Interpretation of Technology in curriculum documents – a comparative analysis

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Abstract

This paper is set up to examine the understanding of technology in curriculum documents of four countries – Australia, the UK, the USA and Russia, and to provide a basis for possible ways of expanding knowledge about technology in technology education curriculum.

On the theoretical level, the understanding of technology is controversial, partly because it is developed by different disciplines. In the paper two broad categories, taken from the philosophy of technology, will be used for the analysis of curriculum documents:

- *engineering (applied science) – humanities approaches*
- *technological – value-driven (social) determinism.*

The result of comparison will be presented in the table. Then the argument will be developed that a more critical and more balanced view on technology is needed for developing an adequate concept of knowledge about technology in technology education. A more critical view could include:

- *Reasonable doubt in technological progress: technology can escape from the peoples' control.*
- *The integration of people and society into the technical world.*
- *The relationship between power and technological knowledge.*
- *Uncertainty should be treated more seriously.*

A more balanced view has to reflect, on one hand, that development of technology depends on human values, and on the other hand that it has its own laws of development. This proposal is based on the Ellul's analysis of technology.

Keywords: understanding technology, philosophy of technology, curriculum; comparative perspective, knowledge about technology

Introduction

The purpose of this paper is to compare the interpretations of technology in curriculum documents of four countries – Australia, Russia, the UK, and the USA – with the aim of providing a basis for the possible ways of expanding knowledge *about* technology in technology education curricula. The analysis will be made through a critical account of curriculum documents and reports developed at the national level in each country. A list of the analysed documents is in Appendix 1.

Understanding of technology will be interpreted through direct descriptions of the phenomenon in curriculum documents, and through indirect assumptions following from the description of technology education. In spite of the documentary nature of the material discussed in this paper, there is no single 'right' way of interpreting the topic. Theoretical frameworks for understanding technology vary greatly and have been developed within different paradigms.

The approach for this analysis will be framed by the following questions:

- To what extent is technology analysed in the documents and considered as a starting point for curriculum development?

- What features of the phenomenon are chosen and emphasised and what theoretical interpretation could be used to characterise technology?
- What features of technology have not been discussed?

To what extent is technology analysed in the documents and considered as a starting point for curriculum development?

The level of direct description of technology in curriculum documents varies in each country. The National Curriculum for England (DFE/QCA, 1999) does not consider any conceptual interpretation of technology. The previous Orders and Reports do not describe it either. However, the Working Group, which was established to develop a rationale of a new subject, closely identified technology with design and used this ‘unitary concept’ interchangeably with ‘design and technological activity’. This indicates that technology and design are closely associated with the process, although a direct definition of technology is not provided.

Technology as a phenomenon is not considered by the Working Group as a starting point for development of the subject. Instead of a conceptual interpretation of technology, the Working Group set themselves the quite different question: ‘What is it that students learn from design and technological activities…?’ (DES/WO, 1988). Thus the key starting issue is more practically oriented: what will students learn? In the *Final Report* (DES/WO, 1989) it is stated that the approach to design and technology is built ‘upon good practice in primary and secondary schools’ (p. 1).

In the Russian *Standards* (Lendev, Nikandrov and Lazutova, 1998) the attempt is made to define Technology in the context of the third technological revolution and post-industrial society which put new functional requirements: the person has not only to fulfil the productive function in the economy, but also can make decisions, be involved in creative work and do projects. Technology is defined as:

> a body of knowledge [in Russian language – science] about the transformation and use of materials, energy and information for the interests of the person and according to his plan. (Lednev, Nikandrov and Lazutina, 1998: 246)

Compared to the *Draft of the Standards* (Ministry of General and Professional Education, 1998) the interests of society and environmental protection are excluded from the definition. Separate from this definition, statements of what should be included in the learning area and the aims of technology education are presented. A rationale for the accepted approach is not explained. It has not been developed either in non-published reports presented by the Working Group. Thus, technology as a phenomenon is not considered as the important starting point for curriculum development. The aims of the learning area play an important role in this process.

In the Australian documents more treatment is given to description of technology. It is defined as ‘the generic term for all the technologies people develop and use. It involves the purposeful application of knowledge, experience and resources to create products and processes that meet human needs’ (Curriculum Corporation, 1997: 3). Several attributes of technology are listed: knowledge, experience, resources, products, process and volition (needs) without any explanation on their relationships. The concept of technology is not presented as a coherent one, it has no clear boundaries and is not well structured.

The *Interim Statement* (AEC CURASS, 1992) throws some light on the understanding of technology. The definition of the phenomenon here is based on the UNESCO’s approach where technology is ‘the know-how and creative processes’ (AEC CURASS, 1992: 1). In the description of technology for the school curriculum, the process of designing, making and appraising is specified as ‘central to technology’ (p. 2). It is also emphasised that this document has been developed ‘on effective practices in schools [not on theoretical analysis of technology]’ (p. 4).

In the American concept of technology education the following definition is advocated: ‘Technology is a body of knowledge and the systematic application of resources to produce outcomes in response to human needs and wants’ (Savage and Sterry, 1990: 7). In *Technology for All Americans: A Rationale and Structure for the Study of Technology* (ITEA, 1996) the notion of the term is developed further, it is described as both knowledge and processes. The full description of technology is much broader and more systematic than in the other countries, and it is used to justify the need for technology education and the chosen approach for curriculum development.

The above examination demonstrates that the understanding of technology is different in curriculum documents of four countries and the importance of considering it as a starting point for curriculum development also varies. According to these different perceptions of technology, knowledge *about* technology plays a more central role in the USA curricula than in the other countries.

What features of the phenomenon are chosen and emphasised and what theoretical interpretation could be used to characterise technology?

On the theoretical level, the understanding of technology is controversial, and it is developed by different disciplines (Laudan, 1984; Parayil, 1991). In the following analysis two broad categories taken from the philosophy of technology (Mackenzie and Wajcman, 1985; Mackay, 1991; Leiss, 1992; Mitcham, 1978; Salamon, 1981; Vries de, 1996) will be used to examine understanding of technology in curriculum documents of the countries under consideration:

- engineering (applied science) – humanities approaches
- technological – value-driven (social) determinism.

Those approaches have been chosen as the most influential for the current discussion.

Engineering – humanities approaches

The Western countries in this research consider technology in the humanities paradigm of technology. They believe that technology is a part of social development, so the only possible way to analyse technology is in a social context. Technology is an integral part of our social structure. This structure can be defined in part by its use of technology which transforms the environment, ideologies, and its sociological elements (Savage and Sterry, 1990: 7). Particular technological applications are judged by their impact on communities and environments and their effect on the personal wellbeing and ways of life of individuals (Curriculum Corporation, 1997: 3).

The Russian approach is closer to 'technology as applied science' understanding. They see a clear path from scientific knowledge to the technological product. This is a reflection of the polytechnical principle that scientific concepts are applied in the practical activity of the students. However, it is not possible to classify this approach only as 'applied science'. Traditional crafts still play an important part of technology education.

In the curriculum documents of the Western countries the role of values in technology is specified. In the UK documents there is a requirement that value judgements are made at every stage of human activity within technology. In the Australian documents the values of individuals and groups play a leading role in making decisions about the development and use of technology. There is also a strong belief that it is possible to make predictions about the future impact of technology. Although the American documents do not place such attention on values, it is mentioned that decision-making process should reflect the values of the people because there are always more than one solution for the technological problem. In Russian Standards (Lednev, Nikandrov and Lazutina, 1998) a general statement is made on the importance of ethics and aesthetics in the current era. It has not been developed further in the document.

There is a person/society-oriented approach to technology in the Western countries, in Russia a more science/machine oriented one. Hence, in the case of the Western countries values are included in the body of knowledge about technology, in Russia – the priority might be given to technical knowledge only. A humanities approach to technology does not specify to what extent technology is manageable by people's values: to what extent can a person control technological innovation, or can s/he only assess, communicate, and manage the risks. To understand this, analysis on the basis of 'technological – value-driven determinism' approach has to be done.

Technological – value-driven determinism

It is possible to characterise the UK documents as close to technological determinism. The super power of technology is seen from the *Interim Report*: citizens can only appreciate the 'social and economic impact of design and technology' (Interim Report, 1.14) and cope with changes. *The Interim Report* (DES/WO, 1988: 5–6) states:

> The consequences of technological change are profound and pervasive. Furthermore, *technological revolutions are irreversible*; no technological change can be uninvented after it has taken place. We need to understand design and technology, therefore, not only to solve practical problems … but also so that we can acquire a sense of its *enormous transformatory power*. Used wisely, they bring new and worthwhile goals within reach.

This statement illustrates a degree of technological determinism contained by the writers of conceptual framework. Technology is seen as an autonomous process which has a life of its own, independent of social intentions and power. Students have to know and appreciate technology. A well-developed system of values could play its positive role, opening the door for worthwhile goals. However, values could not control technological development for full extent.

A similar position is demonstrated in the Russian *Standards*. The technological revolution presents new requirements for the person. Thus the person needs to be prepared for them (Lednev, Nikandrov and Lazutina, 1998: 246).

Positions expressed in the Australian and the American documents are aligned to value-driven determinism: individuals and groups always make the choices and have the ability to control technology. Through education, society must spread the information that makes everybody able to choose. In Australia, the working group understands technology as a manageable, positive and progressive phenomenon (Curriculum Corporation, 1997):

> People need to make informed decisions about the sustainable development of technology and its impact on people and the environment. (Curriculum Corporation, 1997: 3)

The American documents advocate the idea of neutrality of technology. 'It is the human who conceives what should be developed, and it is the human who should control its [technological] destiny' (Savage and Sterry, 1990: 7). Technology can be used to promote 'good' or 'bad' impact on society. 'Nuclear energy can be used to provide power to heat millions of homes or to destroy millions of lives' (ITEA, 1996: 3). People's goals and values shape technology, thus 'the promise of the future lies not in technology alone, but in people's ability to use, manage, and understand it'.

Positions of technological – value-driven determinism have been strongly criticised on the theoretical level, in particular, the belief in neutrality of technology and ability of the person to control it to a full extent (Ellul, 1987/1990; Pacey, 1983; Rapp, 1985/1989). However, these critiques are not reflected in curriculum documents.

All documents present an understanding of the aims of technology as creating products and solving problems to meet human needs, and a strong belief in technological progress is also evident through the analysis of all documents. A review of the findings is presented in Appendix 2.

What features of technology have not been discussed?

On the basis of the analysis made in this paper and theorising of technology made by Beck, 1997; Ellul 1987/1990; Giddens, 1994; Habermas, 1968/1971 and others, it is important to make two main comments: a more critical view and a more balanced view on technology are needed for developing concepts of knowledge about technology in technology education.

More critical view

There is a lack of a *critical approach* to technology in curriculum documents when the relationship between society and technology is considered. However, it is crucial that the following features of technology should be examined:

- Reasonable doubt in technological progress. Technology can escape from people's control.

A strong belief in technological progress is presented in documents of all countries. Although in Australian and American documents there are several statements on the cost and backdrops of technology, the positive character of the progress and the ability of people to manage technology is stressed elsewhere. In the UK, documents a critical judgement of technology has been made: it is emphasised that technological change cannot be reversed and has enormous power, but this statement has not been developed in the Order.

- Integration of people and society into the technical world.

A close relationship between technology and society is stated in the American documents: 'Technological systems have become so interrelated with one another and with today's social systems, that any new development can have far reaching effects' (ITEA, 1996: 3). However, the process of the integration of people and society into the technical world as a *very negative trend* (analysed on theoretical level by Ellul 1987/1990; Habermas, 1968/1971 and others) is not explored. The increase of the adaptive behaviour is one of the features of this integration.

The danger of technocratic consciousness has to be explored in technology education. Purposive-rational action and adaptive behaviour should not be predominant categories in the conceptual framework for technology education.

- The relationship between power and technological knowledge.

A number of authors, including Giddens, Ellul, and Habermas, agree on the strong relationship between power and knowledge (particularly scientific/technological knowledge). In modern life, theoretical knowledge increasingly becomes the strategic resource, the axial principle, of a society: 'what is true to technology and economics is true to all modes of knowledge' (Bell, 1974: 26). Scientific-technical progress has become an immediately productive force, an independent source of surplus value, on which the economic growth depends. Knowledge has become the agent of social change. 'Social groups of all types depend on and are mediated by knowledge. Similarly, power has frequently been based on advantages in knowledge and not only on physical strength' (Stehr, 1992: 111).

Thus the relationship between power and technological knowledge is important to consider in the technology education curriculum. Students have to know the role and place of technological knowledge and the perspectives it opens in the modern society.

- Uncertainty should be treated more seriously.

Uncertainty is one of the main characteristics of the modern world, however, it is only mentioned in the Australian and the USA documents. On the one hand, 'people have to deal with uncertainty in an informed way' (Curriculum Corporation, 1997: 4), on the other, universals of technology are considered to be significant and timeless even in an era dominated by uncertainties (ITEA, 1996: 15).

This is not addressed directly in the English documents for design and technology, except in the requirement that pupils should be taught to 'identify and use criteria to judge the quality of other peoples' products, including the extent to which they meet a clear need, their fitness for purpose, whether resources have been used appropriately, and their impact beyond the purpose for which they have been designed' (DfEE and QCA, 1999). However, it is dealt with thoroughly in the recommendations of the report of the Sustainable Development Educational Panel (1999): These recommendations are supposed to inform teaching in all subject. One of the key headings is 'Uncertainty, and precaution in action, in which desirable learning outcomes are specified. These can be built into the design and technology curriculum – it remains to be seen if they will.

Uncertainty has its strong impact on technology, some of which are ambivalence, unpredictability of development, double feedback (positive and negative) (Ellul, 1987/1990). As the understanding of these has to play an important role in helping the individual consciously act in the modern world, it should be reflected in knowledge *about* technology in school curriculum. Some positions proposed by Ellul (1987/1990) could be used for reinforcement of the concept:

- all technological progress has its price
- at each stage it could raise more and greater problems than it solves
- its harmful effects are inseparable from its beneficial effects
- it has a great number of unforeseen effects.

More balanced view

In the documents analysed, the attitude to technology is unbalanced, close to a one-dimensional determinism. At the theoretical level, determinism in understanding relationship, between society and technology has been criticised. Thus, it is important to formulate a balanced view on technology and to include this knowledge in the curriculum. Technological development is neither good, bad nor neutral. It is a complex mixture of positive and negative elements. The usage of it is 'as much the result of human choice as it is of technical determination. The technical universe also makes determinations that are not dependent on us and that dictate a certain use' (Ellul, 1987/1990: 37). Recent history shows that we cannot talk about the total mastering of technology. Technique has 'its own weight, its own determinations, its own laws. As a system it evolves by imposing its own logic' (p. 150). This view needs to be strongly presented in curriculum.

Conclusion

The following points summarise this analysis:

- discussion of technology on a theoretical level is made explicit to different degrees in curriculum documents of the countries under consideration. One of the important shifts in understanding the phenomenon from applied science to social interpretation is visible in the Western countries. Although in Russia, technocratic ideology is predominant, some attempts are being made to modify this understanding. They appear to be influenced by British and the USA educational policies but they have not yet found the adequate reflection in the Standards. This difference in paradigm has the major influence on understanding technology in technology education.

- in two cases (the UK and Russia) technology is not considered as a starting point for curriculum development. As the result the phenomenon which exists in reality is not discussed in the educational documents to their full extent (in Russian Standards a definition is made). This could lead to an unrealistic and segmented approach to knowledge *about* technology in technology education.
- in the USA and Russian documents knowledge is emphasised as an important part of technology. This could influence understanding of the important place of knowledge in technology education.
- a critical and balanced view on technology as a phenomenon which is developed in theory is not presented or well developed in the rationale in the documents analysed. However, it is extremely important to acknowledge these features of technology in the modern world and include them in the body of knowledge *about* technology in the school curriculum. This could help students develop their reflective/critical intelligence.

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Appendix 1: The following documents for each country are used for the analysis:

Australia – K–12 Technology Curriculum Map: A report to the Australian Education Council, August 1990 (1991), the Interim Statement (1992) and A Statement on Technology for Australian Schools (first published in 1994).
UK – the Interim Report (1988), the Final Report (1989) and Design and Technology, the National Curriculum for England (1999)
USA – A Conceptual Framework for Technology Education (1990), Technology for All Americans: A Rationale and Structure for the Study of Technology (1996) and Standards for Technological Literacy: Content for the Study of Technology (2000)
The influence of the documents is different in each country. The main distinction is statutory status (the UK and Russia) and consultative nature of the documents (Australia and the USA).
In the case of the UK only English documents have been analysed.
Russia – A Federal Law 'About State Educational Standard of General Education', Supplementary 11 – Educational Area Technology (Draft, February 1998), Compulsory Minimum Content: Learning Area Technology (August 1998), and The State Standards for the comprehensive schools: Learning Area Technology (1998)

Appendix 2: Understanding technology in curriculum documents – comparison between four countries.

To what extent the phenomenon is described (rating out of 4)	Australia 2	UK 0	USA 3 (most extensively)	Russia 1
And considered as a starting point for curriculum development	To a very limited extent school practice is emphasised as a starting point	No. Aims of learning and good practice are the starting points	To full extent	No. Aims of learning is a starting point
Technology is	A process	A process – design and technological activity	Knowledge and process	A body of knowledge about activity
Aim of technology	To create products and processes that meet human needs	To design and make products that meet human needs	To develop systems that solve problems and extend human capabilities (to meet human needs and wants)	To reshape materials, energy and information for the purposes and interests of person, society and environment
What position can be used to explain the phenomenon	Social determinism	Technological determinism	Social determinism	Technological determinism
What to do with technology?	Manage, understand, use, made the informed decisions	Cope, understand	Use, manage, understand	Not specified
Humanities – applied science approaches	Humanities	Humanities	Humanities	Applied science
Values	Play a leading role in making decisions	Require value judgement at every stage	Decision making should reflect the values of the people (more than one solution)	Values are stated as external to technology: common human values are important to consider
Attitude to technological progress	Belief in technological progress, it is positive	Belief in technological change that cannot be reversed and has enormous power	Advantages and disadvantages of technology, belief in progress	Belief in technological progress