagne (2005), Mayer (2005) and Renzulli (2008) all include an element of commitment to performance within their conceptions. In support of this Fox (2005) cites Ericsson's (2002) study of eminent musicians. Ericsson suggests elite performers are recognised at an early age by their talent or interest and are then given 'superior conditions', 'expert coaching' over long periods and demonstrate 'intense dedication to concentrated practice' (Fox, 2005: 127). For Ericsson, eminence is a matter of practice and dedication. Achievement then would appear to be a vital element in the identification of giftedness in D&T. Environment, opportunity for practice and persistence also play an important part in encouraging the development of high ability in D&T. This leads us away from a conception of giftedness based on traditional testing techniques. However there is support for an element of cognition which underlies all abilities, regardless of domain and that this ability can be measured using standardised tests. This ability is referred to as general intelligence or 'g' and the concept is widely supported in the literature.

Jensen (1981) cites Spearman (1863-1945) as the originator of the term 'g' and who suggested that all tests measure 'g' to some extent. Jensen suggests support for this concept is indicated by 'positive inter-correlation' between tests indicating, in Jensen's view, that individuals who perform well on one test, also perform well on others. Lubinski (2009: 351) sees 'g' as the foundation of cognitive abilities, which is supported by other 'specific factors' such as 'mathematical, spatial and verbal abilities'. Lubinski (2009) cites a collective expert view attributing 'g' to 'a very general mental capacity that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience' (351). Renzulli and Reis (2008: 16) also recognise a form of general intelligence which they call 'schoolhouse giftedness' and attribute this to the ability to perform well in general lesson learning situations, which in their view is 'easily measured' by cognitive ability tests (CATs). Renzulli and Reis suggest high performance on CATs translate into high performance in school exams.

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Criticism can be found for the concept of 'g', particularly where it is used as the sole measure of identification. Gardner (1997), although supporting the use of tests as an element of the identification process, suggests that a conception based on 'g' is limited and posits an alternative approach based on 'multiple intelligences'. Gardner (1993) originally identified seven intelligences that he called logical-mathematical, spatial, musical, bodily-kinaesthetic, linguistic, intrapersonal and interpersonal. Eysenck (1996) supports Gardner's view, suggesting that traditional intelligence tests do not measure all aspects of intelligence, although also notes that those scoring highly on one test often score highly on others as well. In Moran, Kornhaber and Gardner's (2006) view however, using a multiple intelligences approach widens the possibility of identifying individuals with particular aptitudes, rather than labelling them with either "smart" or "dumb" (23).

However the concept of general intelligence as a cognitive process has been 'shown' in evidence from fMRI (functional magnetic resonance imaging) scans (neuroimages). Geake (2008a) asserts gifted, creative individuals are able to 'fluid analogise', the ability to take into account many more possibilities, answers and areas of knowledge when problem solving, in conjunction with working memory. Geake, using the evidence from neuroimages and IQ tests, asserts much of the brain is involved with much of a problem solving task, adding further support for 'g'. For this reason, Geake (2008b), while recognising individual differences in subject specific abilities, sees intelligence as interconnected, rather than separate and is critical of the multiple intelligence approach.

The concept of general intelligence and its use as a measure of general ability is well supported in the literature. A strong link has been made between standardised tests and 'g' (Frey and Detterman, 2004), which suggests that CATs can make a contribution to our understanding about student's abilities. However what is not clear is what relationship 'g' has to creativity, visual spatial skills or practical skills; those elements considered important for the identification of giftedness in D&T and therefore it is not clear whether high achievement on CATs are any indication of giftedness in D&T.

The importance of creativity as an aptitude for success in D&T has also been well documented (Balchin, 2005; Kimbell, 2000). It might be speculated that this aptitude is difficult to identify using traditional standardised testing instruments. However researchers have emphasised the importance of general intelligence in conjunction with creativity. Renzulli and Reis (2008) for example, place

creativity alongside intellectual ability and task commitment as part of the Enrichment Triad Model, adding some support for the use of CATs in identification. Renzulli and Reis (2008: 17) use the term 'creative productive giftedness' and describe this in terms of activities which lead to the production of 'original material and products' designed for a particular 'audience'.

Sternberg, Grigorenko and Jarvin (2006) define creativity in a similar manner to Renzulli and Reis (2008). Terms such as 'create, invent, discover, imagine, suppose or hypothesize' are used to describe the outcome of endeavour using skills (Sternberg et al., 2006: 10). Sternberg's et al., (2006) conception of giftedness, based on the original Sternberg (1985) triarchic theory of successful intelligence, reflects an individual's ability to adapt to and be successful in life beyond the tradition of academic success. It is 'socio-culturally' based and relative to an individual's aspirations, according to Sternberg et al., (2006). This is in agreement with Sak and Maker's (2005) belief that creativity is domain specific and leads us towards identification which is also domain specific.

A fair compromise might be to use the non-verbal subtest within the MidYIS battery as one method of identification in D&T, since it draws upon students' visual spatial ability. Newcomb (2007) has documented the importance of the use of visual spatial skills within D&T in connection with domain specific abilities and outlines the link between D&T thinking and visual spatial abilities.

Methodology

The study aimed to explore the validity of the use of CAT data in relation to identifying gifted students in D&T. To provide a deeper understanding about the possible relationship between CATs and applied skills subjects, Art, Drama and Physical Education (PE) were also involved in the data collection process. The research design draws on the mixed method and pragmatic philosophies. It is based on a pragmatic viewpoint that allows for 'methodological pluralism' (Cameron, 2009: 141). The approach makes use of both quantitative and qualitative methods and supports analysis that can be developed in conjunction with the research and cultural situation. According to Arcidiacono and Gregorio (2008) this 'post-modernist' methodology '[maintains] that no single correct explanation of reality under study exists' (119).

In support of this methodology, Cameron (2009) notes two benefits of interest to this project, including its use to triangulate between data and explore more comprehensively the research situation. Arcidiacono and Gregorio (2008: 118) also support mixed methods for

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triangulation purposes, pointing out its use in approaching a research problem from a number of 'different levels'. This methodology allowed for the qualitative interpretation of the survey results and attitudinal data from teachers, as an addition to largely quantitative methods.

As a comparison with subjects considered traditionally academic, data from History (Year 8) was also collected. The research also considered CATs in relation to a D&T specific assessment, the department's Year 8 end of year exam design question. Figure 1 gives an outline of the structure used in the three phases of the study.

Phase one

In phase one, GCSE D&T raw scores from 2008 (the last full year to take GCSE D&T in the school) were compared with those students' MidYIS and YELLIS scores using Pearson's product moment correlation coefficient. A comparison of mean scores was also made between the subject strands resistant materials, graphic products and

systems and control in an attempt to identify whether the YELLIS score has particular validity in any of those areas. It was hoped that this exercise would highlight any trends between performance on CATs and GCSE achievement.

Phase two

In phase two a survey asked teachers in the four applied skills subjects to identify their gifted Year 8 students and respond to a questionnaire about their use of CAT data and approach to gifted and talented identification. A total of 15 teachers contributed to the survey (three in Art, four in D&T, two in Drama and six in PE). The History department provided identification data from their records of the same year's gifted Year 8 students. Year 8 was chosen as in D&T teachers teach their groups throughout the year, thereby maximising the reliability of results for this subject. The students identified as gifted in D&T were compared with their Year 7 National Curriculum Level assessment to check the reliability of identification. The survey used the following QCDA (2009) criteria for

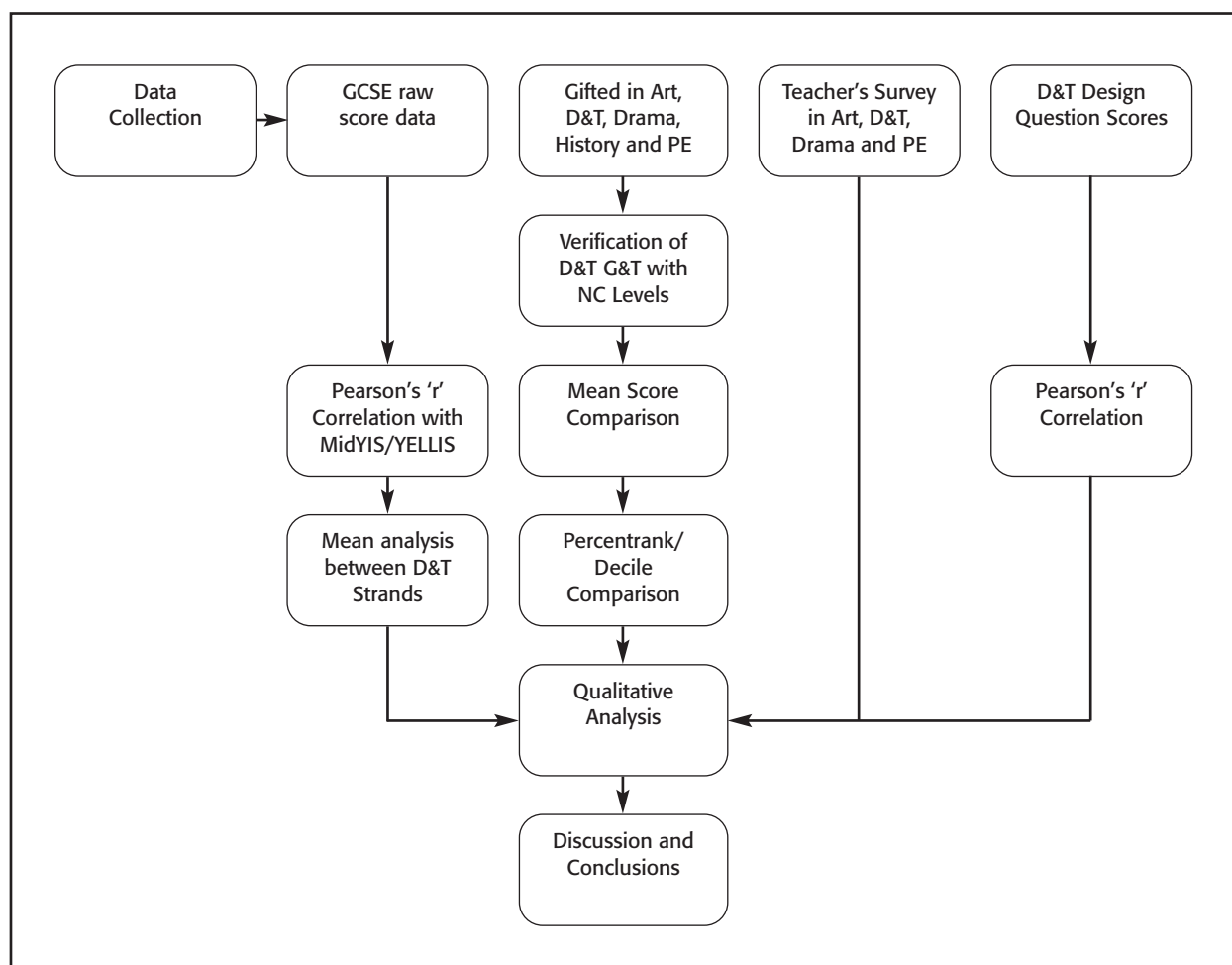


Figure 1. Outline of the structure used in the study

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the identification of gifted students in D&T:

- demonstrate high levels of technological understanding and application;
- display high-quality making and precise practical skills;
- have flashes of inspiration and highly original or innovative ideas;
- demonstrate different ways of working or different approaches to issues;
- be sensitive to aesthetic, social and cultural issues when designing and evaluating;
- be capable of rigorous analysis and interpretation of products;
- get frustrated when a teacher demands that they follow a rigid design-and-make process;
- work comfortably in contexts beyond their own experience and empathise with users' and clients' needs and wants;
- performance at an unusually advanced national curriculum level for their age group;
- the outcomes of specific tasks;
- evidence of particular aptitudes;
- the way pupils respond to questions;
- the questions that pupils ask themselves.

The other subjects surveyed were provided with subject specific criteria. A comparison of mean scores was first obtained to identify general trends in the data between the gifted samples and the rest of Year 8. To examine the validity of any assumptions, a comparison was then made between the gifted samples' CAT scores and their populations by obtaining ranked percentiles and comparing these within each decile. The following questions were included on the teachers' questionnaire:

- Are you the sole teacher of this group? Yes or No. If you answered Yes, please go to question 3.
- If your teaching group is shared, or rotated between teachers during the year, how have you standardised the identification process between you?
- Do you normally take account of MidYIS data when identifying gifted and talented individuals? Yes or No.
- Please explain your reasons for using, or not using the MidYIS data.
- Please add any other comments about the identification of gifted and talented students generally, or the use of MidYIS data in their identification.

Phase Three

In phase three MidYIS scores were compared with a D&T specific assessment, the Year 8 end of year exam design question. The design question was modelled on those found in GCSE D&T examinations, which require students to provide different solutions to a design problem, based on a given design specification. Comparison made use of Pearson's product moment correlation coefficient. It was hoped that this exploration would highlight any trends between CAT data and assessments which take account of subject specific aptitudes such as creativity and visual spatial skills.

Results

Phase one

A positive correlation was found between GCSE raw scores and MidYIS (Figure 2) and YELLIS (Figure 3) scores. This indicates that the higher a student's achievement is on these tests, the higher the achievement is likely to be at GCSE for this sample. Figure 3 includes a larger sample due to students joining the school too late

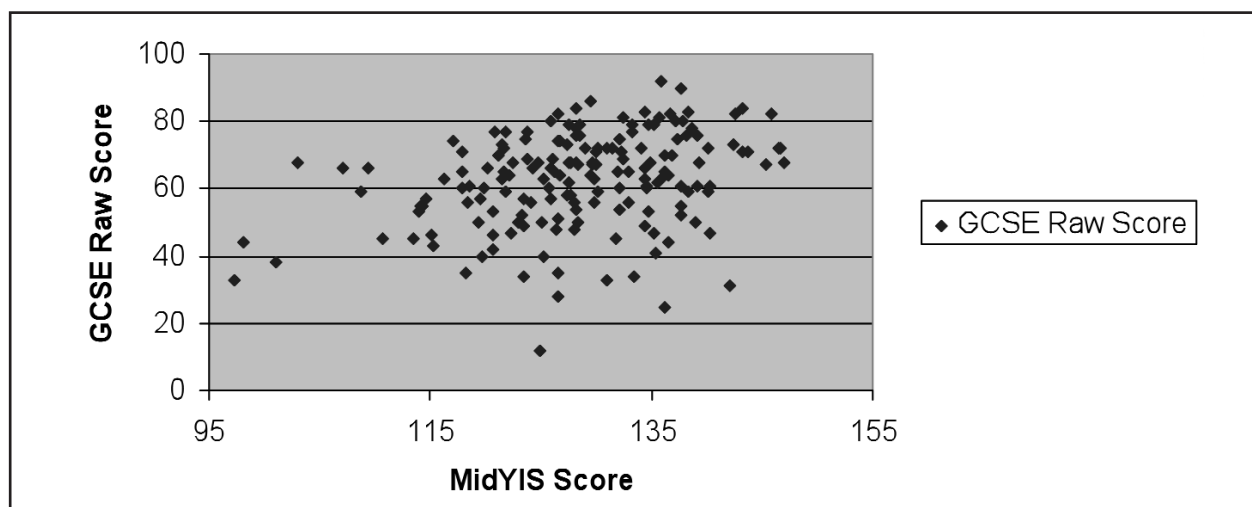


Figure 2. Comparison between GCSE (2008) Raw score and MidYIS score ($n=170$, $r=0.31$, $p<0.01$, 100 degrees of freedom)

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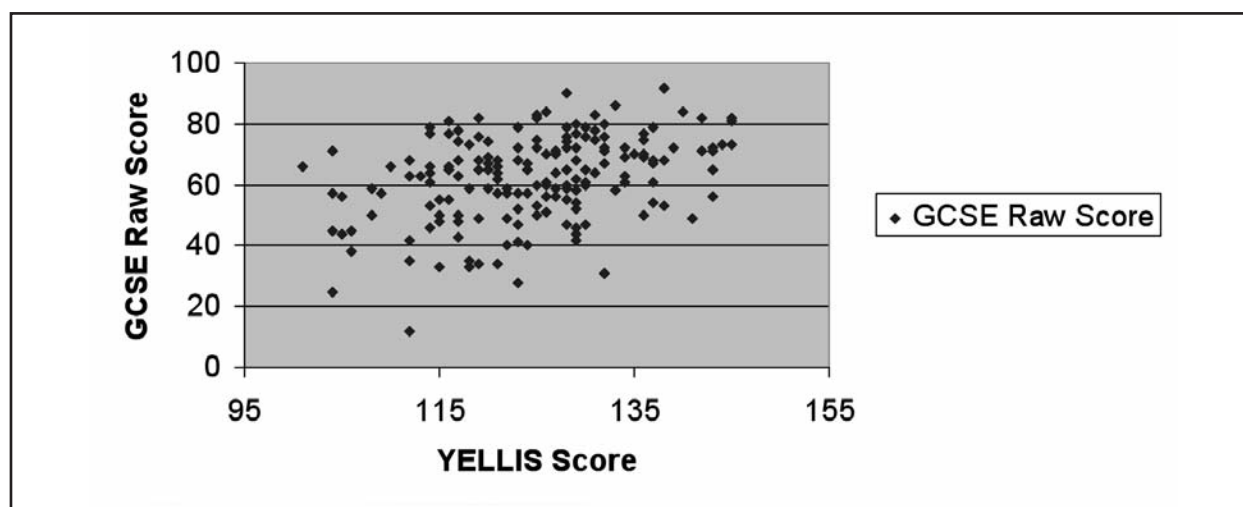


Figure 3. Comparison between GCSE (2008) raw score and YELLIS score ($n=183$, $r=0.37$, $p<0.001$, 100 degrees of freedom)

for MidYIS testing in Year 7. Of interest to this study was whether mean CAT scores and subtest scores differ according to which D&T strand a student opted for and therefore whether the score or subtest score has increased validity in different D&T disciplines. Table 1 shows the results of a comparison of mean between the D&T strands and indicates no notable difference in achievement on the YELLIS test, that of interest for GCSE grade prediction.

Phase two

As a starting point, the mean scores of those students identified as gifted across the four applied skills subjects and History were obtained and are shown in Table 2. Accepting comparison of mean with caution, due to the problems with unequal variance, results indicate that gifted students achieve higher scores on some subtests, than the rest of their year group, in some subjects. For example in D&T gifted students' non-verbal and skills

		Graphics n=42	Resistant Materials n=103	Systems n=38
YELLIS Score	Group (Standard Deviation)	123.40 (8.56)	124.43 (9.56)	125.97 (10.98)
	Rest of Year 11 (Standard Deviation)	124.84 (9.97)	124.63 (9.85)	124.13 (9.27)
Maths	Group (Standard Deviation)	124.26 (12.22)	125.17 (10.74)	125.95 (12.21)
	Rest of Year 11 (Standard Deviation)	125.38 (11.12)	125.06 (12.17)	124.90 (11.15)
Vocabulary	Group (Standard Deviation)	118.02 (7.30)	118.95 (9.97)	120.95 (10.61)
	Rest of Year 11 (Standard Deviation)	119.49 (10.15)	119.41 (9.08)	118.68 (9.26)
Patterns	Group (Standard Deviation)	110.12 (10.91)	107.50 (13.68)	111.19 (13.03)
	Rest of Year 11 (Standard Deviation)	108.48 (13.56)	110.62 (11.88)	108.26 (12.95)

Table 1. Comparison of mean YELLIS score and subtest scores between D&T Strands; Graphics, Resistant Materials and Systems & Control (GCSE class of 2008, YELLIS test taken 2006)

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scores are notably higher than the rest of Year 8, indicating that these scores may be useful in identifying future potential. In Art again the non-verbal score is notably higher and in Drama maths is strength for this sample. In PE the non-verbal score is notably higher with a similar standard deviation.

For comparison with applied skills subjects the traditionally academic subject History was included in the survey. Table 2 shows the higher subtest scores for the gifted in History sample, in particular the maths and vocabulary scores are notably higher in relation to Art, D&T and PE. Drama also records higher subtest scores, although their higher standard deviation is noted.

To test the validity of assumptions based on mean scores, a further examination of the data used a percentile rank and decile comparison to explore whether those students identified as gifted are the students who appear at the top of the CAT achievement continuum. Figure 4 indicates that a wide range of scores are achieved by the gifted in D&T

sample, with a high percentage of students achieving scores in the top three deciles, decile five and decile seven. No gifted students appear in decile four. Although a higher percentage of students appear in the top three deciles, this sample does not cluster at the top of the achievement continuum, as would be expected if MidYIS scores indicated giftedness conclusively.

Exploring the non-verbal subtest reveals a similar trend for the D&T sample. Figure 5 shows the high percentage of students scoring in the top 3rd of the achievement continuum, supporting the comparison of mean score (Table 2). However although there is a cluster between decile one and decile four, the wide variability of scores across the continuum limits the decisive use of this subtest as a measure of D&T potential, based on this sample.

Teachers' responses to the questionnaire indicated that CATs were not found to be useful indicators of giftedness in D&T or the other applied skills subjects. D&T teachers

Total Year 8 Population n=180	Vocab	Maths	Non-Verbal	Skills	MidYIS Score
Gifted in D&T n=29 (16%)	121 (8.87)	130 (10.19)	125 (11.54)	123 (13.98)	128 (7.37)
Rest of Year 8	122 (9.60)	127 (11.37)	120 (12.02)	118 (11.10)	126 (9.42)
Gifted in ART n=14 (8%)	123 (7.49)	129 (12.41)	128 (13.10)	119 (13.36)	128 (8.36)
Rest of Year 8	121 (9.62)	127 (11.14)	120 (11.82)	118 (11.68)	126 (9.18)
Gifted in DRAMA n=37 (21%)	125 (10.41)	132 (10.97)	124 (12.76)	122 (13.30)	131 (9.23)
Rest of Year 8	121 (9.02)	126 (11.03)	120 (11.80)	118 (11.28)	125 (8.76)
Gifted in PE n=9 (5%)	122 (11.75)	128 (12.23)	127 (12.31)	121 (13.06)	127 (9.50)
Rest of Year 8	122 (9.37)	127 (11.21)	120 (12.00)	118 (11.74)	127 (9.13)
Gifted in History n=17 (9%)	126 (8.53)	131 (10.30)	124 (12.34)	123 (10.60)	132 (9.54)
Rest of Year 8	121 (9.41)	126 (11.25)	120 (12.02)	118 (11.81)	126 (8.91)

Table 2. Comparison of mean MidYIS score and subtest scores between students identified gifted and Year 8 population (emboldened scores denote reference to discussion, percentages represent the proportion of the year group)

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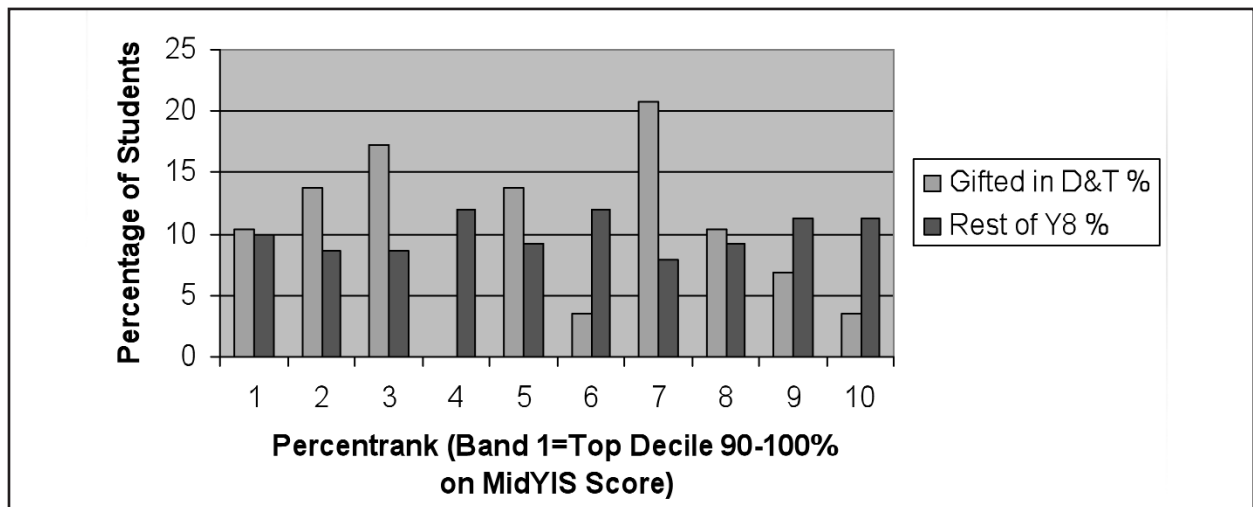


Figure 4. Comparison of deciles between Year 8 gifted in D&T (n=29) and rest of Year 8 (n=151)

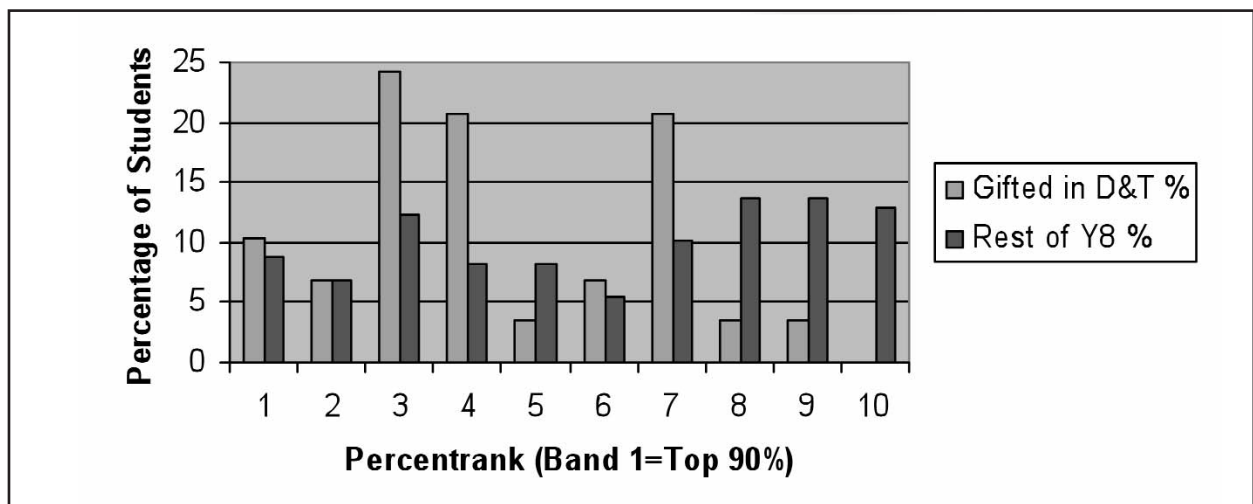


Figure 5. Comparison of deciles between Year 8 gifted in D&T (n=29) and rest of Year 8 (n=151) on non-verbal score

found the following four QCDA (2009) guidance criterion the most useful in identifying gifted students:

- demonstrate high levels of technological understanding and application;
- display high-quality making and precise practical skills;
- have flashes of inspiration and highly original or innovative ideas;
- demonstrate different ways of working or different approaches to issues.

In addition written responses included 'the ability to focus on a task' and 'persistence in completing a task' as important attributes of gifted learners. A similar pattern

was indicated by the responses from the other applied skills subjects, where CATs are considered largely irrelevant to giftedness. For example, in Art the comment 'MidYIS test has little to do with creativity' was made. In Drama however, one teacher uses the MidYIS score as a baseline assessment, in conjunction with a subject specific assessment at the beginning of the academic year, which is evidence that the tests are found to be of use in some applied skills subjects.

Phase three

The comparison of MidYIS data with a subject specific assessment made use of the department's Year 8 end of

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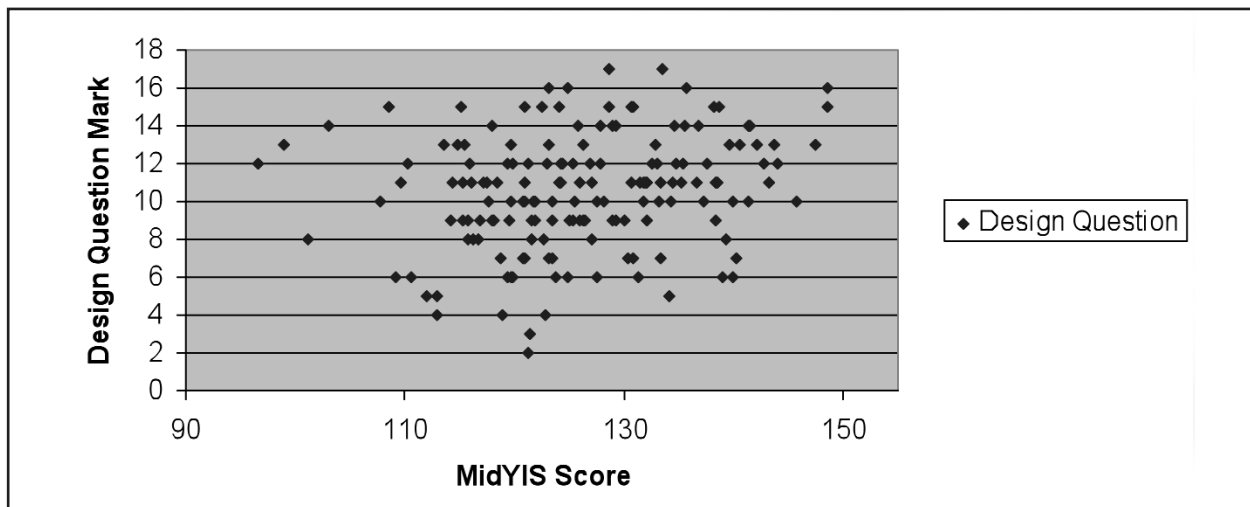


Figure 6. End of Year 8 exam design question mark and MidYIS score correlation ($n=170$, $r=0.21$, $p<0.05$, 100 degrees of freedom)

year exam design question. The data used for this exploration was taken from the Year 8 results in 2009 as the current Year 8 group, that used for the survey, had yet to take their exam. Results indicate (Figure 6) a reasonable correlation between design question mark and MidYIS score. Statistically this is significant at the 5% level, or only five out of 100 pairs occurring by chance. Some outliers are noted which may have affected the correlation. These represent students with identified learning difficulties or who experienced long periods of absence.

It is interesting to note the number of students who performed very well on the examination design question, but relatively poorly on the MidYIS test, particularly some of the outliers (poor is a relative term here since the majority of scores are above the national average of 100). This provides less support for the use of MidYIS tests for identifying giftedness in D&T. An examination of those students' achieving around 15 marks (83%) on the design question (Figure 6), reveals that those who perform well achieve a wide range of scores on the MidYIS test. This correlates well with the earlier comparison between gifted D&T students and MidYIS scores using the decile comparison method (Figure 4).

Discussion

The correlation between MidYIS and YELLIS scores and GCSE raw scores is not surprising given that it has been suggested that those performing highly on one test often do so on others as well (Eysenck, 1996). However the evidence from the survey of gifted Year 8 students in Art, D&T and PE does not suggest that MidYIS scores are a valid method of identifying giftedness. This is due to the

wide variability of these samples' MidYIS scores. This is also the case when comparing the Year 8 end of year exam design question score with those student's MidYIS scores in D&T. The absence of clusters of gifted students at the top end of the CAT score continuum suggests that this measure is not a valid measure of giftedness for these samples.

It could be argued that two different elements have been explored in this study; aptitude represented by students' CAT or GCSE scores and achievement represented by teachers' nomination of giftedness. The QCDA (2009) criteria used by teachers to identify giftedness in this study supports this view. Teachers' attitudinal responses, which relate persistence to giftedness in D&T also concur with the assertions of Mayer (2005) and Renzulli and Reis (2008), who both place task commitment at the centre of their conceptions of giftedness.

An explanation for the discrepancy between CAT performance and giftedness may be found in the concept of general mental functioning, or 'g'. The 'g' factor has been highlighted in this study as an important element in the consideration of an individual's ability (Gagne, 2005; Geake, 2008a, 2008b; Jensen, 1981; Lubinski, 2009). It may be more reasonable to suggest that a trend for performing well on CATs and achieving well on a subject specific assessment, represents 'g' rather than the ability to do well in D&T per se.

Hendry (2009) asserts the MidYIS non-verbal subtest score 'correlates well' with, among others, technology subjects and that it is a good indication of a student's '3D

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visualisation, spatial aptitude...and logical thinking' (69). The results of this study support this view with a general trend found for higher mean non-verbal scores among Art, D&T and PE (Table 2), and a cluster of gifted D&T students achieving nonverbal MidYIS scores in the top four deciles when compared with their population (Figure 5).

The wide variation of CAT scores presented by the gifted samples in this study highlights that performance at the higher levels in D&T and other applied skills subjects does not relate to mathematical and verbal reasoning ability. Limiting the identification of giftedness to a single test score is likely to miss many students with the potential to excel in the subject. Using a multidimensional approach is much more likely to identify those with specific aptitudes (Gardner, 1997; Heller, 2004; Moran et al., 2006) and which relate specifically to D&T.

In the future a more comprehensive assessment of giftedness and reasonable basis for target setting in D&T may be found in achievement measures. Mayer (2005) and Van Tassel-Baska (2005) both include achievement as important elements in their conceptions of giftedness. Using achievement measures encourages a focus on domain specific aptitudes such as designing, creating, visual spatial thinking and manufacturing skills.

Conclusion

The evidence from this small-scale study suggests that CATs can be a useful indication of a student's general intellectual ability. Therefore CATs may provide a broad indication of a student's future potential and provide a basis for target setting. However, the results did not support the use of CATs for the identification of giftedness in D&T or the additional applied skills subjects (Art, Drama and PE) involved in the study. A general trend was found for higher mean non-verbal MidYIS scores among the Art, D&T and PE samples.

Giftedness should be identified using measures related to the abilities considered important for eminence in a particular domain. This message is emphasised by Tilsley (1995) who recommends multiple methods of identification and methods other than intelligence tests for the assessment of creativity. This suggests a focus on achievement measures for the identification of giftedness in D&T, which in turn suggests a focus on the provision we make for all students (Tilsley, 1995).

The aptitudes considered important for eminence in D&T may include the development of multidimensional abilities such as visual spatial skills and creativity. Gardner's (1993) multiple intelligences, although criticised on a cognitive

level (Geake, 2008b), provide a starting point for a multidimensional approach to identification and also encourage us to consider students' personal attributes. Torrance (2004) believes that a love for the work creative individuals do, their high energy levels and the purpose they find in their work is as important an indication of future eminence as traditional measures of intelligence or academic achievement.

Design and Technology is a subject that draws upon a wide range of skills, across wide interdisciplinary subject matter. It requires not just knowledge and understanding, but the development and application of skills in the production of creative, innovative products; the ability to use symbol systems to explain ideas, project manage and persist with difficulties. Many of the successful students in the subject have a clear enjoyment of and enthusiasm for the subject. Taking these traits together, it is difficult to accept that a single performance on a cognitive ability test demonstrates specific ability within the subject, or that it might indicate those students who we consider to be gifted. Banks (1994: 1) describes 'technological activity' as 'all-embracing' and therefore the identification of giftedness in D&T may best use 'all-embracing' methods to identify those students who may develop eminence and future career success in a wide range of creative fields.

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