British Design and Technology: A Critical Analysis

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A great deal of interest has been shown in the British National Design and Technology Curriculum. A number of English Design and Technology education leaders have visited this country and a small group of American technology educators make periodic trips to Britain to observe the curriculum in action.

Many of the reports provided to Americans by these individuals suggest that the British have THE answer and that we are years behind the Brits (Bottrill, 1992). However, Americans who question the British model as the utopian answer are often dismissed as unenlightened conservatives trying to protect skill-based programs.

This paper is based primarily on a review of *Technology in the National Curriculum* (National Curriculum Council, 1990) and a trip to England. This trip included discussions with a shire (county) technology leader, an in-service technology teacher trainer, a technology equipment representative, and over 25 technology teachers who work at all educational levels from infant to secondary schools. The teachers covered the spectrum from one person resisting curricular change to a number of groups expending considerable effort to implement the national curriculum. The sample was not a hand-picked group of success stories designed to show the curriculum only at its best, but represented a reasonable cross-section of the teaching and leadership ranks.

The National Curriculum

The educational program that is often referred to as the British National Curriculum is actually the curriculum for England and Wales. It includes a number of subjects of which technology is one. The other two countries that make up the United Kingdom, Scotland and Northern Ireland, have their own curriculums with a uniquely different type of technology education. Therefore, for the remainder of this paper the curriculum being discussed will be the English and Wales technology education and will be referred to as the National Curriculum.

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The National Curriculum has evolved over time. A detailed historical description of each change, with the corresponding educational and political motives, is not appropriate for this paper. However a broad over-view provided by Wilson (1992), suggested that the evolution of post-war technology-related instruction can be seen in four major steps. The original post-World War II program was a series of separate studies in woodworking, metalworking, and technical drawing. This program was called *craftwork* and focused on using tools to build projects. This program was replaced in the 1970-1990 period by Craft Design Technology (CDT) which added design to the making emphasis of the craftwork program. Starting in 1975 problem solving was fused into the program that added evaluation to the designing/making emphasis of CDT. The final transition was the National Curriculum that was initially implemented in 1990.

The National Curriculum is a mandatory program for all state primary and secondary schools. It includes technology as a foundation (core) subject "which requires pupils to apply knowledge to solve practical problems" (National Curriculum Council, 1990). The subject of technology, according to Layton (1991), merged two separate subjects that were in the schools: CDT and home economics. Technology is divided into two components: design and technology capability and information technology capability. Information technology is seen as cross-curricular and is recommended to be taught as an integral part of all foundation subjects including technology.

Design and technology (D&T) is expected to be taught through themes and projects in the primary school and as a separate subject in the secondary school. D&T instruction is couched within home, school, recreation, community, and business and industry contexts and explores an interrelationship between environments, artifacts, and systems, Figure 1. These three elements, according to Hampshire Education (1990), are defined as follows:

- Environment: Surroundings made or developed by people.
- Artifact: An object made by people.
- System: A set of objects or activities that together perform a task.

D&T includes four basic areas: construction materials, food, textiles, and graphic media (London Borough of Barnet, 1992). Each of these areas focuses on four attainment targets (AT) which are the major organizers of the curriculum. These targets and their objective are described by the National Curriculum Council (1990) as follows:

AT1 - Identifying Needs and Opportunities

"Pupils should be able to identify and state clearly needs and opportunities for design and technological activities through investigations of the contexts: home, school, recreation, community, business and industry" (p. 3).

AT2 - Generating a Design

"Pupils should be able to generate a design specification, explore ideas to produce a design proposal and develop it into a realistic, appropriate and achievable design" (p. 7).

AT3 - Planning and Making

"Pupils should be able to make artefacts, systems and environments, preparing and working to a plan and identifying, managing and using appropriate resources, including knowledge and processes" (p. 11).

AT4 - Evaluating

"Pupils should be able to develop, communicate and act upon an evaluation of the processes, products and effects of their design and technological activities and of those of others, including those from other times and cultures" (p. 15).

Each of these four attainment targets has ten levels that allow students to progress from simple to complex tasks as they move through their eleven years of required schooling. However the ten attainment levels do not necessarily correspond directly with the schooling years. Early levels use familiar contexts such as home and community and simple design problems. At advanced levels pupils explore more complex contexts while they are "given more opportunities to identify their own tasks for activity, and should use their knowledge and skills to make products which are more complex, or satisfy more demanding needs" (National Curriculum Council, 1990, p. 19).

For teaching purposes the levels are grouped into four Key Stages that have their own program of study (PoS). These programs list knowing and doing skills the students should learn and provide suggestions for activities under four major themes:

Figure 1. National Curriculum Model. [Adapted from London Borough of Barnet. (1991). *Design & Technology Design Cycle* (Transparency)]

- Developing and using artifacts, systems, and environments
- Working with materials
- Developing and communication ideas
- Satisfying needs and addressing opportunities.

At the end of each Key Stage the pupils are to be assessed using national criteria and examinations. These key stages with their over lapping attainment levels are as follows:

- Key Stage 1 - Levels 1 to 3 - ages 5 to 7
- Key Stage 2 - Levels 2 to 5 - ages 7 to 11
- Key Stage 3 - Levels 3 to 7 - ages 11 to 14
- Key Stage 4 - Levels 4 - 10 - ages 14 to 16

The relationships among the curriculum's four attainment targets, ten levels, four key stages and the programs of study are shown in Figure 2.

The exposure students have to technology varies among schools. Most secondary students have technology for two to three periods per week. These classes may be in materials, food, graphic media, or textiles. Formal class instruction (lectures, demonstrations, etc.) is minimal because the classes are organized around design briefs. The students are given a design challenge and are encouraged to seek appropriate information as they address the problems they encounter in developing their solutions.

The students are expected to document their work as they move through the four areas of needs and opportunities, generating a design, planning and making, and evaluating. The majority of laboratory work is completed with simple hand tools and very limited machine use. Most class activities seemed to be restricted to using paper, plywood, and hardboard because of the limited emphasis on producing devices and very small supply budgets.

Figure 2. Structure of the National Curriculum

Critique

The challenge for all critical reviews is to identify the strengths and weaknesses of the program being evaluated. The following is this author's list of the key points gleaned from a review of the National Curriculum materials, visits to schools in the London and Sheffield areas, and criticisms leveled by those English leaders outside the design and technology education arena.

Strengths

Technology is designed for all children regardless of age, gender, or career aspirations. The broad clientele for which the *Technology in the National Curriculum* was developed makes it a universal study of an important phenomenon in society. The students at all levels of schooling study technology and are assessed at the end of each of the four key stages. Male and female students work cooperatively and without the attitude that making things with tools are for boys and cooking is for girls that is somewhat common in the United States.

Technology integrates a number of school subjects under a single area The National Curriculum was developed to meet the needs of all students in England and Wales. It includes instruction that was previously taught in home economics; business studies; art and design; information technology; and craft, design, and technology. This broad scope is unique, according to Layton who wrote, “never before has an attempt been made to teach D&T to all children . . .”

Weaknesses

The design process does not provide clear definition for the area of study. The National Curriculum is a process-based program that uses the design process as the vehicle to organize its content. The students engage in a continuing array of design problems as they progress through the various levels of schooling. They identify opportunities, generate designs, build prototypes, and evaluate the design. However, the News (1992, p. 3) reported the criticism of the design process that was leveled by Robison and Smithers. The critics suggested that in using the design process alone most activities become technology - writing a report, conducting a scientific experiment, finding one's way to a railway station. This breadth of the subject had led to a loss of focus that is a major area of concern of the critics of the program. According to a report in The Engineer (Council, 1992) the focus of the program “has turned from being a 'designing and making' subject based on science and maths into generalised problem-solving without a specific knowledge base . . .”

The program fails to address commercialization of designs to meet human needs and wants. With the primary focus on design, students seldom consider commercialization of the design. The third attainment target, planning and making, has been interpreted by most teachers as modeling and therefore little attention is placed on the processes used to make the technology available to people. For example, a group of students in one school was challenged to design the communication media for a rock concert. They developed posters, cassette recording covers, programs, and sweatshirt designs. However, they did not study the process that could be used to produce these items in quantity nor did they progress past the pen and ink, magic marker, or poster paint model stage. Criticism of this sole reliance on the design process has recently appeared in the popular press. Smithers (1992, p. 16), in a Daily Telegram article, suggested that "technology is about making things - not just planning and design."

Technology is often broadly interpreted as a study of any system that meets human needs. The National Curriculum studies environments, artifacts, and systems. As stated earlier, a system is described as any set of objects or activities that together perform a task. This definition has allowed some people to study any system that is used by people. For instance, Wilson (1992) suggested that the political system is within the purview of study for technology. The failure to associate technology with technical means has made technology, according to Robinson and Smithers (1992) , so general; that no one can define it.

Technology as defined by the National Curriculum lacks a clear mission. The National Curriculum, in merging home economics, art and design, business studies, and CDT, caused the mission to lose focus. The original intent was to empower people by helping them "understand and control one of the most powerful influence on society . . ." (Layton, 1991, p. 1). However, as Smithers (1992, p. 16) suggested in the Daily Telegraph article, this goal has been confused by allowing two basic experiences that overlap technology to be infused into the curriculum. They are basic life skills and vocational education. He suggested "An important purpose of schooling is to give children practical skills. Among these are a number which are affected by technology but not necessarily part of it. For example being able to cook, use a word processor, or fill in forms. These are all important . . . but to treat them as technology runs the risk of their becoming intellectualised [knowledge devoid of practical application]." Robinson and Smithers were reported in the *News* to have clearly presented the problem of curriculum focus when they suggested *The problem with technology can be stated very simply: it lacks identity.* The first step in focusing the program, according to these critics, is to "delimit it as a subject saying what technology is and, just as important, what it is not" (Problem of technology, p. 3).

Information Technology is in reality computer skills. The original intent of the information technology was to develop pupil's ability to communicate and handle information, design and model real and imaginary situations, and measure and control physical variables and movement. This would suggest the study of electronic and graphic communication and fluidic, electrical, and mechanical control systems. However in practice, the area of information technology quite often focuses on using computers in graphics, word processing, charting, and spreadsheets. Many schools have separate computer labs where this work is done. There was little evidence that computers are an integral part of design technology. Likewise, the study of control systems seems have been lost in the transition from CDT to D&T.

The National Curriculum document and structure are abstract and difficult to understand. The curriculum guide is a legal document that lists attainment targets and levels and presents brief outlines for programs of study for each of its four key stages. The document is a maze of terms, lacks a clear teaching plan, and fails to communicate its focus adequately. For example, Layton (1991) suggested that the four attainment targets that appear to be steps in a design process are not meant to define a process. Instead, he suggests that "they should be seen as a series of windows into the interactive processes of D&T through which information useful to teachers about the performance of their pupils can be obtained" (p. 5). Language like this provides little guidance to implementing teachers. Layton, further suggested "the achievement of the goals of Technology is not always helped by the necessarily legalistic description of attainment targets (ATs), statements of attainment (SoA) and programmes of study (PoS) . . ." (p. 1).

Implications for Technology Education in America

The National Curriculum is very different from most American technology education programs. First it is based on the concept that a national curriculum is superior to locally developed programs. It is also driven by national attainment tests that are used to measure student and program success.

Second the National Curriculum is based on the problem solving or design process while most American programs are content focused. The National Curriculum uses design problems with the intent of leading students to the knowledge of technology. The success of this approach is determined by the design problems used and the expectations teachers have for their students. In contrast most American programs have identified content and then use a combination of design and processing activities to make the content easier to understand.

The lack of a clearly communicated educational program and the loss of focus for technology in the National Curriculum was evident to this author. It also was apparent to a number of influential leaders in England. Smithers (1992) asked, "What is wrong with technology is schools? Almost everyone thought it was a good idea to make it part of the national curriculum. But now, teachers are confused, pupils spend their time on unlikely activities, such as compiling folders on keeping fit" (p. 16)

In response to a tide of criticism, John Pattern, the Education Secretary, ordered "an urgent review of technology in the national curriculum." That this action was taken because, after observing 2613 lessons in 884 schools, Government inspectors found 40 per cent of technology lessons in the secondary schools and more than a third of those in primaries were unsatisfactory (Technology Criticised, p.1). Ward further reported that the action will result in "the first complete shake-up of a national curriculum subject and is in response that too many pupils are offered a 'Blue Peter' approach to technology." (Blue Peter is a British television show where paper, sticks, and other simple materials are used to superficially present scientific principles.)

Pattern (1992) told the House of Commons that the revision is to raise the teachers' expectations of the pupils, specify more clearly the skills and knowledge that the pupils should acquire, give more emphasis on the practical element of the subject, and improve the manageability of the curriculum in the classroom.

Americans have a lot to learn from the National Curriculum experience. First, we need to focus more effort in making technology education available to all students, male and female, at all levels of schooling. We have failed miserably in getting technology recognized as important content for all students, K- 12, and at attracting female students in appropriate numbers.

Second, we need to address more fully the design and development processes used to create technology. This should involve cooperative learning and open-ending design challenges. However, enlarging our focus must be done without loosing the processing component of our program. Our programs need hands-on/minds-on experiences that help students understand how technology is created, produced, used, and assessed. We should not abandon the knowledge and action involved in producing technology and in selecting, using, and maintaining technological devices.

Third, we should keep in mind that technology exists only when technical elements are present. It does not include all systems or all application of resources to solve human problems. Nor does it include all applications of problem-solving techniques. For example, a marriage counselor applies knowledge as a resource to help solve family problems and may not use any technical means.

Fourth, we need to be cautious in defining technology so broadly that anything and everything fits under the description. Our definitions should clearly communicate what technology is and what it is not. We should resist the temptation of embracing the goals of developing life skills and vocational education as central missions for technology education.

Fifth, we should heed the advice that Bensen (1992) gave and, like the British, delete "education" from the name of our field . Students should study technology along with science, mathematics, language arts, and history. According to Bensen, those subjects that use education in their titles (i.e.; driver education, physical education, distributive education, consumer education) are generally perceived as less academically respectable and afforded less respect by educators and the public.

Sixth, we need to keep consider the audience when we write curriculum. The documents should be "teacher friendly" and very descriptive.

Finally, we need to learn from each other. Every country that has technology education programs have something to offer curriculum developers. Also often they have very different philosophical bases for their programs. The basic philosophical difference between the National Curriculum and American technology education (process versus content) makes the two programs almost impossible to compare and to determine "who's ahead of whom." Making such a determination relies almost totally on judgments much like deciding if Michael Jordan's 35 points scored in basketball is superior to Tom Watson's five- under-par round of golf. In the end, such comparisons can be counterproductive by diverting the energies away from educational matters and toward emotional debates.

American technology education is grounded on a solid foundation and heritage. But like the field it presents to students, it must be ever-changing. Its scope and contents must always be examined and modified as time dictates. An evaluation of the British National Curriculum suggests that we should consider expanding the scope of the field to encompass more problem solving and design, more clearly delineate the mission of the field, and continue to develop high quality instructional materials and curriculum guides.

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