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Innovations in Primary and Key Stage 2/3 Design and Technology Education at the University of Greenwich, London
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Abstract
This paper describes an approach and new techniques trialled with primary and Key Stage 2/3 trainee teachers at the University of Greenwich and further trialled with children. Students were introduced to an aspect of technology, explored its importance and were shown the example they would make later. They then followed a ‘recipe’ to make their working example (or core), gaining knowledge, skills, understanding and confidence. Crucially they then developed a wide variety of different products made manageable by the common start. Benefits of this approach seem to include increased motivation and scope for innovation and differentiation. Electrics and mechanisms are used to illustrate the approach and an innovative technique for constructing mechanisms will be described. Work for children based on this approach is to be found in the author’s Design Challenge series (Evans, 1999). The presentation of this paper is to include working starting points and a five-minute video showing projects.

Keywords
design and technology, primary training, new approach, trialled

The aim of this work was to develop and trial an approach to design and technology project work with trainee teachers (but also applicable to pupils) that would allow maximum creativity while ensuring success, coverage of programmes of study and manageability for the teacher. An action research approach seemed to suit what was intended and it was also familiar, being close to the way design and technology practitioners usually work in their subject. Cohen and Manion (1980) describe action research as:

“small scale intervention in the functioning of the real world and a close examination of the effects of such intervention”.

The approach described below was trialled with Key Stage 1/2, 2/3 trainees who were interviewed and observed. Two field trials were conducted later with children. Prior to their first design and technology session, students were given a questionnaire asking them to list National Curriculum subjects in order of how confident they felt to teach them. Of 87 respondents, only one rated design and technology as the subject in which they felt most confident, a large majority rating it towards the ‘least confident’ end of the scale. Only music inspired (slightly) less confidence than design and technology. Encouragingly however, the following comments were quite typical:

“alightly concerned because of inexperience in using materials but keen to learn”.
“I have a limited concept of technology and to a degree it’s the unknown quantity that is cause for concern. However I’m confident this will change.”

The approach being developed clearly needed to increase student confidence in design and technology. Students were introduced to aspects of everyday technology that would form the basis for their design and technology work. This included demonstrating examples of cores that they would make later such as a coin operated switch (Good, 1999), tilt switch (Good, 1999) or variations on the pressure pad (Good, 1999). As their questionnaires showed, many new (non-design and technology specialists) trainee primary teachers lack confidence as they approach design and technology. Demonstrating the core helped to reassure students (student interviews) that they would be able to cope as well as introducing the starting point for their projects.

Establishing the importance of the technology was thought likely to help motivation. This included discussing and researching where the core technology (e.g. pressure pads) is used in everyday life and included using information from a number of sources, including ICT-based sources (NC PoS Key Stage 2 1999).

Another way of highlighting the importance of a piece of technology was to imagine the consequences if all examples of it were to suddenly vanish. This required students to establish where the technology was used before they could comment. Interviews with students support the view that establishing a context and real uses for the
technology we were working with was motivating. What we were doing was seen as part of the ‘real world’ beyond the classroom – it mattered.

Students were then shown how to make their own working examples of the cores by following clear ‘recipes’. At this point the emphasis was on following instructions, building confidence and gaining knowledge, skills and understanding in the process. One advantage of this approach was that the cores ensured that specific skills and knowledge were covered. Another benefit was that students with little experience were prevented from embarking on designs that might not work and for which they could not be given sufficient remedial support. Government initiatives in other areas of the curriculum have put considerable pressure on the time given to design and technology at Key Stage 1/2 and this is very much reflected in primary teacher training. This approach allowed making to start quickly with a very good chance of some encouraging success.

Crucial to the approach was that students should go on to develop a wide variety of different outcomes. Rather than confining students to variations on a theme e.g. different desk tidies, this approach seemed to allow scope for designing and making products with different purposes. The variety was made feasible with whole groups by the common tutor input and practical starting point. From observing and listening to students it was clear that design ideas had often begun to develop while the core was being made and that having an actual working starting point (literally in their hands) subsequently helped to stimulate ideas. The cores also gave early success which helped confidence. Because students could design and make ‘whatever they wanted’ (within reason and as long as they started with the core), motivation was helped as designs could be linked with a perceived need, existing area of interest, other subjects or a problem that they had experienced. Less confident or creative students could be guided towards a narrower area to explore e.g. some kind of money box that included the core coin-operated switch. However, many students initiated their own ideas e.g. using the switch to trigger a computer control program, make a timing device or sort materials. Developing cores also offered opportunities for using other aspects of ICT such as clip-art, computer generated text and graphics. Some students were able to negotiate modifications to the cores, either at the outset or more commonly to fit their designs as they developed. The fact that the main input was common was what made diversity of outcome manageable.

Students and children should work with and understand mechanisms because they play an important part in their lives as well as featuring in the National Curriculum. Creating the cores for mechanisms based work gave an opportunity to critically examine existing practice. We had been using ‘Jink’s construction’ (card triangles and wood) to make the supporting structure for any machines but as in school, time and space was a problem. Less design and technology time for primary students meant the usual structure would take too long, leaving little for the mechanisms or development. Students need to be shown how things could be done quickly and cheaply if they are to attempt similar work in school, especially with literacy and numeracy so dominant.

Our core mechanism support (Good, 1999) is now made quickly from corrugated cardboard. This material combines the virtues of being free, with easy working and rigidity that helps hold working parts in place. Rectangles of card cut on a paper trimmer needed only to be cut part way down the middle from each end before they could be quickly folded into a structure with a top, front and ends. The open back allowed mechanisms to be seen working. These structures were held together by two paper fasteners at each end and could be stored flat, saving space and making them easy to take home to work on further. Dowels to hold cams and other working parts were held in slots by strips of card secured by the same paper fasteners already mentioned. This core could be made in different sizes and proportions. Second year students who had used the original frame method in their first year were interviewed and asked to compare the two methods. The much greater speed of construction was often identified and students commented that even when machines were almost finished, children would be able to store them flat in their work trays just by undoing the fasteners. Others commented on how easy they found it to measure, mark, cut and decorate the flattened structures. The general response to interviews was that this core would be much better for school use.

Pulleys, friction drives, handles and the fixing points for cams and other parts were all made using an innovative card rolling technique (Good, 1999) at the heart of our primary level mechanisms projects. The end of a strip of thin card was glued to a wooden rod. When fixed, the rest of the strip was glued and wound tightly round the rod to form a solid boss. The rolls bonded strongly and concentrically to the wooden rod and other parts e.g. card disks could be glued securely to them. This method transformed easily worked thin card into strong, reliable working parts once the glue was thoroughly dry. The strips of card were produced quickly on a classroom paper trimmer. This new
‘super core’ allowed a range of mechanisms to be used in a class as only one basic method had to be taught. Students interviewed commented on how much easier this core was than using MDF wheels and other more resistant materials. Others appreciated that schools would need to buy less and that reliable fixing would save teacher time.

Field research was necessary to make sure that pupils in the target age range (7–13) could make the cores successfully. A primary student teacher trialled the method in a London school with considerable success in that most pupils managed with very little help, leaving him able to discuss designs. Photographic evidence of the children’s success work was gathered for use with trainee teachers. Further field trials were carried out by the author with a cub pack who went from introduction to working products in one busy evening. A technically sound core is important as it is the foundation of all the varied projects.

Starting with part of ‘a solution’ and then finding a need or problem that can be met (rather than starting with a ‘design problem’) is not such a strange way of working. Even when a new material or piece of technology is developed to meet a specific problem, designers and technologists often look at it as a source of inspiration for other new products. With this approach students never needed to be shown a finished product that the teacher ‘made earlier’ and which they might simply copy. Rather they were shown the starting point for many possible projects. In many subjects, the teacher does of course have the one right answer which the student has to work out or if known, memorise and return. We need to establish the designing is special and that ideas will be considered on their merits against the need, design problem or project brief. Designing is a play-like activity where ideas and materials are manipulated to explore what might be, what could be and what should be. One of the strengths of design and technology at its best, is that participants examine and judge their solutions against a task for themselves. In the case of the cores the basic question was ‘What can I do with this?’ In this trial students were shown part of a solution but to a problem which they had to identify for themselves – no problem (other than how to apply and develop the core) or ‘right answer’ was offered. Students also needed to establish their own criteria for a successful project as each was designed to meet different needs.

Organisations like the Technology Enhancement Project (TEP) are making new technology like thermocolour sheet and smart wire accessible to schools. Because this approach focuses on the technology it seems well suited to making the most imaginative uses of any new materials as they appear.

In conclusion, it seems that although the approach and methods described in this paper need larger scale and perhaps more formal research, they are worth pursuing.