CHAPTER 5: THE DEVELOPMENT OF PRACTICAL PROBLEM-SOLVING CURRICULA FROM TRADITIONAL CRAFT CURRICULA

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Introduction

The transition of technical curricula to practical problem-solving curricula (often called the "design and make approach") may be divided into two main phases:

(a) The curriculum development phase in which technical subjects are reviewed, syllabuses developed, tried and evaluated, and

(b) The wider implementation phase.

The experience of many countries has emphasised the need for setting up administrative procedures to facilitate the change and the allocation of finance to support a development phase of three to four years. Wider implementation will require in-service training and more resources. The readiness of teachers to accept change, the needs of pupils, the support of education authorities and the expectations of the community must all be taken into account when converting school workshop and technical drawing curricula into design and make concepts.

Definition of Terms

1. The traditional approach: The traditional approach to teaching woodwork is often teacher-dominated. Concern in the workshop with safety procedures, workshop organisation, workshop management and maintaining control of the pupils tend to overshadow the learning objectives of workshop subjects. The teacher selects the article to be made from a source of well-tried and proven plans, makes alterations, decides what material should be used and how the article is to be finished. He organises the production sequence, demonstrates each process, and guides the class step by step in the manufacture of the article. Workshop teachers feel confident within this lock-step teaching process in which the whole class produces the article. Great emphasis is placed on the finished product and in many instances principals and parents judge the effectiveness of the manual craft teacher by the standard of the completed article. Where relevant, theory is used to complement the practical component of the course. Technical drawing subjects tend to emphasise plane and descriptive geometry, and pictorial and applied drawings. The technical drawing curriculum rarely prepares pupils for industry where

drawing is used as a design instrument to solve practical problems. Instead, the subject is generally taught as an academic discipline in graphic communication and may not even be interrelated with the pupils' practical work in school workshops. Such a tightly directed teaching approach causes a corresponding lack of involvement and commitment by the pupils and it deprives them of opportunities for personal growth and development. The learning process is reduced to a programme where they are told everything and discover little. Because pupils are protected from the decisions that are implicit when making articles they are ill prepared to make those decisions at the end of a traditional course.

2. The practical problem-solving approach: The practical problem-solving approach aims at involving pupils, to an extent that their readiness permits, in all the development phases of a product. Pupils in this situation are presented with a design or project brief which clearly states the practical problem to be solved and includes any specifications which the teacher considers necessary. Design briefs can originate from a number of real situations or genuine needs and may range from the simple to the very complex. Design briefs may be craft-oriented, such as design and make a storage unit or a chair. These briefs are concerned with craft skills and craft technology and encompass the type of design problems which can be realised in the school workshops with a technical teacher. In essence it is product design.

Design briefs may also have a technological bias, such as design, and make an instrument for measuring wind velocity, or a solar water heating unit or a burglar alarm. Such projects require technological skills and knowledge, and their design elements overlap with the disciplines of science, particularly physics. This kind of project work fosters the interrelation of science, mathematics, technical and vocational curricula. Ideally, the teacher would have a good background in all these subjects, as well as in design. Design briefs can also be a combination of both craft and technology. In this approach the student develops design skills, including:

(a) Investigation: ability to recognise a problem and search for a solution. This activity includes searching for information, experimentation, and using analytical skills and judgements to reach sound conclusions.

(b) Invention: ability to initiate and develop ideas, and to adapt existing solutions or complete a partial solution. Invention includes the complementary communication skills of drawing and language.

(c) Implementation: ability to organise and plan the construction of a prototype within available resources.

(d) Evaluation: ability to discriminate and critically to appraise the merits and shortcomings of the finished product.

Skills and knowledge are taught as the need arises and therefore at a time when the student is strongly motivated. Technology studies are closely related to the needs of the pupil to design and make an article. Students are encouraged to make decisions and be responsible for them. However, the teacher's role - to teach, guide, counsel and approve - is of critical importance if students are to experience satisfaction and success.

The traditional disciplines of craft skills need not be sacrificed in the practical problem-solving approach. However, craftmanship skills and technical knowledge are no longer the main criteria for the assessment of pupils taking a practical course using a design and make approach. As part of this approach the traditional content of technical drawing is extended to include design work where pupils can be presented with abstract and practical problems. Imagination and inventiveness have more scope in this kind of drawing course because designs evolved need not meet the criterion of being capable of construction in a traditional workshop. In essence, the practical problem-solving approach is that of teachers guiding learners towards independence in their learning. The discovery, enquiry, design, creative and analytical thinking, and decision-making - traditionally the province of the teacher - is shared with students.

Steps in Transition - Climate for Change

A significant number of technical teachers believe that some of the traditional outcomes of the technical curriculum should continue because tool skills and technical knowledge continue to be important for future careers and for leisure activities. At the same time there is a growing awareness that the potential of technical education is not being used to meet the general educational needs of students. The relationship between tool skills, technical knowledge and creative thinking should be investigated by curriculum designers in order to tap this potential.

Traditional vocational links in technical education tend to limit the intake to technical courses to the middle and low ability spectrum of the school population, who usually aspire to

be tradesmen. The technical institute system established for the craftsman and technician is now well established in a number of countries and this provision tends to free the secondary sector of its previous role of preparing pupils for particular vocations. Although vocational links are still important there is a growing awareness that all students need to develop knowledge and skills about materials, tools and processes as a component of living and as a balance to the academic bias in their education. Conflicting philosophies about the future role of technical education emerge as schools and teachers take different attitudes on a number of issues affecting technical subjects. Indeed, technical education seems to be going through an identity crisis.

Design as a creative and disciplined decision-making process is in contention with the acquisition of tool skills using set projects and prescribed knowledge. A greater response and understanding from students are needed if they are required to design and implement a solution to a practical problem. Breadth of knowledge taught as a component of general education is in conflict with depth of knowledge required for vocational purposes. Self-learning and enquiry methods of teaching are in tension with closely controlled teaching situations.

The flexibility of open-ended curriculum statements is opposed by the desirability of definitive content-based statements. The internal assessment of pupils taking a practical subject for a national certificate confronts the traditional assessment by external examinations. These issues are likely to divide technical teachers, but they also cause teachers to think in fundamental terms about the purpose of technical curricula in schools.

In this uncertain flux of technical education some educational authorities are expressing dissatisfaction with existing technical curricula, and examining bodies are exerting pressure to review workshop subjects. At the same time individual teachers are working experimentally and in isolation on design concept project work. The influence of international developments in technical curricula is also a factor in creating a climate for local change. Technical subjects are caught up in rapid technological change and some countries are reviewing their subject boundaries to update and clarify curricula - in some cases by allowing subject boundaries to overlap with art and science.

One major restraint to design concepts in the technical curricula is the initial opposition of traditional teachers who feel insecure and threatened by the proposed change. Their backgrounds, training and teaching practice have not prepared

them for the significant changes caused by student involvement in design of workshop projects. Education authorities may be faced with a weak or even hostile teacher climate during a transition from traditional to design curricula and this could slow down the rate of change. Because curriculum development work associated with the transition could be influenced by the teacher climate, a small beginning in one subject at one level may be a wise course to follow. Teachers can and will change their attitudes but it takes time and they must be convinced of the rationale for design education in school workshops. The experience of some countries confirms that the involvement of teachers in the change is an effective way of changing their philosophy and attitudes.

The Procedure for Change

Experience in some countries has shown that one effective procedure to bring about change is to concentrate on one aspect at a time - for example the curriculum in school workshops - and establish a developmental committee to review current practices and then to consider and recommend new curricula with all the implications for buildings, equipment, materials and staff retraining. Such an approach may well take several years and there will be development costs for the trials and evaluation required during the process.

Some of the fundamental issues that can be raised when considering a change in, say, workshop practice are:

(a) What are the deficiencies of present workshop practice and what are the strengths that should be preserved?

(b) What are the worthwhile activities that students should practice in workshops?

(c) What are the students' needs for the future?

(d) How can experiences in the workshop provide for these needs?

(e) What is society's expectations of students who have a technical bias in their education?

(f) What attitudes, skills and knowledge are to be encompassed in workshop practice courses?

(g) Should the emphasis be on process skills and conceptual development or the finished product of the practical work?

(h) What is the place of practical problem-solving in a workshop course?

(i) Will future workshop practice courses maintain their craft identity?

(j) Should applied science have a prominent place in school workshop courses?

(k) What is the aim of workshop practice subjects at junior, intermediate and senior levels?

(l) What are the general objectives of workshop practice in terms of attitudes, skills and knowledge?

(m) Should self-learning skills be one of the educational objectives?

(n) Is it desirable that students should study and become aware of the influence of technology on the lives of people?

(o) Should the curriculum be objective-based or content-based or include both?

(p) Should a modular approach be investigated?

(q) Is it necessary to have a full set of teaching resources from which schools may choose items to form programmes?

(r) What materials form the basis of a course?

(s) Is some form of national assessment necessary? If so, what mark-weighting ought to be allocated to craftsmanship, design ability, knowledge and attitudes? Does this weighting change at different levels of the school?

(t) How will the curriculum be taught and assessed?

(u) Is the proposed curriculum suitable for existing teachers with some in-service training?

(v) Are there expensive implications for buildings and equipment?

(w) What are the links between the proposed curriculum and other curriculum areas?

There will also be even more practicable issues such as what name is to be given to the new subject, what is a desirable class size and how many hours per week are required.

Pilot Trials of New Curricula

Trials in, say, 10 to 20 schools over a two or three year period are desirable. Such trials must be effectively managed, monitored and evaluated, and the teachers involved will need in-service training to prepare them.

The desired curriculum change is not merely a change in content; it represents a new approach to teaching and learning which implies differences in the facilities and staffing required and different strategies including different workshop management and assessment.

The objectives of the trial stage would include:

- Student reaction
- Viability of proposed curriculum
- Changes necessary to the draft curriculum
- Teaching strategies that encourage practical problem solving
- Programme planning techniques to achieve the curriculum objectives
- Assessment and moderation procedures
- Class management techniques for the management of design briefs in the school workshop
- Whether the draft curriculum is adaptable to the needs of all abilities
- Book and audio-visual resources that support the draft curriculum
- Implications for pre- and in-service training of technical teachers
- Implications for buildings and equipment
- Method of wider implementation

The Wider Implementation of Change

The trial of the draft curriculum should produce useful information on the implications of a full implementation of design curricula in ways appropriate to the indigenous needs of country or state. Such information will assist policy decisions

on whether transition to problem-solving technical curricula is to be accomplished in the short-term with substantial resources or in the long-term as resources permits. Whatever the policy, unavoidable costs will be incurred in meeting the need for in-service and reconstituted pre-service training and the provision of minimal resources necessary to support the new curricula. It is probable that countries will be able to implement design curricula on a limited scale using existing facilities, equipment and local materials. The necessary alterations and extensions to existing facilities can be made on a phased basis as economic resources allow.

In-Service Training

As a result of the trial it should be possible to identify the particular retraining needs of existing technical staff who are to teach, manage and assess the design concepts in the new curricula. These needs will include:

- to understand the philosophy that underpins design education in the technical curricula;
- to develop teaching strategies appropriate for teaching design;
- to understand the design process and develop design skills;
- to plan programmes in which design activity is an integral part of the course;
- to develop design briefs that interest and motivate pupils and allow for alternative solutions;
- to evaluate the design briefs in terms of the course objectives;
- to learn class management techniques in the practical problem-solving situation in the workshop;
- to integrate the study of technology with the design and practical activities of their programme;
- to teach graphic communication skills as part of design sketching;
- to assess design ability.

Technical teachers in post may require the equivalent of a one-week course before they establish design-based courses in their school. A follow-up course in their second year of implementation will consolidate progress and reinforce aspects of the introductory course.

Pre-Service Training and Teacher Qualifications

In order to meet the demands of practical problem-solving curricula it will be necessary to re-structure existing pre-service teacher training courses so that they include:

- design and philosophy of design education
- materials and design
- restructured principles and practice of technical teaching
- programme planning using design briefs and study assignments
- process-centred assessment

Current technical teacher qualifications may need up-dating to include design aspects of technical education. Some countries have new teacher qualifications of degree status, orientated to meet the demands of design and technology courses in schools. Some of these pre-service training courses with a duration of four years concurrently qualify trainees for a teaching degree and a teacher's diploma.

Resources Development and Production

In the conversion of curricula to design studies some countries have used existing technical education texts. However, there is a need for new material to help teachers of design and technology - possibly in the form of guide-books and textbooks to introduce ideas for design briefs that teachers may wish to develop for their programmes. One country has produced a set of design briefs with related technology in order to help teachers, and there are a number of authors in several countries preparing books of ideas for design briefs. If such material is based on indigenous needs it will provide valuable assistance to teachers during a transition to design curricula.