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The Unpickled Portfolio: Pioneering Performance Assessment in Design and Technology
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Biographical notes
Professor Richard Kimbell directed the DES funded Assessment of Performance Unit research project in Design and Technology. In 1990 he founded the Technology Education Research Unit (TERU) at Goldsmiths College, University of London, which is now running a wide range of funded research projects in design and technology and IT. He has published widely in the field, including reports commissioned by the Congress of the United States, UNESCO and NATO; he has written and presented television programmes and regularly lectures internationally. His latest book Assessing Technology: International Trends in Curriculum and Assessment won the international technology education book of the year award from the Council for Technology Teacher Education at ITEA in 1999 in Minneapolis, USA.

Kay Stables is Reader in Design and Technology Education and former Head of the Design Department at Goldsmiths College, University of London. She started her career as a textiles teacher, moving to Goldsmiths as a part of the APU D&T research team. From 1990–1992 she was Project Director for the Key Stage 1 Technology SAT developments and followed this as Research Associate on the Understanding Technological Approaches project which built case studies of D&T work from children aged 5–16. Most recently she has conducted, with Richard Kimbell, an evaluation of the impact of a technology education initiative in South Africa and is currently researching into the use of handling collections in developing D&T capability and literacy.

Abstract
This paper focuses on the initial and subsequent developments of a research instrument to assess performance in design and technology activities. The initial development took place as part of the APU (1) D&T project and the paper outlines the rationale behind the development of the original research instrument and discusses certain performance issues that the use of the original instrument raised. It briefly describes four subsequent projects that have developed the methodology further, as a way of illustrating its value as a research tool and also to identify its potential for learners, teachers and assessors.

Keywords
assessment, designing, methodology, portfolio, research, task

Introduction
The assessment of performance in design and technology has always been a problem. Traditionally, assessment has relied on examinations (that cannot measure ‘real time’ performance), or on coursework assessment that is difficult to standardise, cumbersome and therefore expensive. This paper discusses the evolution of, and the power of, an intermediate kind of assessment that was first developed by the authors between 1985 and 1987 for the Assessment of Performance Unit (APU) project in design & technology.(1)

Since that early development in which the research instrument was used with 15-year-olds, the approach has been modified, developed and utilised with students from a range of age groups at both primary and secondary levels and, in addition to England, has been used in the USA and South Africa.

Whilst the motivation initially underpinning the development was assessment, we now recognise that a major strength of the approach has been in promoting student performance, and in helping teachers to understand both design and the assessment of process in new ways. Our approach demonstrates that neither designing nor assessment is dependent on the long-term pickling of ideas, for both can be exposed, examined and celebrated in the raw creativity that our portfolio induces.

Rationale and approach
Traditional models of assessment of process (for example in the UK – CSE, GCE, the 1990 Order for design and technology) have been hampered by a linear interpretation of activity that threatens to strangle creative design performance. The approach discussed in this paper is built on a profoundly different model which views designing as an interaction between mind and hand (inside and outside the head) and the activity as being best described as iterative as ideas are bounced back and forth; formulated, tested against the hard reality of the world and then reformulated. We coined the phrase ‘thought in action’ to summarise the idea and we subsequently described it in the following terms:

“When engaged in a task, ideas are inevitably hazy if they remain forever in the mind, and this inhibits their further development. By dragging them out into the light of day as sketches, notes, models or the spoken word, we not only encourage the originator to sharpen up areas of uncertainty, but we also lay them open to public scrutiny … the act of
expression pushes ideas forward...and the additional clarity that this throws on the idea enables the originator to think more deeply about it, which further extends the possibilities of the idea … concrete expression (by whatever means) is therefore not merely something that allows us to see the designers ideas, it is something without which the designer is unable to be clear what the ideas are.” (Kimbell, et al, 1991)

Figure 1: Linking thought and action (Kimbell, et al, 1991, p.22).

For the purposes of short-term assessment, the key to this process lies in the role of the portfolio response booklet that we designed for students. The problem with conventional test booklets is that they require page-turning, which is very damaging to the iteration we described above because every time you turn a page, you cover up everything that is on it. Accordingly you close down all opportunity for those hidden ideas to feed the creative process. The objective is to allow the portfolio to develop – but without hiding anything that is in it. Our first solution to this problem was to create an endlessly unfolding portfolio – as work is completed on page 1, you unfold page 2, then page 3 and so on.

On these pages we presented students with a sequence of alternately active and reflective sub-tasks: identifying starting points for ideas; thinking about potential clients; identifying key issues for product success; developing the ideas etc. Each stage was presented as a manageable next step – drawing students forward through the process.

Figure 2: Early booklet development.

Our early trials suggested that this ‘stage managed’ process worked well. The booklet had the benefit of allowing ‘real time’ performance to be developed and displayed in its entirety. But it had the serious disadvantages that it was highly wasteful (only one side of the paper was used) and far too expensive to print – since it ended up as a piece of paper A4 high but A1 long.

From this problem emerged the APU style folding-out booklet based on a single piece of A2 paper which unfolded in such a way that each new sub-task was progressively revealed. In Figure 3 we describe the approach in more detail as used in one strand of test booklets focusing on ‘Early Ideas’.

Figure 3: The unfolding response booklet.

Response booklets of this kind (we developed 24 tests based on six different booklets) were the lynch pin to the whole APU approach to assessment.

Students were engaged in activities accomplished in short time frames (typically 90 minutes) and that produced highly detailed ‘cameo’ portfolios that allowed performance to be assessed authentically, efficiently and speedily. The activities were managed through a closely structured ‘script’ which promoted a responsive rather than prescriptive approach to designing, that allowed human need to focus the activity, the generation and development of ideas to drive it and the application of knowledge to assist in resolving tasks being pursued. The assessment model paralleled the activity model in that it too anticipated a responsive, iterative approach to designing. The rubric required assessors to make both holistic judgments (i.e. taking into account all that the student had considered and integrated into their ideas and solutions in relation to the task set) and more detailed judgements about dimensions of capability (e.g. grip on issues, exploring and developing ideas, ability to appraise for value and consequence, Kimbell, et al, 1991 Appendix 11.)(2). Assessors were required to draw on evidence wherever it appeared within the student’s response and not to expect it to appear in a linear sequence. The approach proved successful both in allowing students to demonstrate capability and enabling assessors to judge the level of that capability.

Issues
A number of issues emerged from the initial development of this portfolio system. This APU battery of tests was used (in the national survey of 1988) in the first systematic attempt – anywhere in the world – to measure design capability in short, sharp tests. Our understanding both of student performance and of the power of our portfolio system developed rapidly through this survey, and two issues in particular proved highly influential on the performance of students.

Structuring sub-tasks
The key to the response booklets lies in the sequencing of sub-tasks. Assuming a given time is available for an activity, it can be managed in a number of ways. It might be structured very loosely – with large blocks of time available to the students working independently and only limited interventions from the teacher/script to steer the activity. Alternatively it might be structured much more tightly – with more interventions and instructions by the teacher/script. In tightly structured activities there is plenty of support and students do not typically ‘loose their way’. But by the same token, if teachers keep intervening, there is little opportunity for students to learn (or demonstrate) the skills of project management.
When we designed the APU tests, we had limited awareness of the importance of this factor as a determinant of student performance. Partly by chance, therefore, some of our tests emerged as tightly structured, with sub-tasks every five minutes or so, while others were looser with less ‘steps’ and more time for each of them. It was not until we examined the profiles of student performance that the full impact of what we had done began to dawn on us. It became apparent that performance (e.g. of gender groups and general ability groups) on the tightly structured tests was very different from the same groups on loosely structured tests. In retrospect it is easy to see why, and the details are fully explored by us in the APU report (Kimbell, et al, 1991) and in subsequent writing (Kimbell, et al, 1996).

The issue is simply that a tightly structured set of sub-tasks acts as a guide to the less confident or experienced performer. But it can also be stifling and irritating to the confident performer who wants to get on and do it their way.

**The hierarchy of tasks**

The sub-tasks referred to above are steps along the way towards the achievement of the principal task, and this tasks is itself a matter of great importance. By experimenting with a wide range of such tasks, we came to see them as existing in a hierarchy. At one extreme exist very open and ill-defined tasks and at the other are highly specified tasks. If you are presented with a defined task, it is quite possible to identify the less-defined end of the continuum within which it sits, and equally if you are presented with an open, generalised task it is possible to specify it into a number of different particular tasks.

It matters little how many steps exist in this hierarchy, but it is important that we see the ever more specific tasks deriving originally from an open and contextualised task and subsequently through each successive layer. This progression – from the general to the particular – is nothing more than a recognition that all particular tasks exist somewhere in more generalised contexts. For example, design a traveller’s body purse is a specific task that may ultimately be tracked back to an overriding context of ‘protection’.

“protection”
“protection on the move”
“protection of personal possessions on the move”
“design a traveller’s body purse”

Each one of these layers might be a task or a starting point for a project, but they make very different demands on the students undertaking them.

Figure 4: The hierarchy of tasks.

The tasks we presented in the APU tests were each pitched at different points in this hierarchy and it was the differences in performance on these tests of the sub-groups making up the sample that first alerted us to the significance of the hierarchy (e.g. girls’ as against boys’ performance).

**The performance influence of tasks design and sub-task structure**

Taken together, these two facets (the open/closed-ness of the task itself and the sub-structure of the response booklet) enabled us to construct a very broad array of activities. So powerful are the effects of these two factors on the differential performance of sub-groups of students, that we were moved to make the following observation.

One is led to the somewhat sinister conclusion that it would be possible – given an understanding of the nature of these effects – to design activities deliberately to favour any particular nominated group. (Kimbell, et al, 1991 p.208)

Consequently both the teacher and the researcher need to be acutely aware of the bias they may be constructing within a design and technology activity and all future developments of our initial approach have taken this into account.

**The value of the approach as a research tool**

Since developing the original portfolio approach, we have refined it for use in many different research settings. The following brief case studies illustrate some of the settings and purposes that the portfolio has been developed to inform.

1) The Evaluation of the South Africa (North West Province) Technology Education Project (NWPTEP)

The NWPTEP (3) initiative ran from 1996–1999 introducing technology education into high schools. The project took a learner centred, process based approach that involved students working on projects focused on materials, energy & power, and communications. The learning was primarily ‘hands-on’ and took place through collaborative group work. In March 1999 we used the structured assessment portfolio approach to evaluate the impact of the project in schools. We ran activities in 10 project schools and 10 equivalent schools that had not been involved, and which acted as our control. A distinct difference to the APU project was the need to structure the activity, the portfolio and the assessment to take account of collaborative group workings.
To achieve this we created an activity based on team work, where a mixed gender group of 6 students worked together, with sub-tasks dividing the group into three pairs. There were four response booklets – one in which the whole group’s response was recorded and three in which the pairs undertook sub-tasks.

Figure 5: The structure of the collaborative response booklets.

The tasks were administered by a team of trained fieldworkers who were also subsequently trained to assess the resulting students work. The results demonstrated the validity of the activity, enabled us to assess group work and provided a firm basis for comparing the project schools with the control group.

2 Integrating Authentic Assessment into Project UPDATE/TEI

Project UPDATE/TEI (4) is a Teacher Enhancement Initiative aimed at developing teachers’ ability to integrate maths, science and technology education in elementary classrooms in the USA. The project has worked with a core group of teachers (50) who then undertake to train further groups of teachers in their own locality. From the outset it has seen the incorporation of authentic approaches to assessment as being critical and we have worked with the project to develop the response booklet portfolio in such a way that it can be used to collect baseline data and also as a mechanism for developing understanding amongst the teachers about performance based assessment.

Again there were similarities to the APU requirements that made the approach appropriate, but also there were new challenges. The activity and response booklets had to be self-contained in terms of providing a structure for the activity and guidance to the teacher both to run the activity and assess the outcomes. This resulted in a new development that provided two parallel booklets – one for the students to respond in and one that gave the teacher both activity and assessment pointers. Figure 6 illustrates this approach, showing step 1 from both the student and teacher booklets.

Figure 6: Student response and teacher guidance.

Although the booklets have yet to be used to collect student data, they have been used in the professional development context and the responses were most rewarding and highlight the value of the approach in helping teachers develop skills in this area.

“I learned a lot. This is great for someone with very little experience in this approach”
“(The) instrument was one of the best things to come out of the course.”
“Fantastic –do more please, our schools need this.”

Project UPDATE/TEI Evaluation of Summer Workshop II, July 1998

3 The Evaluation of the Enriching Literacy through D&T Project

The Enriching Literacy through D&T Project (4) aims to enhance both literacy and design and technology capability in Year 2 and Year 6 children through the use of ‘handling collections’ of designed artifacts. As part of the evaluation of the project we are collecting pre and post experience data on the design performance of the six- and ten-year-olds in question in aspects of both design and technology and literacy, and have again used the scripted, activity booklet, portfolio approach. Two major challenges facing us in this have been to create a design activity and response booklet which can engage children as young as six, and to incorporate both literacy and design and technology assessment targets into one activity.

The use of a handling collection (in the case of the pre-test, a collection of different clothes pegs) provides both a contextualising element and a concrete lead into the activity. This technique was used in certain APU tests and also in certain of the other initiatives described above. The booklets became smaller (folded A3 rather than A2) and the time frame shortened to just over an hour. Certain parts of the activity permitted collaboration, to assist both contextualising and clarifying the tasks. Slightly different activity structures and response booklets were been designed for the two age groups.

As this research is still underway, it cannot yet be fully reported on. However, from the point of this paper, it is important to note that we have successfully used the approach with these younger children, and have been delighted by the imaginative and detail responses they have produced. We have also successfully integrated the two curriculum areas (literacy and design and technology) into one assessment instrument.

4. “Wholes and Parts” – perceptual and designing processes in 11-year-old children

This collaborative project(5), involving the psychology and the design departments at Goldsmiths College, was launched when we became aware that there are parallel ideas arising in the psychology and design disciplines concerning the cognitive operations that are involved in seeing and designing. It seemed proper to assume that there might be some connection between perceptual ‘input’ and designing ‘output’, but we were not aware of any research that explicitly explored the connections between them.
As part of the project, we developed two designing tests based on the APU portfolio model. One favoured open and holistic approaches to designing while the other favoured analytic ‘small-steps’ designing. In tests on 80 children in yr 6, we established that their designing styles were remarkably stable, in the sense that if they were more wholist than partist on test ‘a’, then they also tended to display the same bias in test ‘b’. However, the important point here is that we were also able to demonstrate that the two test forms favoured different groups of students. The dominant holists did far better on the holistic test form, as did the partists on the partist test form. This is yet further evidence of the fact that test response styles can be designed to favour particular sub-groups of students.

Concluding remarks

Since the initial development of the portfolio response booklet we have come to see a great deal of value in its use as a research instrument and we are convinced that there are many further ways in which it can be customised for new research purposes. But it has equally had a massive impact on our own understandings of supporting students in project work, whether as a way to ‘fast forward’ students into project work; to help in the teacher and student self diagnosis of strengths and weaknesses in their own capability; or as a way to help students develop new skills within their capability. In all of these areas there is still immense potential for development. Finally however, we have shown that design portfolios do not have to require long-term activity. Whilst extended project activity is one way to measure performance, we are confident that it is equally possible, and often efficacious to engage in the highly concentrated, short, sharp activities we describe here. Our approach does not allow the time for ‘steeping’ and pickling in the process. Rather, our unpickled portfolio exposes and celebrates the raw creativity that is all too frequently lost in examinations.

Notes

(1) The Assessment of Performance Unit Design and Technology Project was funded by the Department of Education and Science and ran from 1985-1991. The aim was to monitor the design & technology capability of 10,000 15-year-old students in 700 schools across England, Wales and Northern Ireland. The project report “The Assessment of Performance in Design & Technology” was published by SEAC and contains all the details of the assessment instruments, the survey arrangements and the details of student performance.

(2) The North West Province Technology Education Project is one of a number of initiatives contributing towards the development of the new South Africa Curriculum 2005. It was sponsored by the UK Department for International Development (DFID) who also commissioned the TERU team at Goldsmiths College to undertake the evaluation. The Project was jointly managed by the Education Department in the North West Province and PROTEC, an NGO in South Africa who have been a key initiator in the development of technology education in South Africa.

(3) Project UPDATE TEI is a curriculum development initiative being undertaken at The College of New Jersey, USA, involving six States in developing Maths, Science and Technology in Elementary schools. The project is funded by the National Science Foundation (NSF) and directed by Professor Ron Todd and Dr Patricia Hutchinson.

(4) The Enriching Literacy through D&T will run from September 1999 to August 2001. It is sponsored by Middlesbrough Education Action Zone and combines a curriculum development initiative which is being undertaken by the BlueFish Consultancy and a research and evaluation project being undertaken by Goldsmiths College.

(5) “ Wholes and Parts “ was a research project based on the collaboration of the psychology and design departments at Goldsmiths College. During the academic year 1998–9, we tested 80 Year 6 children in a primary school in Essex to establish the relationships between their perceptual processes and their designing processes.

References