Is the steady hand game an appropriate project for this decade? An analysis of the factors why teacher trainees in an ITT partnership are not moving projects forward

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Is the steady hand game an appropriate project for this decade? An analysis of the factors why teacher trainees in an ITT partnership are not moving projects forward

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Abstract
This paper considers the issues facing trainers, trainees and schools in an initial teacher training (ITT) partnership in the use of new materials and emerging technologies in design and technology projects. It considers problems with the frameworks offered by the Teacher Training Agency (TTA) and the Design and Technology Association (DATA) in meeting subject knowledge requirements with respect to schools' design and technology provision in the 11 to 18 age range.

Data are used from a survey of an ITT partnership and from Ofsted HMI Design and Technology summaries to explore the extent of problems with existing curriculum provision in Design and Technology. The validity of traditional projects, such as the 'steady hand game' and wooden storage boxes are questioned. What is their merit in engaging and exciting pupils who are surrounded by everyday products, using new materials and technologies, which could be explored as design and make opportunities at school?

The paper discusses how schools involved with teacher training could make more effective use of trainees' recent subject knowledge and experiences, for example from their degree studies or industrial experience. It concludes with suggestions as to how trainees, during school placements, should be moving existing projects forward and developing projects that make use of new and emerging technologies.

Keywords: design and technology, initial teacher training, inspection, training standards, electronics and communication technology (ECT), modern and smart materials, new and emerging technologies.

Introduction
This paper attempts to identify and analyse the underpinning issues and factors as to why teacher trainees do not readily introduce new materials or technologies into their teaching practice placement schools. It is not the intention to criticise either trainees or their supervising teachers, but to suggest that this weakness may be a lack of synergy between the National Curriculum for Design and Technology (DfEE/QCA: 1999), the standards for Initial Teacher Training in Qualifying to Teach (TTA: 2002) and subject knowledge Minimum Competences for Trainees to Teach Design and Technology in Secondary Schools (DATA: 2003).

The title for this paper was prompted by the recent return of twenty-eight PGCE Design and Technology teacher-trainees from their first teaching practice placement. Each trainee was required, for formal assessment, to submit a Key Stage 3 scheme of work and assessment scheme with supporting lesson plans and teaching resources. In addition, they were invited to give an informal short presentation, which evaluated a design and make activity undertaken with pupils in Years 7 to 9 during the placement.

Prior to the start of the teaching practice the trainees had attended compulsory University taught sessions on the use of new materials and emerging technologies in design and technology school-based projects covering the 11-18 age range. These sessions included:
• CAD, through Pro/DESKTOP accreditation training;
• CAM links to 3D printers, vertical millers, and 2D cutters;
• modern and smart materials, covering those associated with resistant materials, textiles and electronics (including PIC micro-controllers);
• sustainable design issues;
• ICT modelling software for electronic and mechanical systems.

Much of the subject material in these sessions was a revision of what had been studied by most of the trainees who entered the PGCE programme as either industrial/product design or engineering undergraduates. However, the context was different to undergraduate studies, with the focus being on classroom practice. Trainees' understanding of the skills, knowledge and concepts were assessed through a series of
designing and making activities appropriate to the age range they are training to teach. Twelve of the trainees had also attended a TTA funded subject knowledge booster course at the University on Electronic Product Design, which focused on enhancing knowledge, appropriate to the 11-18 age range, but with less consideration of pedagogy.

The University teacher-training tutors had anticipated that the submitted formal schemes and informal presentations, totalling fifty-six projects covering Years 7 to 9, would reflect the skills and knowledge acquired from the University taught sessions outlined above. However, this was generally not to be the case. The most significant examples being the 'steady-hand' game project, wooden or MDF boxes and wooden bookends, which were presented by trainees in a very similar format as the projects taught by University Tutors, in their schools, at least 15 years ago. Very few trainees had either been allowed, or seized, the opportunity to develop new projects for schools or to enhance existing projects by incorporating new materials or technologies. The main opportunity lost was allowing aspiring new entrants into the teaching profession to introduce exciting developments to motivate pupils. The consequence of this is predicted in the NACCCE Report (1999):

The National Standards bring clarity to the task of teacher education and set out systematic criteria for student development and assessment. ... As with the National Curriculum for schools, the ITT National Curriculum is likely to prove over full and congested. Providers of teacher education, like teachers in schools, are increasingly required to teach to the test and have little room for dialogue, debate and creative work with students. If the creative potential of student teachers is ignored, it is unlikely that they will be able to promote the creative and cultural development of pupils. (para 278)

This inability to 'promote creative potential' because of the behaviours of 'teach to the test' and 'little room for dialogue' can be seen in the promotion of new materials and technologies in Design and Technology. To do so may imply risk taking in meeting prescriptive curriculum demands. The result of the risk being that pupils may not achieve as well than if they had followed a more tried and tested approach. This may be so for the returnee trainees. They made acceptable progress in meeting the relevant statutory ITT standards in Qualifying to Teach (op cit) for 'knowledge and understanding' and 'teaching'. However, less acceptable progress was made in teaching to the Key Stage 3 programme of study of the National Curriculum for Design and Technology (op cit) because of the omission of modern and smart materials. They made very good progress, through University practical sessions, in meeting the non-statutory subject knowledge Minimum Competences for Trainees to Teach Design and Technology in Secondary Schools (op cit). What did not occur was the continuity of application, in teaching practice, between the statutory and non-statutory frameworks that impact on trainees' progress.

The Steady Hand Game
Of the projects presented by the trainees in their informal presentations the three most frequent ones (18 of 28), related to resistant materials, were bookends, wooden boxes for a variety of purposes, and steady-hand games. The latter of these projects was the only one that made use of electrical (not electronic) components. No textiles projects were presented during the session. Each of the projects was described, by the trainees, as typical of the projects they were asked to teach in schools. However, in defence of schools, other projects are taught, but not by the teachers whose classes the trainees were teaching, or at the time of the teaching placement. The issue here is that the projects presented had not allowed the trainees to extend the project beyond a somewhat traditional form. This was a matter of concern for trainees, though, again in defence of schools, they had not always enquired if it would have been acceptable to do so.

The steady-hand game has been selected for discussion here because of its potential to excite pupils and the possibilities for incorporating new materials and technologies. It is for these reasons that the answer to the question posed by this paper's title may be, 'yes, it can be an appropriate project for this decade.' Branson (2005) stresses the importance of 'exciting pupils about the impact and possibilities of electronics' by looking at the 'products that are part of their everyday world'. The steady-hand game could take this one step further by being a potential vehicle to allow pupils to become active meaning makers (Bruner: 1966) through realising that they can use these technologies and materials in their own designing and making. Furthermore, this is central to modelling in design activity because pupils are being moved from 'acting in and on the world as users and observers' to 'acting in and on the world as designers and makers' (Archer and Roberts: 1979). The steady-hand game shown in Figure 1 was made
by the author, 20 years ago, for fund-raising for a school garden-fete. It has seen long service and still works today. Countless numbers, of varying sizes, have doubtless been made for similar purposes. They have a good track record for ‘pulling the punters’ and they appeal to all ages. They compete well against modern electronic games to create a challenge. Indeed, pupils are eager at the prospect of making their own following the basic recipe of the traditional model. This recipe is an electrical circuit consisting of switch, buzzer and 9v battery connected in series. The switch is the contact between the bent-wire challenge and the metal loop, which is hand-held. Once the loop touches the wire, because of an involuntary hand movement, the buzzer sounds and the game is over.

Figure 1: A steady-hand game c1985

However the circuit in the basic model should not be promoted as an electronic project, which it frequently is in schools; it is an electrical project. The distinction is that electronics makes use of semiconductors in circuits; electrical circuits do not. Dictionary definition reflect this distinction. The National Curriculum for Design and Technology (op cit) also makes this distinction in the programmes of study. Pupils should be taught at:

• Key Stage 2: 4d how electrical circuits, including those with simple switches, can be used to achieve results.

• Key Stage 3, 5d about mechanical, electrical, electronic and pneumatic control systems, including the use of switches in electrical systems, sensors in electronic switching circuits ..........;

5f how to use electronics, microprocessors and computers to control systems, including the use of feedback.

The steady-hand game project, therefore, in the basic model is not a suitable project for electronics, or indeed electrical projects at Key Stage 3, yet it is well located within Key Stage 2. However, there is scope for extension of the project to meet Key Stage 3 requirements for use of modern materials and for new technologies in control technology. Indeed, recommendation two in Building on Success (Barlex: 2003) centres on ‘developing innovative practice’ through a ‘modern curriculum’ using the ‘new and emerging technologies that can contribute to developing young peoples ability to design and make’. Possible examples of applying the steady hand game to this recommendation could be:

• polymorph to fashion a comfortable handle for the wire loop;


• a thyristor as a manually resetable latch;

• a timer circuit to set a time limit for completion of the challenge;

• use of a PIC microcontrollers to count lives (for Key Stage 3 (Branson: 2004), for Key Stage 4 (Akers: 2002));

• a combination of any or all of the possibilities in the above bullet points.

Each of the above has been drawn from observation in schools in the past five years. Yet in an ITT partnership of twenty-four schools providing teaching placements for up to 30 trainees the trainees are not seeing this good practice; and sometimes being prevented from trying out such developments in their teaching. They are teaching the basic model in its traditional form even though they have the skills, knowledge and understanding of the materials and technologies to move the project forward. The key question that arises is, ‘what is preventing projects such as this from being moved forward?’ There is no simple answer, but factors such as congested curriculum provision (op cit), and resource implications (including staffing) may be significant in trying to aspire to replicating good practice from other institutions (Zanker: 2000).
In the next sections of this paper the discussion focuses on:

- the initial teacher training subject requirements for design and technology;
- the profile of the PGCE Design and Technology teacher trainees;
- the curriculum provision for design and technology in the partnership schools.

These three aspects raise some important interlinked issues, which need to be explored if trainees’ full potential is to be realised.

**The Initial Teacher Training Subject Requirements for Design and Technology**

The first round of HMI Inspections of all secondary ITT programmes in Design and Technology (1996-98) raised concerns, reported in the March 1999 Dissemination Conference of Ofsted (cited in Eggleston: 2001). These concerns linked problems in implementing the frequent changes placed on the demands of Design and Technology teachers with teacher training. Trainee's subject knowledge and understanding were judged as good or better in almost three-quarters of providers. This led to the recommendation that trainees are equipped to teach in two fields of Design and Technology at Key Stage 3 and one at Key Stage 4, with one field being linked to trainees' degree-level knowledge.

The *Minimum Competences for Trainees to Teach Design and Technology in Secondary Schools* (op cit) had been produced by DATA in 1995, prior to the 1999 Conference. However, they had not become universally adopted because of their non-statutory status. Subsequent ITT inspections by HMI did not change this status but did cause their universal adoption by ITT providers, and, as a consequence, follow the DATA model for developing trainees’ subject knowledge. Today trainees are selected who can demonstrate that at least fifty percent of the content of their degrees are relevant to teaching in either electronics, food, resistant materials or textiles. This requirement, whilst again non-statutory, is an expedient interpretation of the *Handbook for Guidance* (TTA: 2002) standards for ITT in *Qualifying to Teach* (op cit), specifically standards S2.1 and R1.7:

R1.7 The law does not specify that teachers should have a degree in a particular subject...

Providers therefore need to consider the full range of applicants' attainment not just the tile of their degree. They need to judge whether, in the time planned for training, applicants would be able to bridge any gap between their subject knowledge at the time of admission, and the knowledge required to meet standard 2.1 ... (*Handbook For Guidance*)

Since 1999, Ofsted (2004) has reported improvements in trainees' subject knowledge to teach design and technology:

Most are competent and have good subject knowledge that they apply effectively in planning and teaching. Many have good degrees in their specialist subject. (*Annual Report 2002-03: Teacher Training Development and Supply*)

However, concerns are still reported about teachers' subject knowledge in *Subject Reports for Design and Technology in Secondary Schools*:

...some aspects of the D&T Programme of Study, notably systems and control, modern and ‘smart’ materials, and computer-aided manufacture, are covered inadequately in most teaching programmes.

and:

Most teachers who were assigned to teach the subject when it became part of the National Curriculum had not been trained to teach some of its major aspects. Many have adapted considerably to the challenge, but there remain significant needs for continuing professional development, particularly in:

- the expertise needed to teach modern technologies ... (Ofsted: 2004)

These concerns are consistently reported in annual surveys, which stress the need for resources to keep teachers abreast of modern technological development and to engage pupils in new technologies (DATA: 2003 and 2004).

And most recently:

In some schools, food technology or electronics have been reduced or removed
from the curriculum because it has not been possible to recruit specialist staff. This has significantly curtailed choices for many pupils.

...not enough qualified and experienced teachers of specific D&T focus areas such as food technology or electronics being available in some areas of the country.

Schools are including within their schemes of work the study of ‘smart’ materials (materials that sense and respond to changes in their environment) and use of these resources is increasing. (Ofsted: 2005)

At least two key issues emerge from these findings. These are, trainees being placed in schools where:

- their subject knowledge is often more up-to-date than teachers;
- aspects of modern/smart materials and technologies are inadequately covered.

If these issues are subject to strict interpretation, by example through rigorous application of the guidance Ofsted Framework for Inspection of Initial Teacher Training (Ofsted 2002), then training providers face with problems finding sufficient schools suitable for placing trainees, else run the risk of technical non-compliance. This is a generalisation and is based on one partnership and it trainees, the profiles of which are explored in the next section of this paper. The key question, then, is the specific experience of one partnership's difficulties in matching trainees to schools the general case?

The Profile of the PGCE Design and Technology Teacher Trainees

The present cohort (2004-05) of twenty-eight PGCE Design and Technology trainees has been compared with the preceding cohorts of twenty-four trainees (2003-04) and twenty trainees (2002-03) to analyse trends and differences in their profiles. The University offers opportunities to train to teach two fields of Design and Technology, from electronics, resistant materials, and textiles: the main field across the 11-18 age range, and second field across the 11-14 age range. The University does not offer food technology as a field of training because of lack of facilities. For the small number of applicants offering food it would not be cost-effective for this to change. However, it is hoped that all trainees, at some point during their training, assist with some teaching of food in the 11-14 age range.

The gender profile during the three year period has shown minor variation from 50:50, with overall numbers being 35 female and 37 male trainees. Gender differences are not considered in this paper. However, before the period covered, there had been a steady rise in the number of female entrants onto the programme, for example 5 of 16 in 1994-95 (31%) and 7 of 19 in 1995-96 (37%).

The changes in age profiles are shown in Figures 2 and 3. In Figure 2, the significant trend is the consistent increase in entrants in the 21-25 age group from 65% in 2002-03 to 95% in 2004-05. Consequently, the average age on entry to teacher training has fallen from 25yr 9mth to 23yr 7mth. It may be significant (though not tested) that this age group may be the most exposed to new technologies from infancy to adulthood. The reason for the trend may be the incentive of the training salaries and the payment of student loans. Such incentives are not attracting entrants in the 26-35 age group, which have fallen from 25% to zero in the same time period. However, from the 36+ age group the percentages have not change significantly. Entrants in this category are seeking a career change, they are few in number (2 per year), and, if they have proceeded this far, are less concerned about incentives. From telephone enquiries, many are deterred from applying because of lack of financial aid covering income from present occupations.

The significance of the percentage increase in the 21-25 age group requires a more detailed analysis, which is shown in Figure 3. The most noticeable trend is the decrease in 21 year old entrants, and the increase in the 22, 23, 24 and 25 year old entrants. This trend reflects the increasing popularity of taking either a gap year or trying another career for a few years prior to training. Reasons given by trainees for delaying entry into teaching are invariably related to ‘wanting to see the world’ or ‘trying something else first’ or ‘needing a rest’ before resuming their studies.
An analysis of degree backgrounds in relation to the main field of training is shown in Table 1. Table 2 offers further analysis by showing the numbers of trainees for each cohort by main and second field.

By considering Tables 1 and 2 together some interesting points emerge:

- The numbers of electronics graduates presenting themselves for training is low. However, the numbers for ECT have increased because of the opportunity for trainees to be accredited for Electronics in Schools Initiative (of which the programme leader is a trainer) and attendance on TTA funded subject knowledge booster courses.

- The number of suitable textiles graduates is low, and has fallen to zero. There is a steady number of textiles applicants more suited to art and design, who, therefore, lack sufficient prior knowledge for design and technology training.

- There is a small decrease in the numbers of mechanical, automotive, or aeronautical engineers, which in percentage terms show some significance: from 25% (5 of 20) in 2002-03 to 11% (3 of 28) in 2004-05.

- There is a significant increase in the numbers of industrial or product designers from 50% (10 of 20) in 2002-03 to 75% in (21 of 28) in 2004-05.

- The training model does allow choice of fields for training. With the exception of ECT main and TXT second field, there have been trainees for each combination.

If degree classification is the benchmark used for subject knowledge on entry then the analysis of degree results shown in Figure 4 confirms the Ofsted (op cit) findings of improvement. The most notable improvement is the increase in those applicants presenting themselves for training with upper second class honours degrees from 30% in 2002-03 to 57% in 2004-05. The small numbers of applicants with third class honours degrees were admitted because, for each case, circumstances suggested that subject knowledge was at least satisfactory.
In summary, the main increase in numbers of entrants onto the PGCE design and technology programme has been mainly from those in the 21-25 year age range, with degrees at upper second classification in industrial or product design. Their age and subject knowledge makes them well placed to have very secure subject knowledge of modern and smart materials and technologies. However, their lower average age may make them hesitant at enquiring from their older more knowledgeable others, i.e. their supervising teachers, if they can explore the possibilities in their teaching. (Zone of Proximal Development (Vygotksy: 1962))

The Curriculum Provision for Design and Technology in the Partnership Schools
Prior to the start of the training for the current cohort, partnership schools were asked to complete a Partnership School Profile to indicate the subject/media areas that they were prepared to allow teacher trainees to teach. Table 3 contains the section of the profile used to obtain this data. The intention was to determine what schools could offer, rather than what is taught. However, in practice, having worked with most of the schools for many years and from scrutiny of their most recent Ofsted reports, there is very little difference between what can be offered and what is taught.

### Table 1: Degree backgrounds in relation to the main field of training

<table>
<thead>
<tr>
<th>Specialist degree</th>
<th>02-03</th>
<th>03-04</th>
<th>04-05</th>
<th>Main field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio systems design</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>ECT</td>
</tr>
<tr>
<td>Industrial design or Product design</td>
<td>10</td>
<td>12</td>
<td>21</td>
<td>RMT</td>
</tr>
<tr>
<td>Mechanical or Automotive or Aeronautical engineering</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>RMT</td>
</tr>
<tr>
<td>Metal smithing or Jewellery or Glass design</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>RMT</td>
</tr>
<tr>
<td>Furniture design</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>RMT</td>
</tr>
<tr>
<td>Medical engineering</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>RMT</td>
</tr>
<tr>
<td>Medical electronics or Electronic engineering</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>ECT</td>
</tr>
<tr>
<td>Interior design</td>
<td>1</td>
<td>0</td>
<td></td>
<td>RMT</td>
</tr>
<tr>
<td>Theatre or Costume or Textile design</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>TXT</td>
</tr>
<tr>
<td>Town planning</td>
<td>1</td>
<td>0</td>
<td></td>
<td>RMT</td>
</tr>
</tbody>
</table>

**Key:**  ECT: electronics and communications technology  RMT: resistant materials technology  TXT: textiles technology

### Table 2: Numbers of trainees' main and second fields of training

<table>
<thead>
<tr>
<th>Main field</th>
<th>Second field</th>
<th>02-03</th>
<th>03-04</th>
<th>04-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECT</td>
<td>RMT</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>ECT</td>
<td>TXT</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RMT</td>
<td>ECT</td>
<td>13</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>RMT</td>
<td>TXT</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>TXT</td>
<td>ECT</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TXT</td>
<td>RMT</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

In summary, the main increase in numbers of entrants onto the PGCE design and technology programme has been mainly from those in the 21-25 year age range, with degrees at upper second classification in industrial or product design. Their age and subject knowledge makes them well placed to have very secure subject knowledge of modern and smart materials and technologies. However, their lower average age may make them hesitant at enquiring from their older more knowledgeable others, i.e. their supervising teachers, if they can explore the possibilities in their teaching. (Zone of Proximal Development (Vygotksy: 1962))

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The purpose of the profile was to allow the programme leader to use the data to produce an audit of the provision in relation to trainees’ teaching needs for main and second subject fields, thus allowing a closer match of placements than previously possible.

Responses were received from schools, from which 24 are used as placement schools. Table 4 shows the numbers of schools by age range and ability to offer training places at Key Stages 3 and 4, and Post-16, which is the breadth covered by the trainees following an 11-18 PGCE programme. The data show a tight fit for placing up to 30 trainees in two schools some of whom can only offer single, rather than the preferred paired placements.

The analysis of the data to show schools’ ability to offer teaching experiences for the various combinations of two fields at Key Stage 3 and one at Key Stage 4 and Post-16 is more complex, and an even tighter fit. The Venn diagrams in Figures 5, 6, and 7 show such analysis. However, this needs to be considered alongside the data shown in Table 2 for the 2004-05 trainees (23 for RMT main and ECT second; 2 for ECT main and RMT second; 3 for RMT main and TXT second).
Conclusions
The findings and discussion presented in this paper draw on the experiences of one University led ITT Partnership in providing suitable placements for design and technology teacher trainees. The suitability of the placements is not in question nor is the Partnership’s reputation for high quality design and technology teacher training, which is confirmed through its most recent HMI Inspection as category A, the highest.

Training providers are held accountable, through inspection, for guaranteeing quality of provision, in partner schools. This is not in dispute. Provision requires teaching experiences across two media areas, which, whilst non-statutory is agreed to be sensible and appropriate by all stakeholders in the training process. There is clear evidence showing that the quality of training has improved through selection procedures targeted to attract high quality entrants into teaching at a national level. The experience of the partnership is that trainees enter the profession with degrees, at a higher classification, more closely matching the subject that they are training to teach. They are also entering the profession, on average, at a lower age.

Rigorous training is designed to match competence frameworks, which ensure that trainees have secure up-to-date subject skills and knowledge in the use of modern materials and new technologies. It is therefore reasonable to expect that they will gain experience of using this during their teacher training and then onto teaching as newly qualified teachers. Evidence from observation suggests that the latter occurs, which warrants further investigation.

Nevertheless, during their teaching experiences, trainees do not move existing projects forward, or develop new ones using modern materials and new technologies. A typical example is the steady-hand game, which lends itself to extension. The evidence, for this partnership, suggests that this may be linked to curriculum provision problems relating to risks in exploring new possibilities and to staffing and resourcing. Some of these problems can be overcome by simply allowing trainees to explore with pupils the use of modern materials and technologies. The advantages of this would be to help teachers keep abreast of modern technologies, and to address the lack of synergy between the deliveries of the national curriculum and ITT subject requirements suggested in the opening paragraph of this paper.

Further work, through collaboration and discussion is needed to determine whether the specifics in this paper are the same for the general picture for teacher training.
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