# Developing students' understanding of factors that promote effective learning in Technology: drawing parallels with the classroom

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*Sometimes there are advantages to be had for students and tutors alike, if students' learning is treated in the same way as younger pupils.*

There are key factors concerned with the promotion of effective learning which teachers and tutors alike need to take into consideration when planning and managing technological activities for children or for students. Although the work described below was carried out with student teachers, the issues discussed are just as relevant for teachers working with six-year-olds as for tutors working with 26-year-olds.

## The practical task

The students involved were Primary Technology specialists in the second year of their four-year Primary BEd. (honours) course at Sheffield Hallam University. They were given a practical technological task designed to increase their competence and their understanding of Technology, and to provide them with practical learning experiences from which to draw parallels with children's experiences in the classroom. The task the students were given was to design and make automata using wood and plastics. Automata are mechanical sculptures — mechanisms for entertainment. They are meant to be interesting and fun, off-setting the dry, serious images that the word 'mechanisms' can conjure up. The purpose of the product was to provide a classroom resource which would promote interest, excitement and enthusiasm among children as well as to educate them about simple mechanisms. It was never the intention that after making the automata the students would then expect children to make similar products. The automata could be used simply to show children how mechanisms can produce movement or they could be used as starting points for children to make much simpler mechanisms of their own[1].

## Expectations

Many of the students had limited previous knowledge and experience of mechanisms and structures and consequently had low expectations of what they were capable of achieving. High expectations had to be imposed upon them. However, if the students were to respond positively, and not be overfaced or demoralised by such demands, they had to be given support to live up to them. A number of factors were identified as contributing to and promoting effective learning as well as providing the help the students needed in order to achieve those higher goals.

These were:

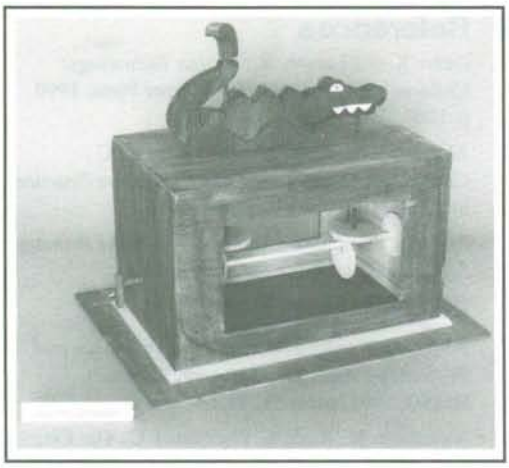
- an effective and supportive classroom climate
- enskilling and empowering the students
- the provision of sufficient access to information
- differentiation in order to meet different needs and capabilities.

## The classroom climate

A supportive climate[2] was established to reduce the students' fear of failure, to encourage them to take risks and to help them face up to and overcome problems[3]. Difficulties that arose were celebrated as opportunities for learning to take place. Equally important was the generation of interest and enthusiasm. A tutor or teacher who appears interested in and enthusiastic about the subject is more likely to develop these qualities in his or her students or pupils. Trust and collaboration[4] were promoted through the sharing of ideas, help, skills and sympathy. Although each student had to design and make his or her own automaton, the group members were encouraged to help, advise and support one another. The eventual outcomes were very much a product of that group interaction. At the same time, individual progress was noticed and appreciated. The task given to the students was very demanding and the stress levels, at times, were very high. It was the job of the tutor to maintain a calm and secure atmosphere by giving support and by dispelling tensions quickly. The attitude of the teacher or tutor is fundamental to the establishment of an effective classroom climate whether it is concerned with developing enthusiasm or establishing how individuals should behave towards one another.

## Enskilling and empowering students/pupils

Whilst a positive climate creates good conditions for learning to take place, it is equally important that teachers feel confident in, and are capable of, helping children to realise their ideas. The students were given help to develop their own capabilities and to grow in confidence so that they might provide such support for their pupils in the future. They also needed to know how to provide that help for children. They experienced a variety of teaching techniques which they in turn could

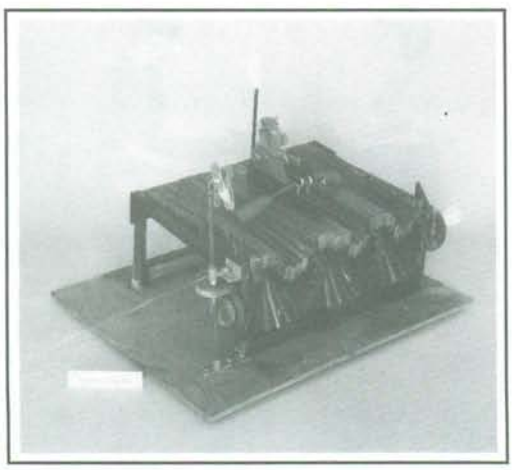


use in the classroom. These ranged from whole-class teaching of skills and knowledge to individual teaching at the point of need[5]. The students were taught how to use tools, about the properties of materials, about different types of mechanisms, how to plan and manage the time for the project and were given ideas for products that might be made. It was important to establish with the students that the role of the teacher is not simply a provider of tools, materials and experiences, but that a teacher also has to teach children something[6], otherwise learning may happen but it will not necessarily be the learning that is wanted.

## Access to information

The students were provided with access to a range of information in various forms. Access to information is a contributory factor in children's ability to succeed in technology[7]. Some of the ways in which this was done for the students were as follows:

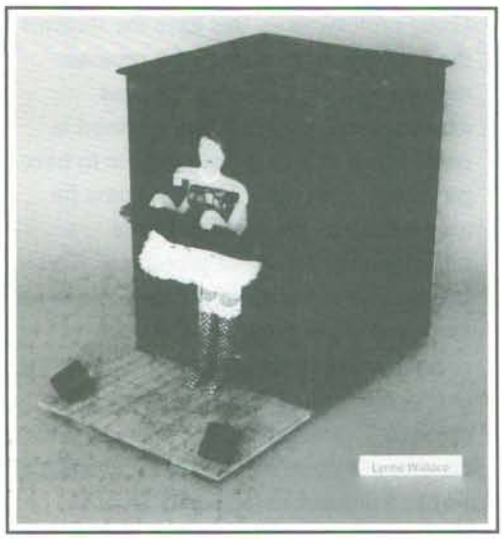
- Investigating, disassembling and evaluating the products of others[8] — as a starting point for the project all the students visited the Museum of Automata in York; some also visited the Cabaret Mechanical in Covent Garden, London
- Using video film[9] — two films were used which showed the work of automata makers and the construction of various mechanisms and structures
- Looking at work produced by other students — this addressed the issue of developing quality over the longer term, ensuring that this year's group or class produced work at or above the standards of the previous group or class[10]. The students were shown good quality work from the previous year. This helped to establish benchmarks of quality in the students' minds and raised the group's expectations of what it might achieve. It had a significant impact upon the quality of the group's products.



- Using prototypes — this gave the students the opportunity to acquire information through practical investigation and experimentation. It had been realised in past years that, due to the pressure to have projects completed within a set time for assessment, the students had been reluctant to make use of prototypes. This had led to a lowering of quality as students struggled to resolve quite difficult designing and making problems while engaged in the making of the final product. This can often be observed in the classroom, where children want to make a finished product immediately and then come up against frustrations and problems which militate against the eventual quality of the outcome. The promotion of the use of prototypes was therefore a major feature of the unit. It was hoped the students would come to appreciate the value of working in this way, for both themselves and for children. That taking time initially, and using easily worked materials to develop the mechanisms and to overcome design problems, not only gets the work done in the available time but also results in better quality outcomes. One student spent most of the time for the project working in prototype, even when those around her were well into making their final products. It took great strength of character on her part to resist this pressure and an act of faith on the tutor's part to allow her to proceed at her own pace. When she eventually came to make her final product it came together extremely quickly and it was one of the most sophisticated, well produced and interesting of all the automata. Those students who worked in this way were able to resolve many of the problems at the beginning of the task. The compromises were made at an early stage and became an integral part of the final design, rather than an *ad hoc* response to a crisis towards the end of the task.

## Differentiation

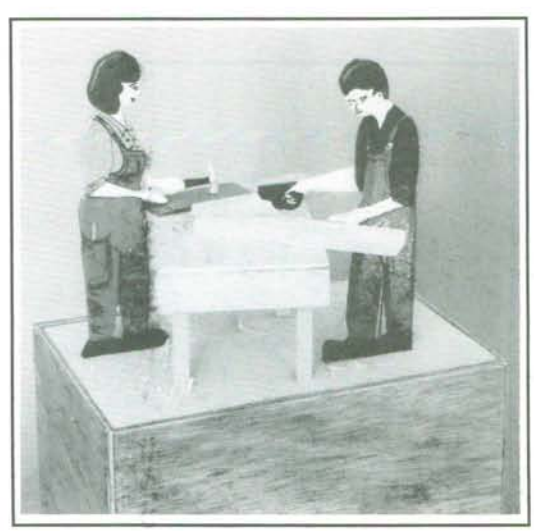
The teaching had to be differentiated to cater for the different needs and capabilities of both small groups and individuals. Those who were under-achieving were challenged further and encouraged to set their sights higher. Those finding the work difficult or who had been too ambitious were helped to set more realistic and



achievable targets. The examination of a range of mechanisms allowed for a range of possible outcomes to be considered, from the very simple to the highly complex. The use of prototypes played a useful role here as all students began by imitating the work of others as a way of developing their own under- standing. For some the eventual product was a simple adaptation of someone else's idea, others were more adventurous and combined different ideas, and a few developed automata which were quite innovative in terms of both structures and mechanisms. What did emerge was that although the outcomes ranged from the simple to the complex, the quality of all the products was very high. It was important to establish that quality should be present no matter how simple or sophisticated the product may be.

## The results

The task proved to be challenging and the students experienced many difficulties and problems — at times it was evident that some thought that they would never produce a working automaton. However, their willingness to learn and their determination to overcome the difficulties resulted in success for everyone. The quality of all the products was very high. Many of the students achieved success way beyond their initial expectations, achieving what they thought to be impossible at the start of the unit. Some are still finding it difficult to believe that they have actually made their automata. All of them display a sense of pride in their achievements. It is hoped that, through both the experiences and the teaching the students have had, they are now in a better position to increase the level of children's understanding and knowledge in mechanisms and structures, and to develop the ability of children to produce quality products. Photographs and a video of the group's products will be used with next year's students to raise the quality of outcomes once again.



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