JOURNAL OF SCIENCE EDUCATION (REVISTA DE EDUCACIÓN EN CIENCIAS) N 2, VOL 3, pp 90-92, 2002

An approach to Primary Design and Technology Education and some innovative techniques.

El enfoque para diseño primario en la Educación tecnológica y las técnicas innovativas

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Abstract:

This paper explains an approach and new techniques trialled with student primary teachers at the University of Greenwich and further trialled with children. Students were introduced to an aspect of technology and explored its importance. They then followed a 'recipe' to make their working example (or starting point), gaining knowledge, skills, understanding and confidence. Crucially they then developed a wide variety of different products made manageable for the tutor by the common start. Benefits of this approach seem to include important opportunities for creativity, good motivation and scope for differentiation. Further research is planned to examine the effects in more detail. Electrics and mechanisms starting points are used to illustrate the approach. An effective, innovative and economical 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 (pub. Evans 1999).

Keywords: technology education, creativity, motivation, innovations

Resumen

En este trabajo se expone una nueva metodología experimentada con estudiantes de la Universidad de Grenwich y después con los estudiantes del colegio. La importancia de los aspectos de la tecnología era introducido para los estudiantes quienes continuaron haciendo sus propios ejemplos, adquiriendo conocimientos, habilidades y entendimiento del material. Después desarrollaron amplia variedad de diferentes productos con ayuda de tutor. Algunos beneficios de este enfoque incluye importantes oportunidades para desarrollar la creatividad, con buena motivación y ampliar horizontes. Los ejemplos de electricidad y mecánica se utilizaron para ilustrar este enfoque junto con las innovaciones y técnica para construir los mecanismos. Los ejemplos para los estudiantes basados en este enfoque se puede encontrar en la serie del autor : *Design Challenge* series (pub. Evans 1999).

Palabras Clave : Educación tecnológica, creatividad, motivación, innovaciones.

Introduction

The aim of this work was to develop and trial a particular approach to Design and Technology (DT) project work with trainee teachers and pupils. The approach was intended to allow maximum creativity while ensuring success, confidence, coverage of programmes of study and manageability for the teacher. Creativity is arguably at the heart of DT so it is important to develop ways to promote it. All too often projects such as 'design a desk tidy that will hold six pencils and a ruler using the material provided' type projects limit the scope for innovation in an arbitrary way. The approach set out in this paper is not proposed as the only one that should be adopted but if it promotes creativity it should perhaps be included alongside others. The importance of creativity in education and in wider society has been highlighted by the UK's National Advisory Committee on Creative and Cultural Education (NACCCE) in its important 1999 report which stresses that due to a rapidly changing world there is :

> growing demand in business world-wide is for forms of education and training that develop 'human resources' and in particular the powers of communication, innovation and creativity.
> Creative abilities are needed in all forms of business and in all types of work including traditional manufacturing trades.

Research (still ongoing) seemed necessary to establish whether the approach set out in this paper had the effects that seemed likely. An action research approach suited what was intended and it was also familiar, being similar to the way DT 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.

Research and discussion

The approach described below was trialled with student primary teachers who were interviewed and observed. Two small scale field trials were conducted later with children. Prior to their first DT session student primary teachers were given a questionnaire asking them to list National Curriculum subjects in order of how confident they felt to teach them. Of eighty-seven respondents only one rated DT as the subject in which they felt most confident. A large majority rated it towards the 'least confident' end of the scale. Only music inspired (slightly) less confidence than DT. The following comments were quite typical however:

> Slightly 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 case for concern. However I'm confident this will change.

The approach being developed clearly needed to increase student confidence in DT. Students were introduced to aspects of everyday technology that would form the basis for their work. This included demonstrating examples of ‘starting points’ that they would make later such as a coin operated switch (Good, 1999a, p.28), tilt switch (Good, 1999a, p.26) or variations on the pressure pad switch (Good, 1999a, p.14-20). As their questionnaire responses showed, many new non-DT specialist trainee primary teachers lack confidence as they approach DT. From student interviews, it was clear that demonstrating the ‘starting points’ helped to reassure them that they would be able cope as well as introducing them to the ‘starting point’ for their projects.

Establishing the importance of the technology involved early on was thought likely to help motivation. This included finding out about the everyday uses of the technology (e.g. the pressure pad switch). Information was gained from a number of sources, including ICT-based ones. Another way of highlighting the importance of a piece of technology was to imagine what would happen 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 supported the view that establishing a context and real uses for the technology was motivating. What we were doing was seen as part of the ‘real world’ outside the classroom.

Students were then shown how to make their own working examples of the ‘starting point’ by following a clear recipe. At this point the emphasis was on following instructions, building confidence and gaining knowledge, skills and understanding in the process. The NACCCE report (1999) seems to support the need for teaching specifics to support creativity and reinforces what many teachers DT have discovered:

Creativity is not simply a matter of letting go. Serious creative achievement relies on knowledge, control of materials and command of ideas. Creative education involves a balance between teaching knowledge and skills, and encouraging innovation.

Teaching the ‘starting point’ with its associated practical tasks was intended to provide the knowledge and stimulus that were to form the basis for designing. One advantage of this approach was that specific skills and knowledge were built in. Students with little experience were prevented from embarking on designs that might not work at all. Our government initiatives in other areas of the curriculum have put considerable pressure on the time given to DT at primary level and this is very much reflected in our primary teacher training. This approach allowed practical work to start promptly and with a very good chance of success.

Crucial to this approach is that students could go on to develop a wide variety of outcomes. Rather than confining students to variations on a theme e.g. similar desk tidies, this approach seemed to allow products with different purposes. The variety was made feasible with whole groups by the common tutor input and practical starting point. By observing and listening to students it was clear that design ideas often began to develop while the ‘starting point’ was being established and that having this literally in their hands was a considerable help in stimulating ideas. The starting points also gave early success that helped confidence. Because students could design and make ‘whatever they wanted’ as long as they began with the ‘starting point’ motivation was helped. Designs could be linked to 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 brief e.g. some kind of money box that included the coin-operated switch starting point. However many students initiated their own ideas e.g. using the switch to trigger a computer control program. Developing the starting points also offered opportunities for using other aspects of computer based information and communication technology (ICT) such as clip-art, text and graphics. Some students were able to negotiate modifications to the ‘starting point’, either at the outset or more commonly to fit their designs as they were being developed. The fact that the main input was common, made diversity of outcome manageable.

The starting point approach can be used across a wide range of technology including mechanisms. By definition the outcomes will all be machines but they can be very diverse in their functions and degrees of sophistication. Students and children need to work with mechanisms because they play an important part in their lives as well as featuring in the National Curriculum of England and Wales. Creating the starting points for mechanisms-based work gave an opportunity to critically examine existing practice. Observing students indicated that their were drawbacks to the usual making methods. We had been using construction method involving triangles of cardboard and strips of wood to make the supporting structure but this took too long. Less DT time for primary students meant that completing the usual structure would leave little time 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. Our mechanism support is now made quickly from cartons (cardboard. with corrugated centre). This material combines the virtues of being free, abundant and ‘green’, with easy working and a rigidity. 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 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, or garden wire crankshafts 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 student teachers that 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, 1999b, p8) at the heart of our primary level mechanisms projects. The end of a strip of thin card was glued to 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 starting point allowed a range of mechanisms to be used in a class as only one basic method of construction had to be taught. When students were interviewed they commented on how much easier this was than using wooden wheels, red plastic pulleys and other more resistant materials. Others appreciated that schools would need to buy less materials and that reliable fixing would save teacher time. It was also noticed that little equipment was needed.

Field research was necessary to make sure that pupils in the target age range (7-13) could make the starting points successfully. Field trials were carried out by the author with a cub pack. We went from introduction to working products in one busy evening. A primary student teacher also 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 successful work was gathered for use with trainee teachers. A technically sound starting point is important as it is the foundation of the designing in this approach and all the varied projects that can result.

Starting with part of a solution and then identifying a need or problem that it could meet, rather than 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 project 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 could and should be.

One of the strengths of DT at its best, is that participants examine and judge their solutions against a task for themselves. In the case of the starting points 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 unless further support was needed. Students also needed to establish their own criteria for a successful project as each was designed to meet different needs. New technology like thermocolour sheet that changes colour with temperature and smart wire that can change its length are increasingly accessible to schools. Because the starting point approach focuses on the technology, it seems well suited to making imaginative any new materials as they become available.

In conclusion it seems that although the approach and methods described in this paper need larger scale and more formal research, they are worth pursuing further. Readers interested in this approach and the books, video CD or INSET based on it are welcome to contact the author. Overseas contacts are especially welcome: k.w.good@gre.ac.uk

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