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Concept of knowledge in technology education: a cross-cultural perspective

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Abstract

This paper reports on the result of a cross-cultural study conducted in three countries Russia, UK and Australia with the aim to examine the interpretations of the concept of knowledge in Technology Education (TE). It is based on the interviews with educators from those countries. The results are grouped in several themes which are considered as a context for examining the concept of knowledge.

The paper discusses key factors influencing the development of the concept, including the difference in cultural and educational tradition and the difference in understanding technology as a phenomenon in the society. Encyclopaedic tradition in Russia and early specialisation in UK, for example, play an important role in developing the concept of knowledge.

On the basis of interviews and theoretical analysis two questions, crucial for the further examining of the concept of knowledge, are considered: What is the relationship between technology as a phenomenon and technology education? and What are the aims of technology education?

Modernity as a context

Nowadays there is a great concern about the nature and status of knowledge in modern life. More and more authors (for example, Beck, 1994, Giddens, 1994, Simpson, 1995) state that in our world the belief of the Enlightenment thinkers in the progressive character of knowledge is false. Growth of the human knowledge creates uncertainties and risks. The 'first' global society is unified in a negative way - by the generating of common risks. However, the knowledge of technical experts still can guarantee some protection for the lay population (Beck, 1994, Giddens, 1994). There is a danger of colonisation of the life-world by the system based on purposive-rational action under given conditions and oriented to success (Habermas, 1996).

The modern world is viewed 'either as a mere occasion for the unlimited satisfaction of desire, or as a resource for unlimited making' (Simpson, 1995:153). Simpson (1995) suggests

"that we view technology as a characteristic part of the infrastructure of post-modern

society. As the infrastructure for procuring the satisfaction of desire, technology - in concert with the capitalist organisation of the processes of production, distribution and consumption - is the material basis of the proliferation of post-modern desire. Post-modernism's emphasis upon novelty colludes with capitalism's interest in proliferating and expanding desire and with the technological promise of satisfaction" (ibid., p.153).

Therefore, there is a close relationship between technology, desire and risk in the modern society.

The Cartesian tradition in analysis of knowledge and the process involved in its acquisition which has dominated theoretical discourse for the last 300 years has been criticised in the mid-twentieth century. Particularly after 1960s changes in the epistemological debate were caused by the works of L. S. Vygotsky and Mikhail Bakhtin, George Herbert Mead, R.G. Collingwood, who consider all knowledge socially and culturally situated. The dialogical character of

knowledge in the process of cognition was stressed by these authors. Another aspect of debate was proposed by American pragmatics who 'breakdown the distinction between practical and formal knowledge, the integration of knowledge and value' (Goodman and Fisher 1995:xxv).

How does this context influence understanding of the concept of knowledge in technology education? Is it valuable? To what extent is it culturally situated, to what extent universally based? What are the major factors which influence the development of the concept of knowledge in technology education?

Organisation of research

This paper presents a discussion based on the results of a cross-cultural study conducted in three countries Russia, the UK and Australia. Leaders in technology education and secondary school teachers from those countries have been interviewed. The research employed a methodology of comparative studies, which has been drawn from a variety of positions and theories. Two separate paths in methodology of comparative education are being recognised: (a) 'a pragmatic', 'reflective', 'conventional' and (b) 'systematic', 'scientific', 'post-conventional' (Liegle, 1992, Schriewer, 1992, White, 1981). 'The first one is oriented on learning about other national systems of education and using foreign experience to support educational reforms at home (the main purpose is utilitarian), the second - intends to propose a way of cross-national theory-building (a search for truth as the opposite to reformist purpose).

The research is considered as 'an uninterrupted two-way traffic' between the level of general ideas, integrative theories, or explanatory models and the level of empirical research and detailed observations of specific events (Schriewer, 1992:54).

The results of the interviews are grouped in several themes. Three of them - Technology as a phenomenon, Technology education (TE), Educational policy in the area of TE are examined as a context for exploring the concept of knowledge in TE.

Findings

For educators of all three countries understanding of knowledge is closely related to the content areas described in the curriculum documents. In the UK and Australia design strategies are mentioned as well as characteristics of materials, structures, information, etc. Russian educators believe that the formal structure of technological knowledge exists but they do not know exactly how it looks.

Most participants in the UK think that TE and therefore knowledge are completely culturally embedded. In Australia and Russia interviewees state that it is at least in some way universal. Russians propose that it is universal to a high degree. Educators in all countries believe that knowledge in TE is valuable but there is no agreement about what type of knowledge and to what extent it is universal. In the UK all educators interviewed think that formal knowledge is not very important; the result of trial and error experience is the main source of knowledge. In Australia, and to a high proportion in Russia, interviewees believe that structured knowledge should be learned by students.

Almost all interviewees would like the concept of knowledge to be defined more precisely. They do not feel comfortable describing the concept and their understanding of it does not go beyond curriculum boundaries.

Two contrasting views on knowledge (formal and experience-based) are closely related with different understandings of technology. In the case of the UK and Australia its main feature is a process, in the case of Russia - it is defined as a body of knowledge.

However, when the interviewees interpret the understanding of technology in society - all Western participants (Australia, the UK) refer to objects like computers, automobiles, machines and all Russian respondents - to the process. So, accepting technology as a phenomenon on the level of common sense is opposite to its interpretation in education.

There is absolute coincidence between understanding of the nature of technology education (process of design) and its

description in the curriculum documents in the UK where the subject is well established. In Australia and Russia the answers are much more flexible in interpretation. In Russia design is not considered as the main approach. In the UK and Australia there is a high level of support for the National/state policies in the area of technology education, however, some possible improvements are proposed. They are connected with teachers' in-service training. In Russia - those who are not related to development of the policy, do not think that it exists or that it means anything.

In spite of Australia's development under the influence of the British design-based approach, in some issues educators' understanding is closer to Russian views than to British. The multicultural environment and the strong impact of the USA could give some explanation for this.

Differences in understanding the concept of knowledge and TE are largely embedded in history and culture. In the 19th century 'technology' meant a systematic knowledge of industrial arts and 'technique' being the means of practical application in English-speaking countries (Mitcham, 1978). In the 20th century this distinction has broken down. 'It appreciates neither the inherently practical

character of "technology" (as knowledge), nor the generality of "technique" (as skill, which can be of playing the piano or even reading a book)' (ibid.,p. 251). In other languages, such as Russian and German, the distinction continues to exist with the opposite meaning to the English version: 'Tekhnologiya/Technologie' vs. 'Tekhnika/Technik', which means process vs. object. The word technique is also used in the Russian language with an equivalent meaning in English.

Historically, in Russia in the educational process, the main attention was paid to 'tekhnika' and on the philosophical level there was a philosophy of 'tekhnika' (and still is). The broad understanding of technology is not widely spread in society. It has been introduced only on a school level (with a special emphasis on knowledge) which causes a great misunderstanding and misinterpreting by most educators. Still in the content of the course technology - 'tekhnika' is one of the main modules (tools, equipment, machinery).

Cultural/educational traditions in the UK and Russia strongly effect the process of curriculum development, including TE and understanding the role of knowledge in it. They could be summarised in the table (Table 1). There is no point similar to each other. This

Russia	UK
focus on group	focus on individual rather than social group
universality and uniformity	child-centered, humanistic approach
emphasis on content	emphasis on process
Pansofia - general wisdom, encyclopedism and broadness of knowledge	specialization, individual choice, depth of perception and understanding
the starting point for knowledge selection - as much knowledge as possible about all subjects appropriate to the age	the starting point for knowledges election - the individual needs and valid acceptability of sources
theoretical approach for scientific research, analysis more important than synthesis	empirical approach to scientific research, knowledge is created cumulatively out of small-scale inquiries
main aim of education - to equip students with knowledge about reality and knowledge about activity in it	the purpose of education - to develop moral capacities: moral ensibility, a commitment to duty and capacity for decision-making based on action (McLean, 1990)

Table 1 Educational traditions

comparison gives some keys for explaining the differences which appeared in the interviews.

Nowadays the influence of tradition is strong, but the process of globalisation creates new tendencies. Technology per se is partly based on cultural characteristics, but partly it is universal. DeGregory (1985) states that technology is both universal and particular. It is universal because its principles go beyond national boundaries. It is particular because as a problem-solving activity it derives from each country's own problems. Transfer of technological change creates, to some extent, the universal body of technological knowledge. The impact of technology is truly global and as a result, 'there is no pure cultures any more' (ibid., p.79).

Some points for discussion

The results of interviews give culturally embedded material. How can it be developed further on 'systematic', 'scientific', 'post-conventional' level? I argue that there are some crucial questions which could help to develop the framework for analysis and define the concept of knowledge. In this paper I consider two of them: What is the relationship between technology as a phenomenon and technology education and What are the aims of technology education?

What is the relationship between technology as a phenomenon and technology education?

Depending on the replies, two extreme positions are possible -(i) a strong or (ii) a weak relationship between technology as a phenomenon and technology education. In the first case, the curriculum is oriented towards understanding the essence of the phenomenon, its main features, basic principles and rules. In the second case, the curriculum is organised around bits and pieces of the phenomenon which are useful for immediate practice. The crucial difference between these extremes is to what degree their supporters advocate a systematic approach to technology as a phenomenon.

The nature of technology is under discussion and to some extent it is easier to develop a technology education curriculum without establishing strong links to the phenomenon

(design based approach is an example). It is widely acknowledged (see Mitcham, 1978, Simpson, 1995, for example) that technology as a phenomenon includes goal-oriented activity as well as orient to minimise the time necessary to realise the goal and increase efficiency. 'Along with utility and the means-ends distinction, other central and privileged items in such discourse are terms such as 'efficiency', 'effectiveness' and 'control'' (Simpson, 1995:77). The design-based approach to curriculum development emphasises the goal (which is oriented on human needs), but does not pay sufficient attention to other characteristics of the phenomenon.

Two different ways of establishing links between the phenomenon and curriculum, frame different understanding of the concept of knowledge. In the first case, systematic knowledge, theoretical as well as practical has to be taught. Technological knowledge is described on several levels : from the highly systematised and formalised knowledge of the engineering profession to the tacit knowledge of the artisan (Mitcham, 1978, Ropohl, 1997). Modern technology has a very close relationship with science, so some technological theories (partly based on contemporary scientific knowledge) need to be known by the students (and to some extent they will be universal).

In the second case, it is a fragmented emphasis on this or that level or type of knowledge. It could be an applied science course, a designed-based or a skill trained course. In the applied science course the level of engineering knowledge is important. In the design-based course technological theories are not studied because they could not be generalised directly from practice. The process is more important than the end. Knowledge has no value *per se*, only the capability has (Medway, 1992). As a result the knowledge is culturally embedded only.

What are the aims of technology education?

The aims of technology education are the other important factors which influence the understanding of the concept of knowledge. What is the aim of TE - to develop a creative

Level	Type of knowledge	Competence
1 Technological awareness	knowledge that	understanding
2 Technological literacy	knowledge that	comprehension
3 Technological capability	knowledge that and how	application
4 Technological creativity	knowledge that and how	invention
5 Technological criticism and why	knowledge that, how,	judgment

(Todd, 1991, p.271)

Table 2 Technological competencies

or technologically literate or technologically capable person? If we consider the examples of Russia, the UK and Australia, the USA the orientations are - creativity, capability, literacy (respectively)(see Ministry of Education of Russia, 1997; Department for Education, Welsh Office Education Department, 1995; Technology: a curriculum profile for Australian schools. Curriculum Corporation, 1994; Technology for All Americans, 1996). How do these three orientations correspond to one another? There have been several attempts to establish a taxonomy of technological competencies. The example of Todd's proposal is presented in the Table 2.

The whole approach to curriculum development depends to a high extent on what level of competencies the subject is oriented towards. 'There are two different kinds of 'progress' in knowledge; one corresponds to a new move (a new argument) within the established rules; the other, to the invention of new rules' (Lyotard, 1996:495). As a result there is a huge difference between design and invention which is discussed by a number of authors. Mitcham argues that the phenomenological difference between invention and design is that 'an inventor creates whereas a designer plans or at most discovers... the designer remains within the familiar and systematic; he does not deal with the unknown but only orders the known along well-established methodological lines' (Mitcham, 1998:248-249).

If the aim of technology education is a creative person, a 'strong link' approach between

technology education and technology should be employed to increase the potential of the student to have a holistic view on technology. It also gives the opportunity to develop two levels of abstract thinking - empirical and concept based. Sohn-Rethel (1978) separates the Real Abstraction and the Conceptual Abstraction. The concept-based abstraction stands outside the real sense-perception. It exists on the level of ideas and is connected with a theoretical level of thought. If the aim of technology education is a capable person, as in the case of design-based approach, only empirically-based abstraction is generated.

Transferability of skills and knowledge has an important impact on developing a holistic understanding of the phenomenon and on operating at different levels of abstraction. The problem occurs in the process of trial and error where 'situated cognition' has a place. The learning process links with the context and does not have generalised qualities (Rogoff, 1990). This result corresponds with research of Galperin and Taluzina (1975) who identify that different types of orientation during the action provide a different effect on the level of generalisation of knowledge and skills.

Kimbell (1996) proposes to use reflection (which helps to turn tacit operations into explicit understanding) as a method which helps to make knowledge and skills more transferable.

Galperin and Taluzina (1975) propose to study the action not only in concrete situations, but

on more general levels - to analyse the task from different points of view, discuss the alternative ways of solving problem. The teacher has to play a very important role in the process of generalising students' experience. From the time when the child has the ability of abstract thinking the teacher has to use it. The successful way of developing transferable knowledge and skills starts from generalisations about the actions then moves to generalisations about the object and then goes back and forth from concrete to more general levels (Novikov, 1986).

Some other important issues which have a crucial influence on the understanding of the concept of knowledge in TE are not discussed in this paper. Among them are, the problem of rationality, the structure of students activity and the mastering of knowledge by the students and the organising of the learning process in the approximate zone of the child's development.

Final remarks

The historical example of the Britannia Bridge supports some ideas presented in this paper. During the construction of this bridge the theory for bending loads had been worked out by D.J. Jourawski in Russia and was not known in Western Europe. 'Thus no theoretical basis was available for analysing the catastrophic buckling of the sides' (Rosenberg and Vincenti, 1978:28). British engineers used practical knowledge gained from model tests. As a result the design of the bridge was heavier than it needed to be. 'The tubular-type bridge was too heavy and expensive to be successful in the long run' (ibid., p.46). Jourawski 'later made an extensive critique of the bridge design based on his theoretical understanding of shearing loads' (ibid., p.33). Also, British engineers did not generalise the theoretical statements, so the experience 'did not contribute significantly to the theory of the subject' (ibid., p.60).

This example demonstrates the value of theory and the need for generalisation. In the context of modern world people who can be rational on the level of thoughts as well as on the level of action are needed. Therefore 'intellectually trained' people (White, 1981)

have to be balanced by intellectuals who can decrease the risks of modern life.

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