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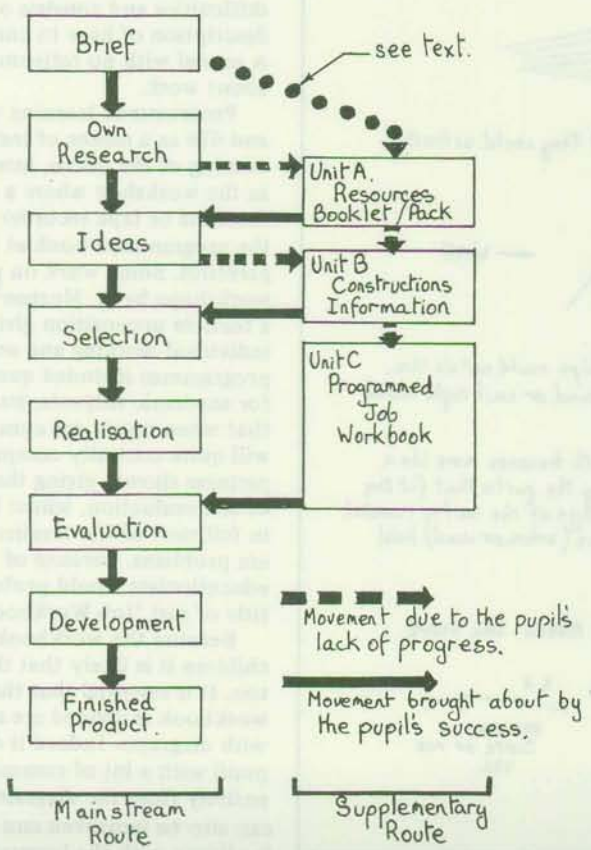
# Mixed Ability Approach to Technology Projects

Members of CDT departments now readily recognise the important role that the problem-solving approach plays in the education of our children. The pages of Studies in Design Education Craft & Technology bear witness to the involvement of staff and pupils in this type of work, ranging from the aesthetic to the technological. Although much has been said and written about the design process and what can be achieved by its implementation, I feel there have been few attempts to outline teaching approaches and instructional procedures by which all pupils can reach a successful conclusion to their projects. 'The most carefully thought out syllabus is worthless if it cannot be put into practice'.[1] It is the purpose of this article to outline a method of teaching technology projects which concentrates on how pupils can reach a satisfactory conclusion rather than what to make.

It is concerned with the type of lower school technology project such as designing and making elastic powered vehicles, model cars, boat, etc., and specifically the type of project that ends with a race or competition. This type of exercise creates a number of problems:– How can the teacher ensure that all the pupils get their projects to the starting line at the right time? How can all pupils successfully produce something that can compete? How do we as teachers ensure that all pupils have been able to attempt all sections of the Design Process? How can we arrange that it is not just the top half of the class that benefits? and wins all the prizes as well! How terrible these effects must be on the slower and less-able pupils, frustrated perhaps by their inability to keep up or even succeed so that they often make up their minds and the teacher's that they can't and don't like Design. Furthermore the ultimate satisfaction, that of finishing a project, is denied them along with any evaluation and development processes which in my opinion are an essential part of the design process, as well as being more exciting and motivational particularly with this type of working model. The task becomes more problematical if one takes into consideration that your class consists of 15-20 mixed ability pupils with slightly disruptive tendencies.




B.K. Down[2] points out that traditional teachers often feel vunerable in the problem solving situation because it is impossible to always be able to answer pupil's questions. However I believe that a greater worry arises from their possible inability to control a workshop in which all the children are working on individual projects and need constant help.

'These organisational problems stem from the need to guide considerable numbers of children working with sharp tool, equipment and machinery. This problem is compounded by the implications of the general convictions that it is desirable that skills should normally be learnt as they become necessary and also by the freedom of action we believe it is right to encourage. Clearly, teachers will need to devise situations which offer a good educational experience but which they nevertheless feel they can control'.[3]

For some time I have held the belief that the demonstration-discussion – individual instruction pedagogy, although admirable in many respects, especially when combined with resource based learning, does not always constitute the best approach to the problem, and my experience of Programmed practical work led me to believe that in this direction a solution could be found. My solution therefore relies in part on the use of programmed learning to supplement the teaching for the slower pupils.

We are fortunate in the CDT area that most lower school aims and goals are fairly generalised leaving the interpretation of themes and lesson management largely to the teacher. My scheme relies on the formation of supplementary teaching material designed to help the strugglers. Diagram 1 shows the layout of the scheme. On the lefthand side is the 'mainstream' route which is taken by pupils capable, creative, industrious and enthusiastic. On the righthand side are the supplementary units for the less able.

'The learning materials should provide alternative routes that are adaptive.

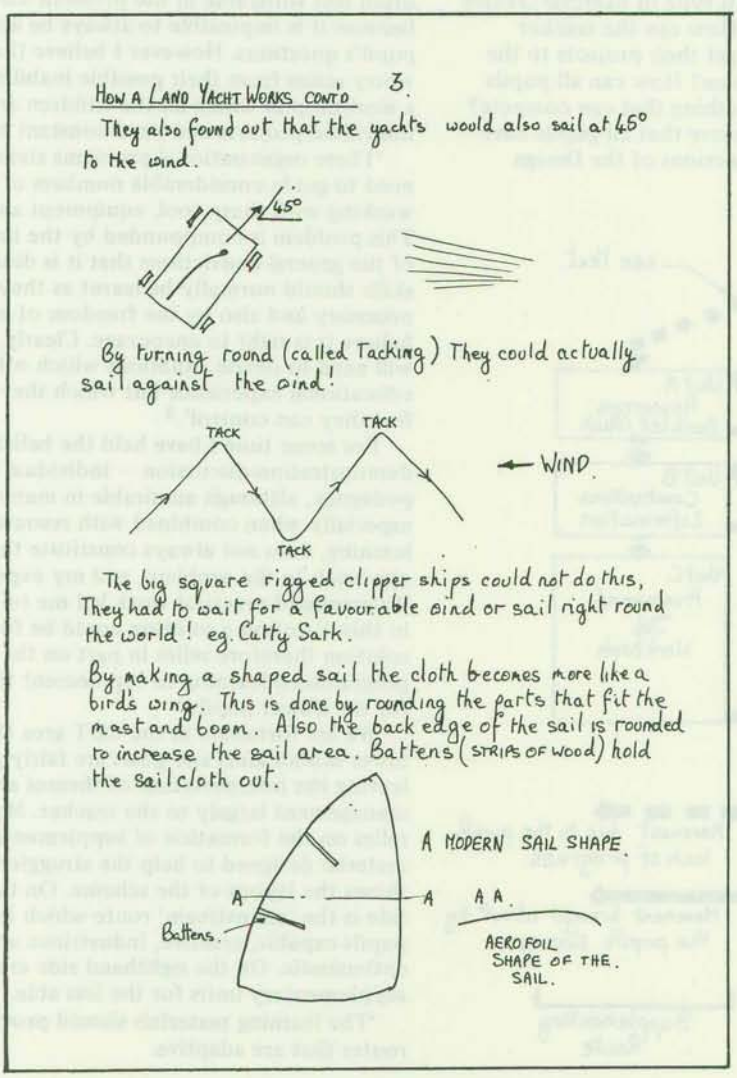
The educational route through a learning sequence can be matched to the characteristics of the learner'.[4]

The idea is that pupils follow the mainstream but when they meet problems and frustration they can move to the supplementary units, gain extra self instruction and thereby catch up with the rest. If the problems continue then the pupil can use all the units in the righthand column. Obviously it is essential that teacher and pupil agree before movement from one column to the other takes place.

**Description of the Supplementary units**

I would like to point out that these are not alternative to the provision of normal design resources, indeed all the pupils still require all the visual stimulus of posters, photos, models etc. The following are additional and for the benefit of the lower half of the class.

*Below: Page from the Resources Information Booklet for Land Yachts.*




*A Resources Booklet*

This is a booklet or pack of information concerning the scientific, aesthetic, historical, aspects of the project. For instance the one concerned with a boats project will contain details explaining bouyancy, wave formation, etc., one concerned with elastic band powered vehicles may give details of how an elastic band gives up its power. The booklet may also give hints on how to design the best model. e.g., Make the chassis as light as possible because . . .

*B Construction Information*

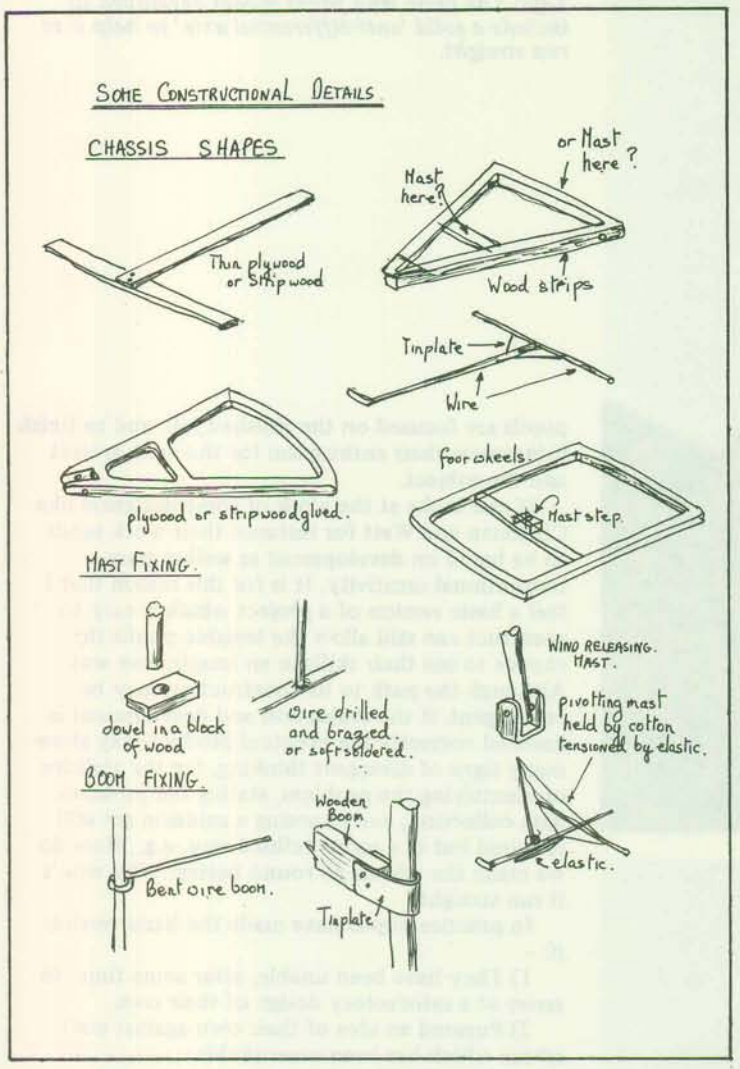
Most lower school projects have a limited number of ways in which the components are made and fixed together. The information in this unit consists of many diagrams showing many features of the project but not a completed one. For instance one concerned with land yachts may give many details of types of chassis, mast fixings, attachment of wheels, sail shapes, etc. The pupil will then be confronted with a multitude of differing options to criticise and select. So in its simplest form a pupil could say 'I will use type A chassis, type B mast fixing, etc. etc., but he still has to decide sizes and whether type A chassis is compatible with type B mast fixing.

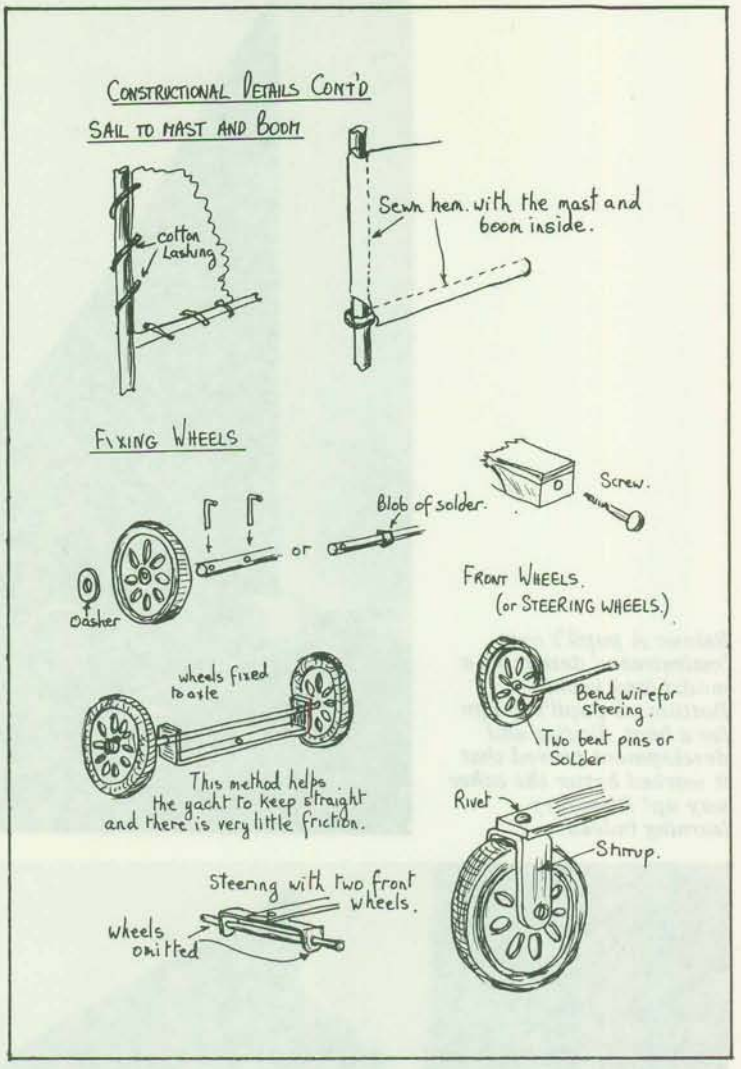
*C Programmed Job Workbook*

This is for the pupils that are having the greatest difficulties and consists of a detailed stage-by-stage description of how to construct a very basic model. A model with no refinements but one that will just about work.

Programmed learning was popular in the 50s and 60s as a means of instruction but with the coming of the micro, interest has waned. However in the workshop where a computer, video, teaching machine or tape recorder are in imminent danger the programmed booklet is cheap and can be very plentiful. Some work on programmed learning in workshops by A. Morton[5] proved that it could be a feasible proposition giving the advantages of individual working and self pacing. My own early programmes included questions like those written for academic subjects, but experience has shown that when pupils are constructing something they will quite critically compare their work with the pictures shown, giving themselves some measure of self evaluation, whilst because the work is usually in full view of the teacher he can see quickly if there are problems. Because of the lack of questions some educationists would probably be happier with the title of just 'Job Workbook'!

Because the workbook is for the very poor children it is likely that they will be poor readers too. It is essential that the stages into which the workbook is divided are small and well illustrated with diagrams. Indeed it should be possible for a pupil with a bit of common sense to work almost entirely from the diagrams. A pupil's reading ability can also be improved and there is considerable scope for liason with the language specialists in the school.




*Above: Pages from the Constructions Information Booklet for land yachts.*

I have also noticed that the disadvantage normally attributed to academic programmes with a large number of stages is less important in practical programmes, possibly due to the extra enthusiasm the pupil gains from seeing the project go together.

Depending on the level of the pupils for which the workbook is intended, the last page can include ideas on how the basic model can be improved and therefore be competitive with the products of the mainstream pupils.

**Practical Implications**

It can be seen from diagram 1 how the units are arranged and how the movement takes place between them. The overriding principle is that the teacher must make sure that a capable pupil follows the mainstream and does not take the easy way out. The only exceptions to this in practice have been pupils who have missed part of the work due to absence. For instance if the pupil misses a number of lessons at the start of the project he may be directed onto the resources booklet and then perhaps the construction information in order to catch up.

The decision to allow some pupils to have extra and easier information is controversial and tied up in mixed ability teaching methods. A teacher must ensure that all pupils have the opportunity to do the work without extra help and that the pupils that do work unaided command greater esteem. If this can be achieved then hopefully the majority of pupils will relish the freedom of choice. At the same time there is an opportunity for capable pupils to develop proper attitudes to those not as able as themselves. The movement of a pupil onto a supplementary unit has in practice come about because the pupil is not making progress and needs substantial help. Pupils have been willing to use the supplementary units just to get things moving again knowing that in the eyes of their peers they are taking an easy way out.

Often I have felt it necessary to move from the discussion of the brief straight to the resources booklet. There are 3 reasons for doing this:–

1) When there is no suitable information at all in the resources area. e.g., There are few simple books that explain the balancing of a land yacht. To proceed without a mention of this would be to loose some of the scientific significance of the project.

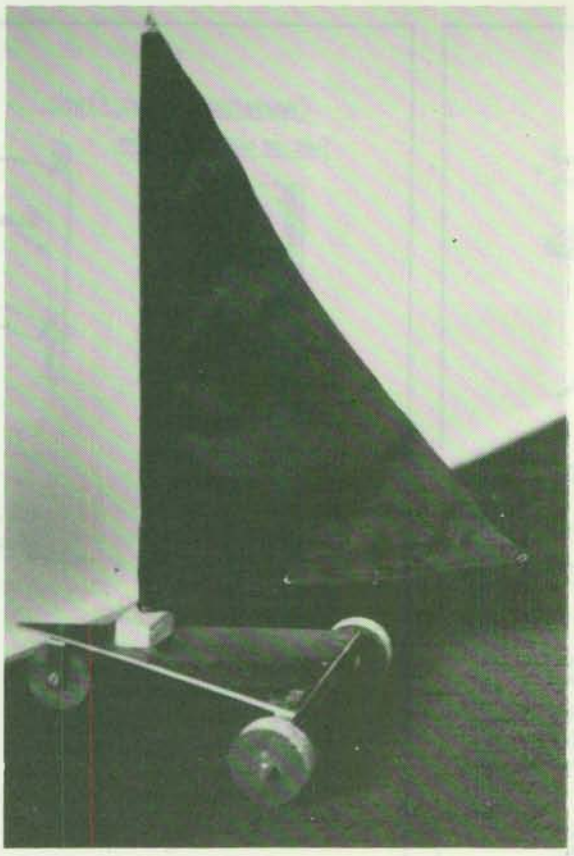
2) When there are not enough resource materials for all the class to use at the same time.

3) When the pupils are new to the design process and it needs illustration.

Even so the use of the resources booklet at an early stage does not rule out the child doing further research of his own.

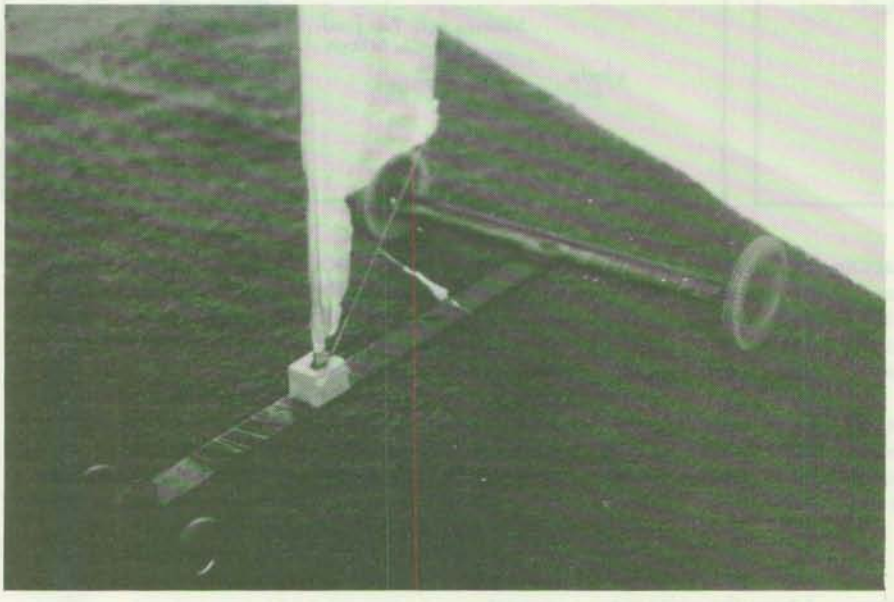
After the resources booklet the teacher should try to get the pupils to develop their own ideas, however for those in the class who are not succeeding the use of the constructions information gives a very simple system for designing. I contend that the discrimination, for logical reasons, of certain constructional details from a variety of them, is a fundamental intellectual activity of designing and therefore worthwhile in an effort to encourage pupils to design on their own.

The use of a programmed job in an open ended, problem solving activity rests on the argument that the most important sections of the design process may be those at the end of the design process:– Evaluation – Development – the finished job. Certainly the immediate thoughts of most less able



*Left: The basic land yacht model developed to include a solid 'anti-differential axle' to help it to run straight.*

*Below: A pupil's own 'mainstream' design for a model land yacht. Bottom: A pupil's design for a boat. Testing and development proved that it worked better the other way up! Discovery learning indeed!*



pupils are focused on the finished job, and to finish it increases their enthusiasm for the next project and the subject.

If one looks at the work of some designers like Chapman and Watt for instance their work tends to be based on development as well as pure inspirational creativity. It is for this reason that I feel a basic version of a project which is easy to construct can still allow the lessable pupils the chance to use their skills in an imaginative way. Although the path to its construction may be convergent, if the evaluation and development is handled correctly the eventual product may show many signs of divergent thinking, for the abilities of identifying the problem, stating the problem, data collection, and choosing a solution are still required but in a more defined way. e.g., How do we make the wheels go round better? Why won't it run straight?

In practice pupils have made the basic version if:–

1) They have been unable, after some time, to arrive at a satisfactory design of their own.

2) Pursued an idea of their own against staff advice which has been unworkable.

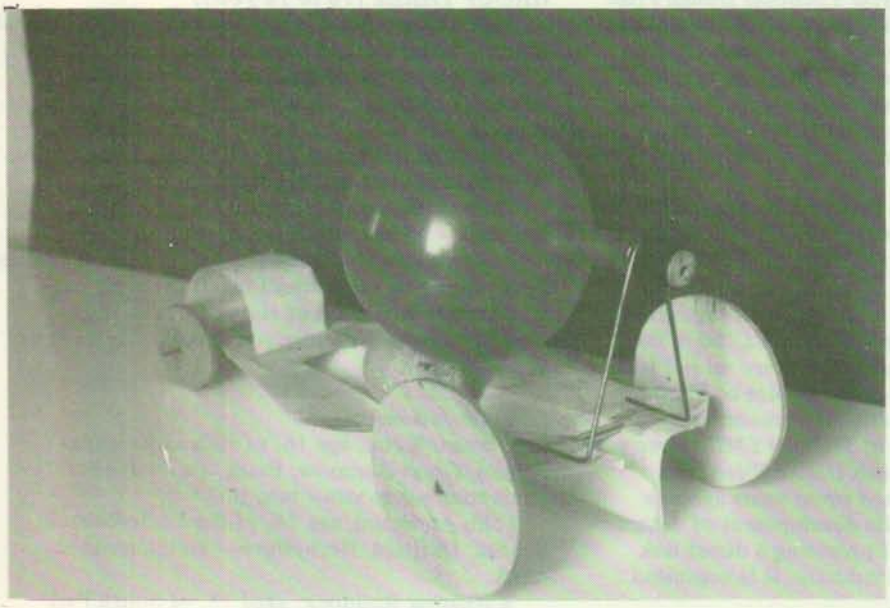
3) Been absent.

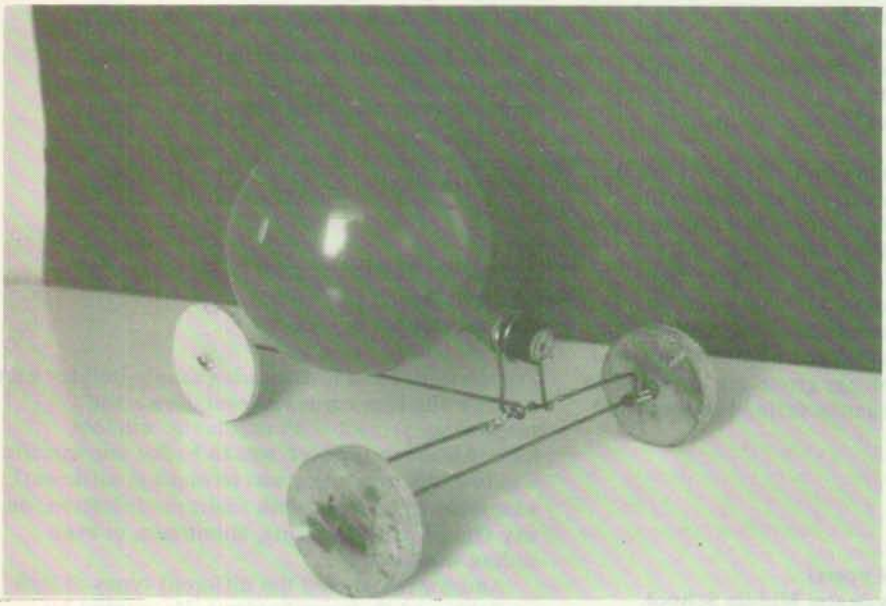
On a few occasions I have taught classes which did not require the programmed job. Annoying if you have spent the time preparing the workbook but enjoyable because all the pupils are following the prefered route, and anyway the material may be useful next time.

The major disadvantage of an approach such as this is the amount of preparation time needed to draw, assemble and refine the supplementary units. However this is offset by the number of times they are used and if teachers work together a considerable number of different projects can be amassed. Certainly my experience leads me to believe that it is well worth the effort in terms of its advantages.

By the adoption of this approach it is possible for the teacher to guide pupils more effectively. This is because he has more time during the lesson to help all pupils, the less able pupils know or can find out what to do and should be gainfully employed. Consequently the teacher can spend more time with any pupil discussing any design in more detail.

Because of the better planning, pupils of a wider ability range can be taught without increasing the number of restrictions or criteria, for instance:– the size of wood or other materials, in the interests of class management. Any restriction inevitably reduces the open-endedness, being detrimental to the more able pupils. Materials for the less able pupils who elect to make the basic version can be precut and likewise wheels and other specialist items can be collected needing a minimum of time during the lesson. For the same reason more ambitious projects can be attempted knowing that the whole class will not be restricted to the abilities of the slowest.





*Top: The basic model for a balloon car.*
*Above: A 'mainstream' design for a balloon car.*

More importantly I feel convinced that a higher number of pupils arrive at a satisfactory conclusion to their project, not only in terms of a completed model that works and is better made but also because they have been given a chance to experience the whole design process. Usually the class as a whole are noticeably more confident, enthusiastic and develop more purposeful attitudes, leading in turn to a calmer atmosphere within the workshop.

In writing this article it has not been my intention to outline the perfect way to present a design project. My purpose has been to outline a strategy which has been successful for me in my school which may be in whole or in part adaptable to the reader's situation, an approach which can add a new dimension to the many existing ways of introducing Design. Any standardization of ways of teaching would be fatal in terms of the vitality and spontaneity so necessary for CDT.

I hope this article will promote discussion in the area of 'Instruction Procedures'.[6] The contact between the teacher and all his pupils is vital to CDT teaching particularly with the introduction of high technology courses and ways in which improvements can be made can only be beneficial to pupils and teachers alike.

'Thus individual learning programmes enable teachers to free themselves of the constraints of group teaching methods and thus exploit fully the rich potential of individual differences'.[7]

**References**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