The development of a technology short course in South Africa

RESEARCH

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PROTEC

This research will help you think about:

- the development of a new technology curriculum *from scratch*
- the strategies that might be used to overcome shortage of resources
- the problem of transplanting one nation's view of technology onto another.

Introduction

In January 1994 a non-government organisation (NGO) in South Africa began to develop a technology course for secondary school pupils in South Africa. The course was originally intended as an enrichment course for pupils on an extra-curricular Saturday school programme. It was to be delivered to pupils in senior secondary school as a first introduction to technology.

It soon became apparent that there was significant interest in implementing the course in schools. There was also a willingness by industry and by the ministers of education in the new South Africa to support a move into schools.

This article will discuss the development of the course framework and highlight some of the aspects affecting technology in South African schools.

Reconstruction and development

The development of this course started in very exciting times in South Africa. Nelson Mandela was out of prison and waiting to be elected as the president of the country's first democratic government. The country was very uncertain yet surprisingly optimistic. Mandela was elected on 27 April 1994 and the new ANC-led government started to try to transform the promises made to an elated nation into reality.

The cornerstone of South Africa's transformation policy is the Reconstruction and Development Programme (RDP). Housing, health, security, education, land and water have been identified as sectors that need special funding. The ultimate aim is to improve the quality of life of previously disadvantaged communities, allowing the country to prosper as a non-racialist democracy.

One of the most refreshing aspects of the new South Africa has been the way the RDP has been welcomed, particularly by industry. This provided an ideal atmosphere to introduce the new approaches and methodologies associated with technology education. It was easy to associate development with the RDP and the transformation of education in the country.

PROTEC – Programme for Technological Careers

PROTEC is an NGO that has been operating in South Africa for many years. It was founded as an extra-curricular programme for pupils from the disadvantaged communities, offering lessons on Saturday mornings and vacation school activities in the school holidays. The programme's general aims are:

- to improve pupils' academic results in maths, science and English to enable them to cope with technology courses at tertiary level
- to improve pupils' awareness of careers and career paths to encourage them take up careers in technology.

PROTEC was in an ideal position to become part of the transformation of school based education because its aims linked those of the education system with the needs of industry.

The development of a technology course for school pupils was seen as a vital addition to the PROTEC programme. It was important for technology to become a subject on its own since it was seen as the only subject that could realise all of PROTEC's aims in the school curriculum. It was also broadly accepted by industry and government that technologically skilled people were essential to the success of the RDP.

The development brief

Before setting up the development team, PROTEC was attracted to a curriculum developed in Missouri, USA, called 'An Introduction to Industrial Technology' presented by Professor Michael Dyrenfurth during a visit to South Africa. The initial attraction for PROTEC was the link between industry and technology. The brief given to

develop the course was based on this curriculum.

The task was to develop a technology course for the PROTEC Saturday school pupils in Standards 8, 9 and 10. The course was to consist of 30 one-hour lessons for each year group, i.e. 90 lessons in total. It was to be based on the Missouri curriculum and delivered by PROTEC facilitators on Saturday mornings. It was also required to fit in with the aims and objectives of the PROTEC programme as a whole.

This seemed particularly easy. Take 90 lessons from the Missouri curriculum, adapt them, deliver them, 30 per year. The Missouri curriculum, however, involved over 500 hours of teaching time, and very few activities that could be completed in an hour.

The contrast between the US and UK curriculum models also became apparent. The UK model specifies outcomes in the form of process based competencies, under the headings of 'designing' and 'making'. The US model, on the other hand, specifies objectives based on specific technological topics which are organised under the headings 'energy and power technology', 'communication technology' and 'materials and processing technology'.

Both a curriculum model and a set of topics within that model had to be chosen. A coherent framework was therefore needed to make sure that the decisions were relevant to the South African situation and consistent with PROTEC's aims.

A clear aim

The overall aims of the course were easily distilled from those of the PROTEC programme and were combined into one easily remembered and focused sentence which read as follows:

> To encourage and enable more and more of our young people to take up technological careers when they leave school.

In South Africa technology was seen, particularly by disadvantaged communities, as a career for the very clever. More pupils needed to be encouraged to successfully engage with technology to give them some reason to want to stay with it in later life. Technological activities needed to be popularised.

There was also a very poor pass rate among students doing technology courses at universities and colleges in South Africa. The course therefore needed to enable pupils to cope with tertiary career courses, to empower them for their futures.

Defining technology

South Africa had not yet had technology as a subject in its schools. The benefits of adding technology to the curriculum therefore had to be clarified. Even within PROTEC, with its clear technological focus, the added value of the extra subject had to be argued.

At the time the PROTEC programme consisted of four main subjects: maths, science, English and the world of work. In order to introduce technology as a subject in the Saturday school programme, an extra period had to be added to the day. The benefits of doing this had to be made very clear.

A definition of technology was sought that could express the nature of technology and also what pupils might be able to learn through the subject. The definition eventually chosen was the following:

> Technology is about people who use knowledge, skills and resources in order to solve problems which make us more able to do things.

It was worded very simply, keeping in mind both the South African language situation and the technology classroom, and is the same definition used for pupils during the course.

The definition was an attempt to put people at the centre of technology without using impersonal phrases like 'technology is the use of' or 'to achieve human purposes'. It embraced a vision of technology about

empowered people seeking ways of furthering their empowerment.

'Using knowledge, skills and resources to solve problems' also reflected a broad vision of technology as a process, problem driven, practical and purposeful.

Problem solving in a technological context was understood to include the realisation of solutions. The uniqueness of the subject was thought to depend on solutions being concrete (making models, writing working computer programs, etc.).

This definition was believed to be broad enough to embrace most other commonly quoted definitions but it was also usable, unaltered, in a technology classroom.

Technology education

A technology course was envisaged where pupils would be the 'empowered people' engaged with technological activities in order to solve problems. The educational value of such a course then needed to be articulated.

Three core areas of outcome that could be better developed by technology than by any other subject in South Africa were identified:

- problem solving
- investigation and research
- communication.

Problem solving would involve using methods and procedures that had practical technological solutions as outcomes. The technological method (design, make and evaluate), the systems approach, fault finding and repair were all suggested.

Problem solving as an educational outcome was seen as including all aspects of designing and making but it was also viewed in a broader sense. In the South African situation sensible innovators would be needed far more than product designers. A general practical problem solving 'know how' would be needed to increase productivity in South African industries.

Investigation and research are a fundamental part of technological method and could therefore have been included as part of problem solving. The South African educational system, however, was still trapped by rote learning methodologies that would take years to overcome. This was therefore kept as a separate area of outcome.

Technology had a purposeful approach to knowledge that was ideally suited to developing meaningful learning. It was thought to be essential for young people to be able to find and use relevant knowledge rather than depend on previously learnt knowledge. This would be particularly important in a field where current technologies could become completely redundant in ten years.

Communication, in all senses of the word, was another huge challenge facing the country. There were eleven official languages and the majority of pupils were being taught in their second or third language.

While communication was thought to be essential for technology to progress, the subject would be less dependent on language because ideas could be communicated by bringing them into reality. There would also be a wide range of opportunities for pupils to work together in teams, using a language of most effective communication.

Through technology as a subject, pupils' ability to communicate technological ideas through their written explanations, their drawings and their verbal presentations would be developed.

The three core areas identified were seen as essential for pupils to be able to succeed in future technological careers. They were generic educational outcomes, all of which had aspects specific to technology. They also all addressed reconstruction and development needs in the South African education system as a whole.

Technology in the past

In the past, people had completed school based education without technology and had gone on to become successful technologists. However, these included very few South Africans from the disadvantaged communities.

Maths and science had been the traditional breeding grounds for successful technologists. Both of these subjects were thought to require higher levels of abstract conceptualisation and better language skills than the more concrete technology. While maths and science were still believed to be vital for future technologists, it was thought that technology would add both interest and understanding to both subjects.

The best of the West

At this stage a process-based curriculum model had been chosen, the outcomes being specified independently of specific topics. The particular choice of topics had become much less critical as long as the topics chosen were suitable for developing pupils in the three core areas of outcome. This did not help however when it came to choosing the topics.

The USA had structured the topics in the Missouri curriculum under three headings:

- Energy and power technology
- Communication technology
- Materials and processing technology

These headings were interpreted as referring to the primary purpose of different products of technology. The systems approach, used to analyse products, was superimposed onto each topic heading. The following interpretations emerged:

Energy and power technology is about products of technology or processes whose primary purpose is to convert an input energy into a different output energy, for direct use (lights, heaters, levers, electrical circuits, mechanical systems, transport, pneumatic and hydraulic circuits).

Communication technology is about products of technology or processes whose primary purpose is to convert input information in order to communicate an output message (telephone systems, computers, radio, TV, video, drawing, photography, control systems).

Materials and processing technology is about products of technology or processes whose primary purpose is to convert input materials into more useful products (food processor, cement mixer, tools, casting, forming, cutting, etc.).

Many products would fit into more than one of these topic areas and most products would have a subsystem from another area. A computer, for example, may be a communication technology product but its energy and power systems are essential and the printer processes paper.

The traditional technical courses (woodwork, home economics) were believed to have overemphasised the processing of materials. The newer technology courses, on the other hand, while still designing and making products, were trying to embrace topics that fitted more comfortably under the other two headings (electronics, control, electrical circuits, mechanical systems).

The Missouri curriculum offered a structure that would ensure that pupils covered a balanced range of technology topics. This could be done without sacrificing any of the advantages of the process based model and without being restricted to presently available topics. This was ultimately believed to offer the best of both worlds.

The topics

The topics for the first unit were chosen easily from the above structure, using the Missouri curriculum as a guide. Electrical circuits, pneumatic circuits and mechanical systems were chosen under Energy and power. Electronics was placed under Communication technology, to reflect that it was thought to be more about information (signal) processing than about energy conversion. Simple communication systems were also covered (Morse code, telephones). Under Materials and

processing technology industry and industrial processes were chosen to reflect PROTEC's aims and objectives. Three areas were covered: production in factories (push and pull manufacturing), manufacturing methods (casting, forming) and construction (using cement, roof structures).

It was decided that, irrespective of the topic choice, all lessons would be presented as problems to be solved, all of them would involve building a model or a product and all of them would require pupils to investigate the information needed to solve problems for themselves. Pupils would be expected to complete their own record of the process in order to develop the communication outcomes. In this way pupils' abilities in the three core outcomes could be developed regardless of the topic presented.

Materials development

The framework was found to be a good working foundation to develop materials. Three trial sites were selected to deliver lessons as part of the development process. The development schedule was always one lesson ahead of the trial delivery schedule. This put a lot of pressure on the development team but also gave very quick feedback.

The choice of three sites meant that at least some of the lessons could not be delivered by the materials developer. Typical facilitators, with no special training, were selected for each of the sites. Pre-lesson meetings were held before each new lesson was delivered both to transfer the technological background to the facilitators and to familiarise them with the model building equipment.

The development therefore proceeded very firmly within the constraints in typical South African classrooms. There were no specialist teachers, very little time (55 minute lessons once a week), very little money (£2,500 per site) and under resourced schools that required the transportation of all that was needed every week.

Implementability

Delivery, particularly with regard to the RDP, was a concern with a national political profile at that time. It was therefore central to the development that the course could be delivered and replicated successfully.

Pupils were found to be very responsive although unfamiliar with 'hands on' technology activities in the classroom. No prior knowledge of technology could be assumed. It became very important to ensure that pupils were able to succeed regularly, to maintain interest and to break down low self-esteem with regard to technology. The problems set up for pupils therefore had to have a very closed solution path and subassemblies were introduced into the equipment kits to enable the models to be built within the allotted time.

The information made available to pupils also needed to be directly relevant to the task, to avoid delaying the start of the practical activity. Information booklets were developed to supplement each lesson which successfully developed pupils' abilities to index information.

Recording the process on the task sheets had to be kept to a minimum. Drawings of solutions were limited to very simple systems diagrams or sketches and recording was often left incomplete because of time pressure and pupils' preference for the practical problem solving aspects.

Getting pupils communicating in groups, however, was seen as a great success. Pupils were in groups of approximately five or six and they were all expected to cooperate to produce one model. They tended to be positively engaged with the tasks for the duration of the lessons. The information was read aloud by one pupil in each group and then translated and discussed in different languages. This approach to the spreading of knowledge may be a key way forward in South African classrooms.

Facilitators also responded well to the pupil centred methodology. Initially they did spend time in unnecessary explanation, but they soon changed, largely due to time pressure.

Having different groups doing different lessons had very positive spin-offs in this regard. Facilitators had little option but to allow pupils to take control of the activities but were so busy that they were left in little doubt of their valuable role in the classroom.

The task of developing the materials was an exciting one. The resulting lessons were consistent with the ideological framework originally planned but perhaps with more realistic targets. A high level of pupil interest was maintained throughout the development and technology was consistently ranked as the favourite subject of the PROTEC programme. At least one of the target aims was successfully being realised.

The move into schools

Towards the end of 1995 PROTEC was invited by the electricity supply industry (ESKOM) to start to deliver a technology course to 40 schools in South Africa. This was to begin with the Standard 8 pupils at the schools and would involve over 6,000 pupils.

PROTEC decided to accept the challenge and started to package the technology materials into booklets, to be published by Macmillans Boleswa of Swaziland. Artists, photographers and DTP consultants were brought in to improve the layout and design of the materials. Equipment kits had to be manufactured and packaged, management committees had to be established and teachers and fieldworkers had to be found and trained.

At the start of 1996 PROTEC had requests and funding to start to implement the course in over 70 more schools. The requests had come from several other industries willing to support schools in their areas. An interest in technology education in South African schools had clearly been established.

Present situation

The development of the PROTEC technology short course is still ongoing. The second module of 30 lessons was trialled in 1995 and will be published this year. The final module, which will consist of three projects (technology, industry and careers) will be trialled and ready for publication in 1997.

The national education department and the regional departments of the nine provinces in South Africa are all currently working on technology curricula for schools. There is a national initiative called Technology 2005 which aims to have technology in all schools by 2005.

Progress towards the RDP goals has so far been slow and competition for the limited funds has been fierce. Educational priorities involve the provision of basic classrooms rather than the transformation of the curriculum.

Technology as a compulsory school subject would probably be more expensive than other subjects. It would also undoubtedly be much more difficult to implement because of the lack of qualified teachers. It is widely believed, however, that technology can play a major role in improving the quality of education in the country. However, that role may well need to be facilitated by NGOs like PROTEC and the ORT-Step Institute, in partnership with industry, for some time to come.