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Girls in Technology – an alternative approach

In recent years, much has been written on the subject of girls in technology. Whilst it is certainly true that we must do everything possible to encourage girls to take up technological subjects, the national shortage of girls in CDT has many hurdles to overcome before a balance may be achieved. The GATE project, the Equal Opportunities Commission and the DES have all highlighted many of the reasons why girls should be involved in this very important area of the curriculum. In a publication 'The What, Why and How of G.A.T.E.' the project stated:

'Career possibilities are improved by facility with tools, the ability to communicate graphically and a general technological competency'.

It has become apparent however, that if such projects are to succeed and if we are to attain equality of the sexes in CDT, some practical answers must be sought.

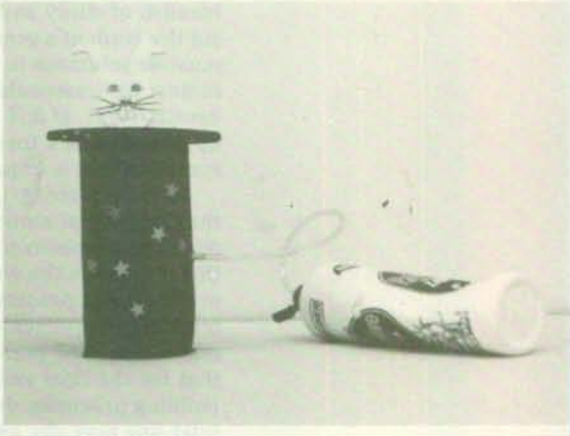
This article looks at one aspect of the problem, that of introducing technology into the curriculum of a single sex school and the particular difficulties that this may create. The intention is not to preach solutions but to give an account of my own approach and to offer suggestions from which further discussion would hopefully arise.

In July last year I was asked to go into a girls junior high school (11-14 years), in order to set up a course in technology. The prospective accommodation was to be a former needlework room. A pillar drill, a bench bandsaw and a grinder had already been purchased by the school and were awaiting installation. Small screw on bench top vices, a few hand tools and some miscellaneous pieces of equipment were also provided. A capitation allowance of eight hundred pounds was available which not only had to provide materials and stationary for the year but was to finance the buying of tools and any other necessary equipment.

My interest in developing the opportunities for girls in CDT combined with the challenge of tackling such a problem made it difficult to refuse and so, as the saying goes, I jumped in at the deep end.

It may be necessary at this point to expand briefly on the reasons behind developing this course. Girls from the junior high school at the age of fourteen, transfer mainly into the corresponding girls senior high school. A few years ago, it was felt that girls should be given the opportunity to take modular technology courses at examination level if they so wished. No facilities or specialist staff were available at the girls school and so links were forged with the local boys school and subjects were timetabled to allow girls the flexibility needed in order for them to be able to attend the boys school for their modular technology courses.

The disadvantage of this system was that the girls had no previous experience of being in a workshop and were unfamiliar with both tools and materials. There was an obvious need to provide pupils with some form of foundation course which would help overcome this problem and would hopefully encourage a greater number of girls into this area.



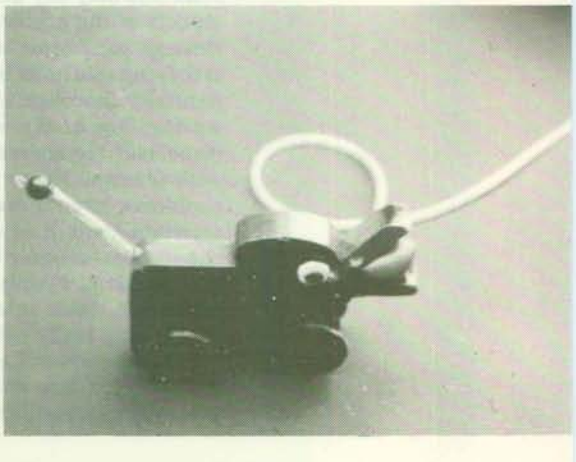


Figure 1: Moving toys operated by a simple pneumatic system. Both the 'dustbin' and the 'hat' are made from empty plastic lemonade bottles and card.

The aims of the course stem directly from this need:

- to provide pupils with an understanding of basic hand tools and materials.
- to develop in pupils the ability to recognise a need and to explore possible problem solving techniques.
- to develop the pupils' ability to communicate ideas.
- to develop both technological awareness and understanding.

It should be noted that it was the schools wish to provide a foundation course in 'Technology'. Technology however, cannot I feel be separated from design and I have attempted therefore, to keep a balance between these two intrinsically linked areas. It will become apparent that the work within the department is in nature, technologically orientated but that the design and problem solving approach plays a central role within this.

The room that I had inherited was part of a typical Victorian school building, with magnolia walls and shabby yellow cupboards and doors. It had obvious potential for improvement and during the summer holidays I bought some leafy green paint and set about cheering the place up. It takes little effort to provide pupils with a bright and cheerful place in which to work and I am

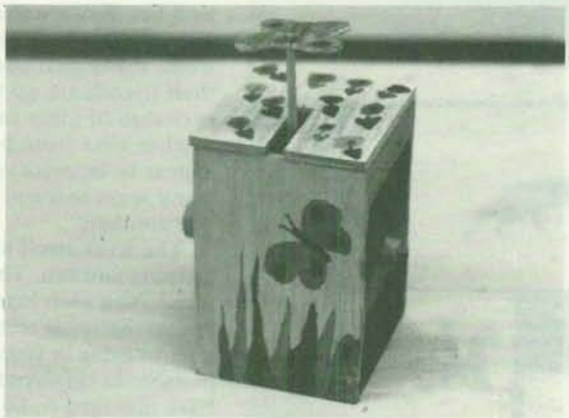


Figure 2: Mechanical box incorporating cam mechanism.

Figure 3: Moving faces.

convinced that motivation is easier to achieve from working in a pleasant and interesting environment.

A variety of posters on the walls added a finishing touch and it was all systems go for September – or so I thought!

The machinery was due to be installed during the holidays and a week prior to the beginning of term I went to check that all was in order. It did not come as a great surprise that nothing had been touched; however, I left with re-assurances that all would be settled by the following week.

It was a month into the beginning of term before the work was completed. Anyone who has ever had to work surrounded by electricians and workmen will sympathise with our circumstances.

Many problems had to be overcome during this month. The equipment bought five years previously was claimed to be substandard by the electricians and they refused to install it. There had only been provision made for one safety cut out button in the room which was quite inadequate. No benches were available for the equipment to be attached to – and so the list goes on. Every spare moment was spent on the telephone, speaking to electricians, administrators and education officers. No advisor was in the borough and this in itself presented difficulties as there was no-one available to put pressure on the relevant authorities.

During this time, the pupils still had to be taught and armed with slides and examples of work done in previous schools I set about 'selling' them Design/Technology.

Technology had been timetabled against home economics and groups were therefore divided and taught in two half yearly blocks. Initially it would only incorporate the second and third year as there was insufficient space on the timetable to offer it to the first year.

What struck me at this school was the curiosity and enthusiasm which the girls displayed for this area of curriculum development. It is worth noting that girls in a single sex school appear to be far less inhibited about taking what is still traditionally a male orientated subject than girls in a mixed school do.

Whenever I meet a new group of pupils I attempt to put a slide show and question and answer session on for them. Whether this is to a single sex or a mixed group, I use examples of former pupils' work which I hope will be of interest across the board. One of the most common questions that I am asked by teachers tends to be 'What do I teach that will interest girls'? Girls are just as interested in designing and making an elastic band powered vehicle for example, as boys are. Unfortunately many teachers when faced with a mixed class, will begin the lesson by apologising to the girls for doing a 'boys' project. The girls immediately feel that they are out of place and confidence and motivation begin to fade. I do not believe that there should be such things as 'girls' projects and 'boys' projects but girls are often made to feel uncomfortable about doing work which they

secretly enjoy. Perhaps this is one reason why we lose the vast majority of girls at the end of the third year.

The Syllabus that I had designed, aimed to provide a fairly comprehensive foundation course in technology, emphasising throughout a practical problem-solving approach. It was also aimed at providing a course which could be taught with a minimum expenditure. Money has been one of the major difficulties in the setting up of this course and I am sure that many people will realise that £800 does not go very far, particularly when it has to cover tools as well as materials. In a two year span, the following areas were covered:

Mechanical control
Pneumatic control
Hydraulic control
Energy and Power
Problem solving

Time is another influencing factor. There is a great deal of work to cover in a very limited period and it is important that pupils gain experience in all areas within their two half yearly slots. An understanding of materials, tools and processes has to be accommodated within the structure of the course. This is attained by supplementing practical lessons with short lectures and demonstrations relevant to particular projects. This is not an ideal situation but is the only feasible one within the constraints of such a system.

Once the initial problems had been overcome and the room was equipped with power and machinery, it was possible to begin work in earnest. Each pupil had designed and made a folder in which to keep both design and theory work (pupil made folders are considerably cheaper than commercially available ones).

I find it useful to have as many different schemes of work running concurrently as is possible. This system does have a tendency to culminate in extra work but I feel that its advantages outweigh the disadvantages. Many pupils are motivated not only by what they are doing but by what their counterparts are doing also. During the course of a week, many girls come in, in order to observe what their friends are up to. This provides an interesting exchange of ideas and prevents both pupil and teacher alike from becoming complacent. Girls appear to be more communicative than boys in many ways and will readily discuss their ideas with one another.

The work itself aims to encapsulate a mixture of learning and fun. There were no funds available for purchasing such luxuries as Fischer-Technic kits and as materials were in short supply, I asked the girls to bring in from home as many everyday household throwouts as possible. Consequently we have managed to build up a large stock of items from egg boxes to squeezy bottles! Many of these products have provided a useful basis for projects to be built around as can be seen by the examples illustrated in this article. As a result of this, it has been possible to run the course on a relatively low budget. Shampoo bottles have been used to make anything from an air powered boat to a hydraulic plant watering device. Egg boxes and paper cups are used for work in structures whilst empty squeezy bottles demonstrate the principle of pneumatics.

Girls tend to be more imaginative than boys and although they will become just as profficient in the handling of tools and materials, they appear to have the ability to combine both conventional and unconventional items in order to solve problems both efficiently and economically.

Figure 4: Mechanical money box incorporating bell crank lever.

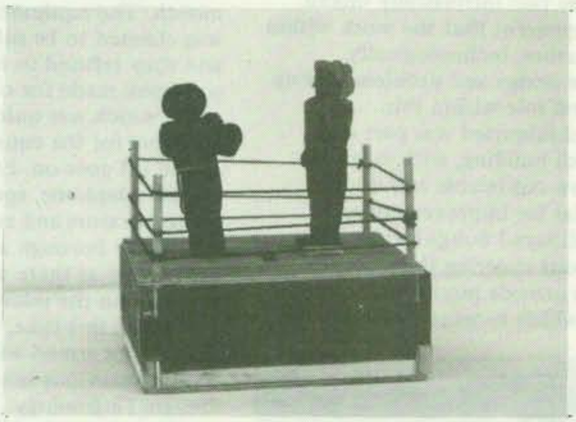
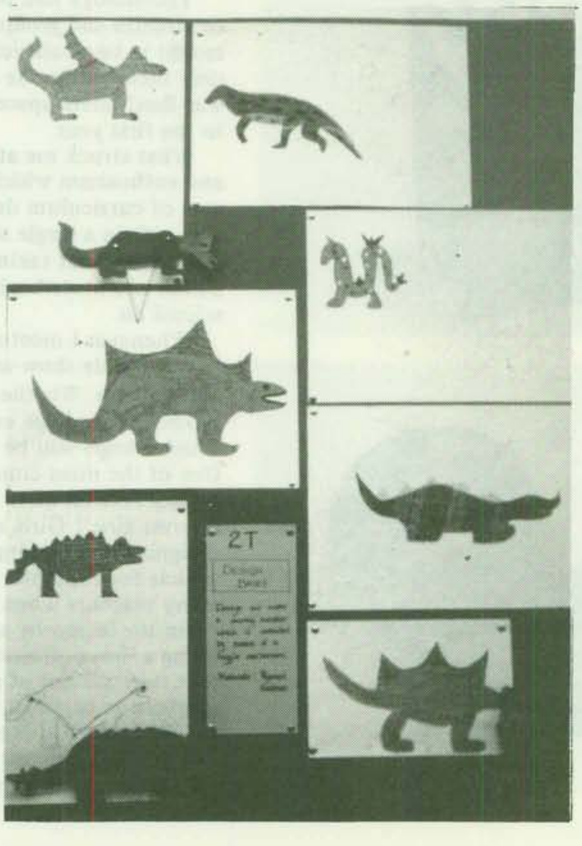


Figure 5: Design work and final solutions to 'Moving Monsters'!



Each section of the course examines applications of the subject area, relating to the world around us. If pupils are to develop technological awareness, it is vital that they are able to link together the 'fun' aspects of the course work to the real needs of society. The overlap between technology and other areas of the curriculum is very apparent during discussion work in this context. Pupils will often refer to information that they may have come across in perhaps history, for example and find that they can relate the development of certain areas of technology to work that they have covered in another area. Whereas the majority of boys tend to be impatient to become involved with the doing and making stages of problem solving activities, girls appear more willing to examine the background of a particular area in order that they may develop their understanding of it.

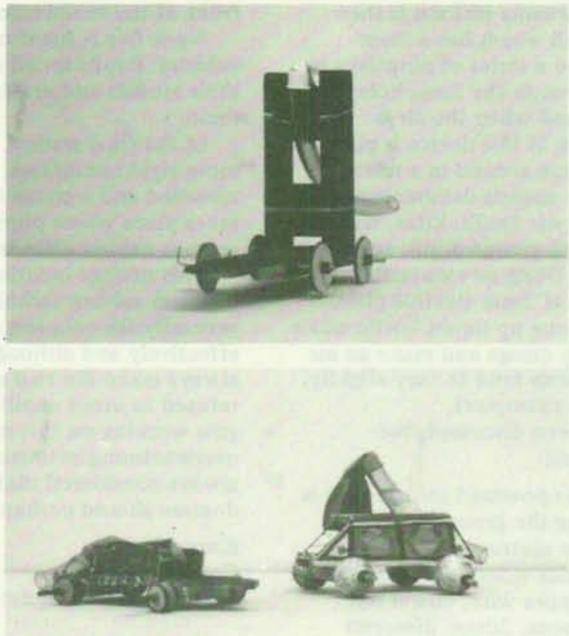


Figure 6 & 7: Final solutions to the air powered vehicles.

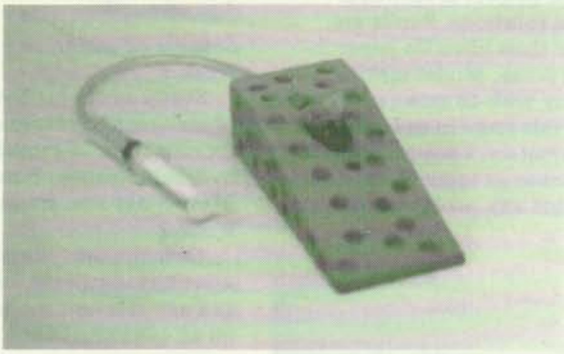


Figure 8: Hydraulically operated mouse in cheese!

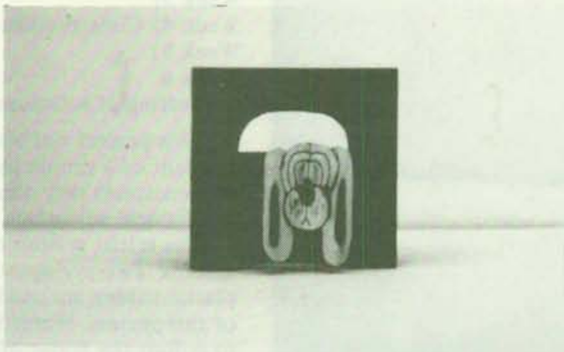


Figure 9: Hydraulically operated dog in kennel.

Anybody who finds themselves in the position of initiating a new department where capitation is in short supply, may find it useful to look at a more detailed account of the type of project work that pupils undertake. Much of this work can be easily adopted for use in primary schools or in schools where no specialist facilities exist as is perhaps the case in many all girls schools.

I have devised a series of worksheets for each area within the course. these worksheets form the core of each specialist area but are not used in text book fashion by pupils. Their aim is to provide a nucleus around which an initial session of discussion and ideas can be based. Design briefs are left fairly open ended and pupils are encouraged to investigate possible solutions to whatever problems may arise. One word of warning – if this type of work has not been attempted before, it should be tightly structured. I sometimes hear of people advocating failure as a part of the learning process; this may be perfectly valid in some circumstances but it is worth considering that pupils may be particularly vulnerable at this age and failure to produce a finished product can destroy both confidence and motivation for future work.

Example 1.

Course Module:	Energy and Power
Specific Area of Study:	Air as a source of power
Project Work:	Air powered vehicles
Time Factor:	Six weeks
Age of Pupils:	Twelve years

Scheme of Work

Week 1

Discussion of air as a source of power. Methods of control and utilising energy. Demonstration of various models which use air in order to perform a function. Problem solving activity working in small groups. Further discussion and evaluation of solutions to set problem. Design brief stated.

Week 2

Design work. Initial ideas stated. Possible solutions drawn up. Investigation into certain areas. Model making where necessary. Discussion of ideas on an individual basis.

Week 3) Construction of solution to problem.

Week 4) Testing. Brief group evaluation.

Week 5

Modification of solutions.

Week 6

Testing of solutions. Group evaluation and discussion of results.

This project has proved to be both motivating to pupils and successful in terms of results. As stated in the scheme of work, the initial session begins with a discussion of air as a source of power. The idea of control is introduced by inflating a balloon and letting it go. The sudden release of air causes the balloon to fly across the room in a very uncontrolled fashion! The same balloon is then pulled over a pingpong ball which has a 5mm hole drilled in one end and a series of pinpricks in the other. By blowing through the 5mm hole, the balloon may be inflated and when the air is released, it slowly deflates. If this device is placed in a bowl of water, it will chug around in a relatively controlled manner. Other models demonstrated to pupils are the hovercraft, windmills, kites, sailing boats etc. Working in small groups pupils are now given a problem to solve. Using an empty flat shampoo bottle, a length of 5mm flexible plastic tubing, a cap from a washing up liquid bottle and a balloon, they are asked to design and make an air powered boat. The solutions tend to vary slightly. Figures 6 and 7 illustrate examples).

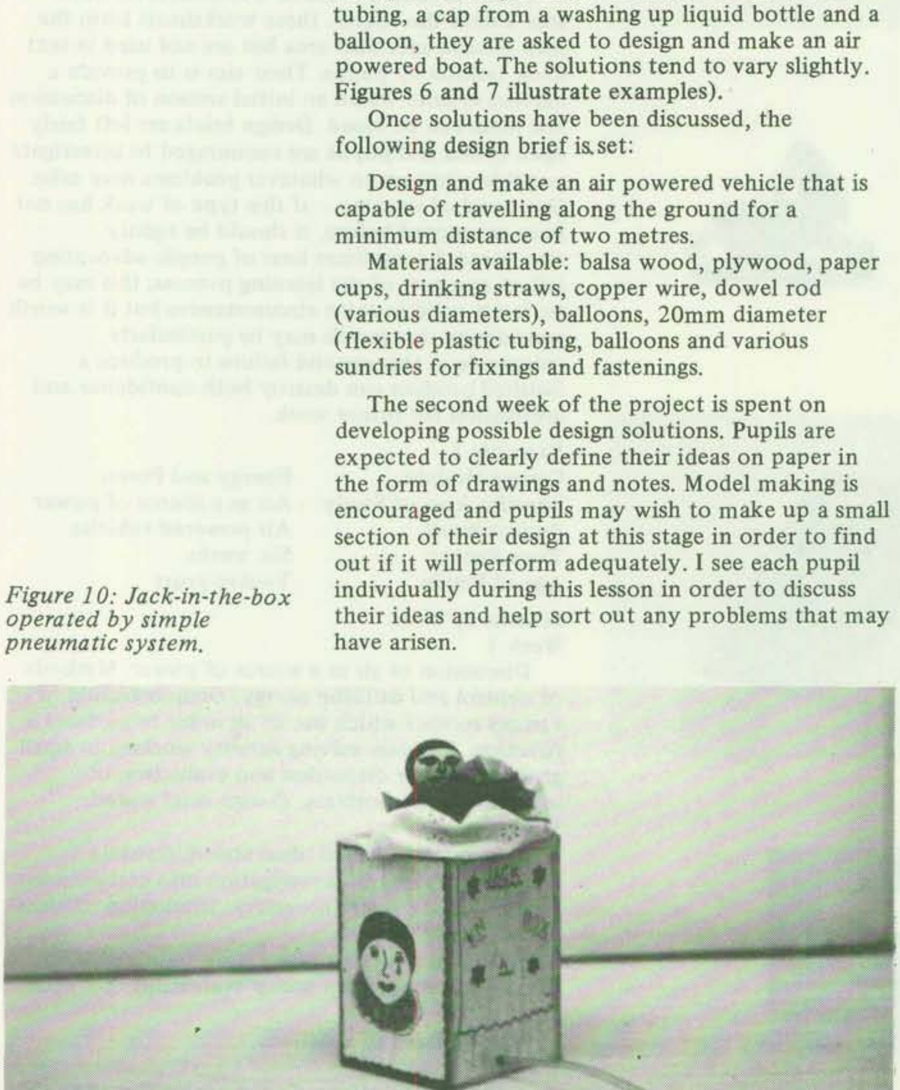
Once solutions have been discussed, the following design brief is set:

Design and make an air powered vehicle that is capable of travelling along the ground for a minimum distance of two metres.

Materials available: balsa wood, plywood, paper cups, drinking straws, copper wire, dowel rod (various diameters), balloons, 20mm diameter (flexible plastic tubing, balloons and various sundries for fixings and fastenings.

The second week of the project is spent on developing possible design solutions. Pupils are expected to clearly define their ideas on paper in the form of drawings and notes. Model making is encouraged and pupils may wish to make up a small section of their design at this stage in order to find out if it will perform adequately. I see each pupil individually during this lesson in order to discuss their ideas and help sort out any problems that may have arisen.

Figure 10: Jack-in-the-box operated by simple pneumatic system.



Both week three and week four are spent in the construction of the final solution. Towards the end of the fourth session all pupils are taken to the hall in order to test their vehicles. This testing brings to light problems that may have been previously over looked such as the need for friction on the wheels to prevent skidding or insufficient weight at the front of the vehicle, resulting in it taking off!

Week five is spent modifying and finishing the vehicles. Pupils spend much of this time testing their models and making various adjustments to them.

In the final session, the cars are tested under more rigid conditions. The performance of each is recorded and a group discussion and evaluation takes place where pupils are encouraged to suggest reasons behind differing levels of success.

This project incorporates a wide variety of problem solving techniques for the pupil. It is generally the simplest designs that work the most effectively and although some vehicles do not always make the two metre mark, none have as yet refused to move at all! The response from the girls working on this project has been one of overwhelming enthusiasm and anyone who has always considered that model cars are a boys domain should perhaps think again!

Example 2

Course module	Hydraulics
Specific area of study:	Simply hydraulic system as a control mechanism
Project work:	Child's toy incorporating movement
Time factor:	Six weeks
Age of pupils:	13 years.

Scheme of work:

Week 1

Study of simple hydraulic system. Demonstration of mechanical advantage by differing cylinder sizes. Examination of models that incorporate simple hydraulic system. Examples of hydraulic systems in everyday use. Design brief stated.

Week 2

Design work. Initial ideas stated. Possible solutions drawn up. Investigation into specific areas and any relevant model making. Discussion of ideas on an individual basis.

Week 3)
Week 4) Construction of solution to problem.
Week 5)
Week 6

Testing of solutions and group evaluation.

This project not only introduces pupils to the concept of a simple hydraulic system but demonstrates very clearly what is meant by mechanical advantage.

The initial session examines a simple hydraulic system. Two syringes linked by a length of flexible plastic tubing are used to demonstrate the principle of this system. Water is used as the fluid (it is useful to colour the water in some way – undiluted orange

squash is ideal – in order that pupils can see what is happening). The group carry out experiments that demonstrate hydraulic control, mechanical advantage and possible deficiencies in the system such as air. Pupils are often surprised to find that it is the smaller 'Master' syringe that reduces the amount of effort required in order to lift a load.

'Real life' examples of hydraulic control are discussed such as braking systems, lifting devices etc., and various models that use a simple hydraulic system in order to achieve a controlled movement from a distance are examined. The following design brief may then be set:

Design and make an amusing child's toy which allows a hydraulically controlled movement to take place when operated from a distance.

Materials available: two syringes (5mm and 2mm) a length of flexible plastic tubing, plywood, softwood offcuts, dowel rod, any household throwouts and various sundries for fixings and fastenings.

The second week of the project is taken up with designing possible solutions. It is important that pupils have the syringe unit in front of them whilst they are working, as one problem to be solved is how to house the system successfully. Pupils may use the hydraulic mechanism to activate a secondary mechanism in order to create movement and when this is the case, a model becomes invaluable. Individual discussion of ideas is particularly important here as pupils often have to modify ideas due to either forseen constructional difficulties or over ambitious projects within the available time.

Figure 11: Ghost with an inflatable eye!

Three sessions are spent in the construction and finishing of these models. If the design brief is left as open ended as this one, these lessons can prove both demanding and exhausting as pupils come to discuss problems that may arise or run into technical difficulties.

The final session is spent on a group evaluation and discussion of the project. Pupils are asked to talk about their designs for a few minutes and to inform the group on the types of problems encountered and methods adopted for solving them. The group are encouraged to give constructive criticism of one another's work and to pick out good or bad points about it.

Conclusion

I have attempted in this paper to bring to light some of the problems that all girls schools may be faced with in the setting up of a design/technology department – particularly where little or no funding is available. It would be impossible to detail every project in the confines of this article but I would hope that the two projects that are mentioned will give some insight to the type of work that it is possible to achieve with a minimum of specialised equipment, tools and materials.

Girls enjoy the process of designing and making every bit as much as boys do and when not patronised or made to feel inferior, they work with the same open enthusiasm.

It may be interesting to note that this course started in September 1983. Option choices are now being made by third year pupils and although final figures are not yet available, indications are that a high number of girls have chosen to take technology at examination level. If this is the case then I believe that the introduction of such a course to be a valuable asset to any school.

As I said at the beginning of this article, it is not intended to preach solutions and there are many aspects of the course that may be improved upon. If however, the balance between boys and girls taking design/technology subjects at examination level is to be corrected, then a practical start must be made somewhere.