A Comparison of the Relationship Between Creativity, Learning Style Preference and Achievement at GCSE and Degree Level in the Context of Design and Technology Project Work

Stephanie Atkinson, Sunderland University, England

Abstract

This paper compared the relationship between creativity, achievement and learning style preference in the context of design and technology activity for two contrasting sets of learners. Data was collected from fifty-four students studying on an Initial Teacher Training Design and Technology degree and fifty pupils studying for their GCSE Design and Technology examination.

A creativity score for each sample member was established and individual achievement data was collected using marks from coursework projects at GCSE and degree level. Learning style data were collected from all participants using an established Cognitive Style Analysis test.

Results indicated that there were relatively few highly creative individuals, and that this was particularly noticeable in the student cohort, however the results did indicate the expected positive relationship between creativity and achievement for both cohorts. Similarities between the two samples in terms of learning style groupings were found. Analysis of the data also indicated that there was a clear relationship between level of achievement, being creative and certain learning styles, although for some learning style categories the results did not support existing research. Creative divergent thinkers did not achieve the expected results. This suggested the potential for a new study to see if the anomalies witnessed in these findings would be found in other pupil and student cohorts. There is also the need to research the relationship between the design process adopted and the way it is assessed to try to ascertain why certain creative pupils belonging to certain learning style categories are not reaching their potential.

Key words: creativity; learning style; achievement; design and technology project work; secondary education; tertiary education.

Introduction

Economic imperatives since the early 1990s have led the British government to prioritise learning achievements in an educational context. Unfortunately it has been argued by many (Woods and Jeffrey, 1996; NACCCE, 1999; Craft, Jeffrey & Leibling, 2001; Cropley, 2001), that the technical and bureaucratic processes which have been employed to enable this to happen have led to a diminution of creativity in education. However, recently there has been a considerable push from various quarters to revitalise the place that creativity holds within both education and industry (Design Council, 1998; NACCCE, 1999; Craft, 2000; Jeffrey & Craft, 2001; HMI, 2003). The government talked of a new learning age where creativity, enterprise and scholarship were harnessed for the common good (reported in Lucas, 2001). Various initiatives such as Creative Partnerships and individual LEA schemes have generated positive interest (HMI, 2003), whilst the research community has set up Special Interest Groups (e.g. BERA, 2001) and conferences (DATA, 2004) to continue the debate.

Preferred learning style

The terms learning style and cognitive style have been widely used by educational theorists for the past seventy years. Terminology has varied from writer to writer (Kolb, 1976; Curry, 1983; Biggs, 1985; Honey & Mumford, 1992; Riding & Cheema, 1991), although many (Tennent, 1988; Biggs & Moore, 1993; Riding & Pearson 1994; Riding, 1996; Cropley, 2001; Cassidy, 2003) have agreed that it is a distinct and consistent way of encoding, storing and performing, and one that is mainly independent of intelligence.

Riding and Rayner's (1998) analysis of the multiplicity of constructs concluded that the terms could be grouped into two principal styles and a number of learning strategies. They referred to the two cognitive styles as a 'Wholist-Analytic Cognitive Style Family' and a 'Verbaliser-Imager Cognitive Style Family'. These dimensions they explained were independent of one another. The 'Wholist-Analytic style' dimension they defined as an individual's preference to process information in wholes or in parts, whilst the 'Verbaliser-Imager style' dimension

they defined as an individual's preference to represent information during thinking in text or pictures. Although names for the dimensions might differ in terms of linking learning style and creativity Riding & Rayner (1998) and others (Kolb, 1976; Honey & Mumford, 1992; Cassidy, 2003) have suggested that those who were found at the Analytic and Verbaliser ends of the two dimensions tended to be convergent thinkers whilst those at the Wholist and Imager ends of the two dimensions tended to be the divergent, creative thinkers.

Achievement

In educational settings the terms used to describe the sub-activities of design and technology project work have been presented in a simple linear form as an assessment model in order that achievement could be managed and understood by all those who used it. The need for accountability in both schools and universities has led to the prioritising of a learning achievement agenda. In schools this has in turn persuaded teachers of the need to help pupils gain high marks in public examinations. In order to achieve this teachers have encouraged pupils not to stray from the prescribed assessment criteria, and as a consequence there has been a tendency for pupils to produce targeted convergent thinking rather than encouraging divergent, creative thinking that may not provide tangible evidence to meet all the assessment criteria (Atkinson, 1997; 2000).

In the past the culture and traditions of Universities were primarily rooted in enriching learning. However, recently there have been indications that the balance between learning and assessment has altered. Various factors similar to those found in schools have led to the development of a predominantly categorising assessment culture in Universities as well as schools.

In researching the literature associated with creativity, learning style and achievement the multifaceted pattern of factors that affect the pupil/student's learning and performance whilst designing have been well rehearsed (Naughton, 1986; DES, 1989; Kimbell et al., 1991; NCC, 1993; Atkinson, 1994; 2000; 2003a; 2003b). Set against this complex background the comparison of the relationship between creativity, learning style preference and achievement at GCSE and degree level in the context of design and technology project work has been examined and reported in this paper.

Method
School Pupils
The group of fifty school pupils (thirty-six boys and fourteen girls) referred to in this paper were a sub-set of an original sample of 112 pupils selected as a purposive non-probability sample of 16 year-old pupils studying for their GCSE design and technology examination in eight schools in the North East of England. The gender imbalance was checked against the gender distribution of pupils entered for the design and technology examination nationally at the time data were collected and found to be similar.

University students
The sample of fifty-four university students used in this study were a purposive non-probability sample of fifty-four students (twenty-seven male and twenty-seven female) studying on an Initial Teacher Training (ITT) Design and Technology degree at a University in the North East of England.

Instrumentation
The following materials were used:

Learning Style.
After a thorough investigation of the various constructs and because of the nature of the activities being discussed in this paper it seemed appropriate to utilise Riding's definitions of cognitive style and use his well-established Cognitive Style Analysis Test (CSA) (Riding & Cheema, 1991), which was computer presented and self-administered. This indicated an individual's position on both the 'Wholist-Analytic' (WA) and the 'Verbal-Imagery' (VI) dimensions of learning style by means of an independent ratio for each (Riding and Rayner, 1998). Every member of both samples carried out the CSA in the manner prescribed in the CSA administration documentation (Riding, 2002).

Achievement.
In both instances one set of post-project results were used. In the case of the pupils it was their GCSE project mark awarded by the school and moderated externally. In the case of the ITT students it was the mark awarded internally for the students, first design project carried out as a culmination of a year's study. This had also been cross-moderated by an external examiner.

Creativity.
Many tests for creativity have been devised (Torrence, 1988; Guilford, 1976; Meeker, 1985; Kirton, 1989; Oxlee, 1996; Urban & Jellen, 1996; Sternberg; 1997). The majority of those researched used written rather than drawn responses with the analyses mainly focused on scoring three aspects of divergent thinking: fluency, flexibility and originality. In this study a creativity test developed by Oxlee (1996) was used to ascertain the levels of creativity of the GCSE pupils as it focused on the three recognised scoring criteria; and the responses needed to be drawn rather than written. Further details of this test can be found in Atkinson's article (2000).

The creative level of each university student was ascertained through a questionnaire. Lecturers, who taught the students for their design activity, completed the questionnaire; this asked them to retrospectively report on the level of creativity shown by each student. The responses used a summated rating scale.

The scores for both cohorts in the sample were then collated and a mean score calculated. In both instances members of the sample with a high score were considered more creative than those with a low score.

Results and discussion

Cognitive style
The WA ratios of the total sample ranged from 0.610 – 2.980 with a mean of 1.340 (sd=0.480). Wholists being >1.06 and Analytics being <1.05 on that dimension. The differences between the GCSE pupils and the degree students' ratios were insignificant as can be seen in Figure 1 and Figure 3. In both cases there were more Analytics (over 60%) than Wholists.
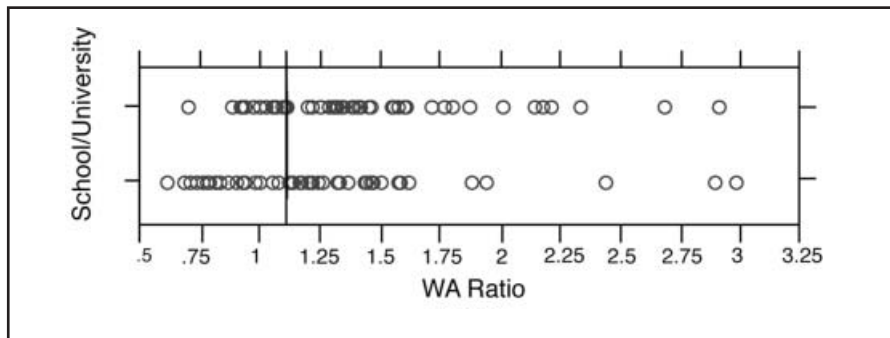

Figure 1: A comparison between the WA ratio found in the sample of GCSE pupils and the degree level students

On the other dimension the VI ratios of the total sample ranged from 0.730 – 1.880 with a mean of 1.080 (sd=0.158). Verbalisers being > 1.05 and Imagers < 1.04 on that dimension. Once again there was an insignificant difference between the two cohorts. These results can be seen in Figure 2 and Figure 3. In both cases there were more Imagers than Verbalisers, although this was only significantly so in the University sample.
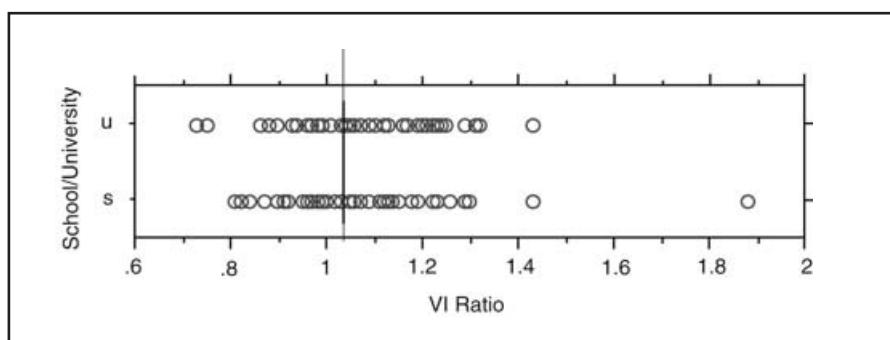

Figure 2: A comparison between the VI ratio found in the sample of GCSE pupils and the degree level students

Institution	Wholist	Analytic	Verbaliser	Image
School	19 38%	31 62%	23 46%	27 54%
University	18 33%	36 67%	19 *	35% 35

*65%
* p-value <.0001;varience 128.000; df=1; chi-square 128.00

Figure 3: The numbers and percentages of the sample in each cognitive style category split by institution.

This later result was not surprising, as one would have expected to find more Imagers amongst students who had chosen to study a creative subject rather than in the case of the GCSE pupils where design and technology was a compulsory subject for all. In fact, one would have expected there to be more students at the extreme Imager end of the VI dimension than was found to be the case, as data from Riding's Standardisation Sample of 999 (2000) indicated that scores of up to 4.000 with extremes as high as 5.600 could be expected. In trying to ascertain the reasons for the low student Imager ratios it was noted that as well as choosing to study design and technology these students were also training to become teachers, and as such, the ability to work competently with both text and images and be able to communicate with pupils at the extremes of a dimension could imply that being at the centre of the dimension would be an advantage.

Achievement
The range of marks for GCSE pupils was 5% - 98% with a mean of 47%. The range of marks for the university students was 38% - 76% with a mean of 58% (see Figure 4). A comparison of achievement between GCSE and degree level was not the intention of this study rather it was the comparison of the relationship between levels of achievement, levels of creativity and the various learning styles of the two samples.

Institution	Mean	Minimum	Maxim
School	47%	5%	98%
University	58%	38%	76%

Figure 4: Observed frequencies – Achievement Split by Institution.

Creativity
Once scores for creativity levels had been calculated for each individual this data was converted into four categories descending from those who were highly creative to those who had poor levels of creativity. This data were placed in two rank order lists split by institution. There was found to be no significant difference between the levels of creativity for the two samples (chi-square p-value .3616) however in both samples there were significantly less creative than uncreative individuals and this difference was even greater in the student cohort (see Figure 5).

Level of Creativity	School	%	total	University	%	total
1 Low creativity level	17	34%	29*	18	33%	36*
2	12	24%		18	33%	
3	9	18%	21*	12	22%	18*
4 High creativity level	12	24%		6	11%	
(*chi-square p-value <.0001)						

Figure 5: Observed frequencies – levels of creativity split by institution.

In a comparison of the relationship between the four levels of creativity and achievement both pupils and students achieved the expected positive result: the higher the levels of creativity the higher the mean score for performance. This data is reported in Figure 6.

Level of Creativity	School	RO	University	RO
1 Low creativity level	31%	bottom	52%	bottom
2	57%	2	61%	3
3	42%	3	62%	2
4 High creativity level	61%	top	64%	top

Figure 6: Observed frequencies – achievement split by levels of creativity and institution.

With regard to the relationship between creativity and learning style, similarities between the results for the pupils and the students were once again in evidence. However, the overall trend was not as expected. Due to the nature of the activity being studied and the cognitive style research evidence it had been anticipated that that it would be Wholists and Imagers who would be the most creative. This proved not to be the case; Analytics and Verbalisers were found to be the most creative in both instances (see Figure 7).

Dimension	School	RO	University	RO
Analytic	2.516	Top	2.194	Top
Wholist	2.000	Bottom	1.944	Bottom
Imager	2.217	Bottom	2.029	Bottom
Verbaliser	2.407	Top	2.263	Top

Figure 7: Observed frequencies – creativity score split by institution and cognitive style category on the two dimensions separately.

With regard to the relationship between learning style and achievement, on the WA dimension it could be seen that Analytics achieved better results than Wholists in both cohorts (see Figure 8). Whether this result was influenced by the skewed data, as over two thirds of each cohort was Analytic (see Figure 3); whether it was due to the way in which both cohorts tackled the project work by dealing with each sub-set of the design process as isolated units rather than seeing the process holistically thereby disadvantaging the Wholists in the two cohorts; or whether the large number of Analytics in each group influenced the way the few Wholists in each group approached their work, is difficult to ascertain from the data collected.

When scrutinising the relationship between learning style and achievement on the VI dimension a mirror image was evident, pupils who were Verbalisers achieved better results than Imagers, whilst Imagers in the student population achieved the anticipated better results than Verbalisers. An explanation for the success at GCSE level of Verbalisers was first reported by Atkinson in 1998 when she explained that Verbalisers were able to communicate their thoughts in a form that was more easily interpreted by teachers during the assessment process, whereas Imagers who favoured drawn explanations were not always able to produce drawings that were easily 'read' and tended to avoid annotating their thinking which may have been more easily understood.

Dimension	GCSE	RO	Degree	RO
Analytic	52%	Top	59%	Top
Wholist	38%	2nd	58%	2
Imager	43%	2nd	59%	Top
Verbaliser	49%	Top	58%	2nd

Figure 8 Observed frequencies – achievement split by institution, cognitive style category on the two dimensions separately.

In scrutinising the relationship between the three variables together it was found that in the student sample each cognitive style category remained in the same rank order in terms of achievement whether the student was classified as very creative or not creative: Analytics were the most successful in each case, followed by Verbalisers, then Imagers and finally Wholists who were the least successful (see Figure 9).

Achievement Rank Order	Most Creative	Least Creative	Most Creative	School University Least Creative
Top	Verbaliser (73%)	Imager (33%)	Analytic (66%)	Analytic (54%)
2nd	Analytic (63%)	Wholist (32%)	Verbaliser (65%)	Verbaliser (53%)
3rd	Wholist (53%)	Analytic (30%)	Imager (63%)	Imager (52%)
Bottom	Imager (50%)	Verbaliser (29%)	Wholist (58%)	Wholist (50%)

Figure 9: Rank order – relationship between cognitive style category; creativity level; and achievement in the form of mean mark for each category.

At GCSE level there was a mirror image. Very creative Verbalisers were the most successful and those Verbalisers who were not creative were the least successful, whilst Imagers achieved the highest mark amongst the least creative and the lowest mark amongst the very creative.

Although it is dangerous to assume cause and effect from research into relationships the results for GCSE pupils suggest that being creative may have more influence upon success in design and technology project work than learning style and that

this may be significantly so in the case of Verbalisers. Whereas at University level although there was a positive relationship between success and levels of creativity there was also a similarity in the relationship between success and cognitive style whether the students were creative or not. What has not been supported by the data from this study is the widely held belief that creative Wholists and Imagers would be the most successful in their project work; instead the data suggests that those who were creative Analytics and Verbalisers were the most successful groups in both cohorts.

Conclusion

Although a health warning needs to be mentioned regarding reliability between the means of assessing achievement and creativity for the two cohorts in this study the results have supported established research in that there was found to be a positive relationship between creativity and achievement for both cohorts in the sample when they were engaged in design and technology project work. The study also indicated that there was a clear relationship between achievement, being creative and certain cognitive style groupings. However the results did not support previous research findings regarding the relationship between creativity and learning styles. In view of this result further study is needed in three areas. Firstly, into the relationship between achievement, cognitive style and creativity using other cohorts of pupils and students to see if they too provide the anomalies found in this study. Secondly, an analysis of assessment criteria and how these are applied to design and technology project work to see if this might give some insight into why in this study creative Verbalisers and creative Analytics were more successful than creative Imagers and creative Wholists in the context of design and technology project work. Thirdly, to further analyse the design processes adopted by students and pupils to ascertain whether the research community's belief that the best designing will occur when the process is treated holistically, is an oversimplification of what is really happening.

References

Atkinson, E. S. (1994), 'Key Factors Which Affect Pupils Performance in Technology Project Work', in: J. S. Smith (ed.), *IDATER 94,* Loughborough University, Loughborough.

Atkinson, E. S. (1997), *Identification of Some Causes of Demotivation Amongst Key Stage 4 Pupils Studying Design and Technology*, PhD thesis, Newcastle University, Newcastle Upon Tyne.

Atkinson, E. S. (2000), 'Does the Need for High Levels of Performance Curtail the Development of Creativity in Design and Technology Project Work?' in *International Journal of Technology and Design Education,* 10, 225-281.

Atkinson, E. S. (2003a), 'The Relationship between Learning Style Preference, Attitude to Learning, Appropriate Prior Knowledge and Achievement in the Context of Computer Aided Learning in Electronics' in: S Armstrong (ed.), ELSIN 2003: *Bridging Theory and Practice*, University of Hull, Hull.

Atkinson, E. S. (2003b), 'An Investigation into the Relationship Between Preferred Learning Style and Successful Achievement in Contrasting Design and Technology Activities', in: J. Dakers & M. J. de Vries (eds.), PATT13, University of Glasgow, Glasgow.

BERA, (2001), Creativity in Education: Perspectives, Evaluations and Personal Development – Special Interest Group can be found at www.jiscmail.ac.uk/lists/CREATIVITY-IN-EDUCATION.html accessed on 24.03.04.

Biggs, J. B. (1985), 'The Role of Metalearning in Study Processes' in *British Journal of Educational Psychology,* 48, 266-279.

Biggs, J. B. & Moore, P. J. (1993), *The Process of Learning*, 3rd Edn, Prentice Hall, Australia.

Cassidy, S. (2003), 'Learning Styles: An Overview of Theories, Models and Measures', in: S Armstrong (ed.), *ELSIN 2003: Bridging Theory and Practice,* University of Hull, Hull.

Craft, A. (2000), *Creativity Across the Primary Curriculum,* Routledge, London.

Craft, A., Jeffrey, B. & Leibling, M. (2001), *Creativity in Education*, Continuum, London.

Cropley, A. J. (2001), *Creativity in Education and Learning: A Guide for Teachers and Educators,* Kogan Page, London.

Curry, L. (1983), *An Organisation of Learning Styles, Theories and Constructs*, ERIC Document 235 185.

Department for Education and Science and Welsh Office (DES), (1989), *National Curriculum, Draft Orders for Technolog*y, HMSO, London

Design Council, (1998), *Creative Britain,* Design Council., London

Guilford, J. P. (1976), *Creativity Tests for Children*, Sheridan Psychological Society, Orange, CA

HMI, (2003), *Expecting the Unexpected: Developing Creativity in Primary and Secondary Schools,* HMI 1612 epublication.

Honey, P. & Mumford, A, (1992), *The Manual of Learning Styles: Revised Version*, Peter Honey, Berkshire.

Jeffrey, B. & Craft, A., (2001), 'The Universalization of Creativity', in: A. Craft, B. Jeffrey, & M. Leibling (eds.), *Creativity in Education*, Continuum, London.

Kimbell, R., Stables, K., Wheeler, T., Wosniak, A. & Kelly, V, (1991), *The Assessment of Performance in Design and Technology – The Final Report of the APU Design and Technology Project 1985-91*, School Examinations and Assessment Council, Evaluation & Monitoring Unit, London.

Kirton, M. J. (1989), (ed) *Adaptors and Innovators: Styles of Creativity and Problem-Solving,* Routledge,London.

Kolb, (1976), *The Learning Styles Inventory: Technical Manua*l, McBer & Company, Boston.

Lucas, B. (2001), 'Creative Teaching, Teaching Creativity and Creative Learning' in: A. Craft, B. Jeffrey, & M. Leibling (eds.), *Creativity in Education*, Continuum, London.

Meeker, M. (1985), *Structure of Intellect Learning Abilities Test*, Western Psychological Services, Los Angeles.

National Advisory Committee on Creativity and Cultural Education (NACCCE), (1999), *All our Futures: Creativity, Culture and Education*, DfEE, London

National Curriculum Council (NCC), (1993), *Technology Programmes of Study and Attainment Targets: Recommendations of the National Curriculum Counci*l, NCC, York.

Naughton, J. (1986), 'What is 'Technology' Anyway?' in: A. Cross & B. McCormick (eds.), Technology in Schools, Open University Press, Milton Keynes. Oxlee, J. (1996), *Analysis of Creativity in the Practise and Teaching of the Visual Arts With Reference to the Current Work of Art Students at GCSE Level and Above*, PhD thesis, Newcastle University, Newcastle Upon Tyne.

Riding, R. J. (1996), *Learning Styles and Technology-Based Training*, Department for Education and Science, Sheffield.

Riding, R. J. (2002), *Cognitive Style Analysis – Research Administration*, Birmingham: Learning and Training Technology.

Riding, R. J. & Cheema, I. (1991), 'Cognitive Styles: an Overview and Integration' in *Educational Psychology 11*, 193-215

Riding, R. J. & Pearson, F. (1994), 'The Relationship Between Cognitive Style and Intelligence', *Educational Psychology* 14, 413-425.

Riding, R. J. and Rayner, S. (1998), *Cognitive Styles and Learning Strategies: Understanding Style Differences in Learning and Behaviou*r, David Fulton, London.

Sternberg, R. J. (1997), 'Intelligence and Lifelong Learning: What is New and How Can we Use it?', *American Psychology*, 3, 2, 83-100.

Tennent, M. (1988), *Psychology and Adult Learning,* Routledge, London.

Torrence, E. P. (1988), 'The Nature of Creativity as a Manifest in Testing', in: R. J. Sternberg (ed.), *The Nature of Creativity: Contemporary Psychological Perspectives,* Cambridge University Press, Cambridge.

Urban, K. K. & Jellen, H. G. (1996), *Test for Creative Thinking – Drawing Production (TCT-DP)*, Swet & Zeitlinger, Lisse, Netherlands

Woods, P. and Jeffrey, B. (1996), *Teachable Moments: The Art of Teaching in Primary Schools*, Open University Press, Buckingham.