Comparing perspectives: comparative research in technology education

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This paper reflects on a number of different ways by which comparative research in technology education has been undertaken across countries. The history of comparative research in technology education demonstrates that it is possible to identify three major periods in the process of its development. When technology education was established a comparison had been made at the level of curriculum documents, syllabi and State Orders. People involved in the development of technology education were looking around the world for ideas. During this first stage, approaches to the analysis were not very systematic.

The second stage of development of comparative research in technology education could be characterised by a great number of published or presented papers that describe the situation in a particular country. Even though comparison, as such, was not used in this research the underlying assumption was that it should inform the research community on different approaches towards technology education and that it would be beneficial for the field.

The third stage involved comparison between two or more countries about one or more specific aspects of technology education. These include the meaning of the major concepts, teaching methods, comparison of goals, comparison of the balance between the global trends and local specificities, etc.

In this paper it is argued that the essential move towards the next stage should be done – a comparison on the basis of two ideological beliefs about the purposes of general education. These are: whether education is designed to broaden minds and develop all students in the creation of a better society or is it really about training students to live and work in a market-oriented state, to be 'productive' in seizing the opportunities of the market. These two approaches have been chosen because they summarize an important issue that divides different social theories in their views on the role of education in society. They can provide a useful framework for analysing historical influences, curriculum theories, documents, and school practices in technology education in different countries.

Key words: comparative education, technology education, instrumental paradigm, developmental/humanistic paradigm, methodology, education for sustainable development

Introduction

Retrospective analysis of what has been happening in a particular area over a particular period of time can provide a valuable reflection on how a phenomenon is being developed, what issues have been addressed and how it is possible to proceed in the future. This paper reflects on a number of different ways by which comparative research in technology education has been undertaken over the last 20 years. It is possible to identify three major periods in the process of its development. When technology education was established as a learning area a comparison had been made at the level of curriculum documents, syllabi and State Orders. People involved in this process were looking around the world for ideas.

The second stage of development of comparative research in technology education could be characterised by a great number of published or presented papers that described the situation in a particular country (Ajeyalemi, 1990; Putnam, 1992; Middleton, 1996; etc). Even though comparison, as such, was not used in this research, the underlying assumption was that it should inform the research community on different approaches towards the development of technology education and that it would be beneficial for the field.

The third stage involved comparison between two or more countries about one or more specific aspects of technology education. These include the meaning of the major concepts, teaching methods, goals, the balance between the global trends and local specificities, etc. (Lewis, 1996; Gradwell, 1996; Pavlova, 1998). This represented a movement from a somewhat superficial to a more systematic comparison, from comparison as a natural way of learning to comparison as a research method.

Histories of any field are collected and reflected on through the histories of individuals who are involved in the development of the field. The development of comparative education research is reflected in the biographical history of the author's professional development. In 1988-1991 that research aimed at analysing English approaches to technology education and was conducted with the goal of informing and influencing the process of policy development in Russia. In 1997 –2001 the research was focused on a particular issue – knowledge in technology education, with the aim to analyse it across several countries and to develop a framework for its conceptualisation. Writing about Russian technology education was also being undertaken in parallel with this.

Thus the paper will reflect on these stages and personal history of research and propose a way for the further development of comparative research in technology education, the way that can provide a framework for a better understanding of the role of technology education and its contribution towards students' development and learning.

Stage one – help me to establish technology education

From the very early days of establishing technology education, comparative research played a significant role in its development. Technology education as a field of study was widely recognised by the end of the 1980s although the debate on including *Technology* in school curriculum started much earlier. By the end of the 1980s education, coupled with market reforms, became the dominant position in educational policy. Education has been seen as the source of responsiveness to technological change. A close association between education and the economy brought technology education as an important area of discussion in many reports

undertaken by educational authorities in different countries. Changes in educational policy and the existence of different practical courses in school curriculum became the background for including technology education in the curriculum of comprehensive schools internationally.

In particular the assumption was made about the goals of technology education - to be relevant to the economic needs of the nation and to prepare students for work and life in society. Technology education was seen as a means for developing knowledge, skills, attitudes and values which allow students to maximize their flexibility and adaptability to their future employment, mainly, and to other aspects of life as well. In the UK, the former Secretary of State for Education, Kenneth Baker, announced that Technology as a subject was considered to be "of great significance for the economic well-being of this country" (cited in Barnett, 1992, p. 85). *A Statement on Technology for Australian Schools* explained: "Technology programs prepare students for living and working in an increasingly technological world and equip them for innovative and productive activity"(Curriculum Corporation, 1997, p. 4). In the USA it was announced that technology education was "vital to human welfare and economic prosperity" (ITEA, 1996, p.1).

This was the first stage in the development of comparative research in technology education. A comparison had been made at the level of curriculum documents, syllabi and State Orders. People involved in the development of technology education were looking around the world for ideas. During this first stage, approaches to the analysis were not very systematic. Every team that started work on the Syllabus for a particular country looked at the international experience, in many cases by going to other countries as published works were not available.

Similar research had been done at the national level in countries where the educational system was not centralised. For example in Australia this type of research examined developments in Australian schools in the area of technology education in different states. A report of this study the *K-12 Technology Curriculum Map* was published in 1991. It stated that there was no generally accepted definition of technology education. A variety of roles designated for technology education highlight the absence of a common way of providing it in schools. Understanding of technological courses varied dramatically between applied science, informational technology, industrial technology and trade subjects. Technology education programs were focused on:

- the translation of scientific principles and ideas into tangible outcomes (Technology Studies);
- particular crafts (Practical Studies);
- natural phenomena (Science Studies);
- socio-cultural matters (Humanities Studies) (AEC, 1991).

However, the 1991 study identified a shift from an emphasis on physical and practical skills towards the inclusion of the more intellectually demanding processes of identifying needs, designing, problem-solving and appraising.

The results of this study highlighted the need to develop a common rationale for technology education across Australia to provide the different states with a common ground for school education in that area. It was established in 1994, through the National *Statement* and *Profiles*. This comparative research is a typical example of the first stage research. Its main goal was to inform the development of educational policy in the area.

Sometimes the superficial comparisons of this period were not able to provide many insights into what was really happening and why it might be appropriate or not for particular settings.

Comparison of formal parameters such as those presented in Table 1 provides some data but its usefulness was limited.

Table 1. Comparison of the formal parameters.

	Australia (QLD)	France	Russia
Level on which the Syllabus is approved	State	National	National
Subject/learning area	Learning area	Subject	Subject
Compulsory	Y1-Y10	Y1 – Y8	Y1 – Y 9
Number of hour, per week	1 - 2	1 - 2	2 (in Y9 – 1hour)
How is it presented	On 6 levels and beyond via 4 strands	Through the 3 cycles and scenarios	3 levels and 11 content modules

Comparative research at this stage was associated with one feature of the process of globalisation: the international circulation of ideas through social and political networks bringing common elements to curriculum documents of different countries. Compression of the world (Robertson, 1995) provided an opportunity to have a look at the 'universal' elements of technology education, and they had been explored through the supranational connections. The author's research was searching for the 'universal' elements in the English Syllabus that could improve Russian technology education (Pavlova, 1993).

Stage two – let me tell you what's happening in my country

Stage two in comparative research in technology education is related to another feature of globalisation: development of specific, conceptualised characteristics and emphasis on the realisation of policy in specific national settings. By the end of 1990s an issue of universalism versus cultural diversity became the main methodological challenge in comparative education research (Mitter 1997; Masemann, 1997). An argument had been made that the context of the particular country should be extensively analysed so that comparison can happen. Although there was little discussion of comparative methodology in technology education a large number of articles were published in the International Journal of Technology and Design Education (e.g. Potgieter, 2004; Jones, Harlow, Cowie, 2004; Wilson, and Harris, 2004; Compton, Harwood, 2003; Jones, 2003; Ginestié, 2002; Turnbull, 2002; Verner, Betzer, 2001; Given, Barlex, 2001; Volk, Yip, and Lo, 2003; Jones, and Moreland, 2002) as well as papers presented at international conferences (e.g. Huang, 2002; Compton and Harwood, 2002; Molwane, 2001, Lebeaume, 2003) that describe technology education (or particular issues) relevant to a particular country.

This research outlined what was specific for particular countries and how common ideas were being implemented. There were no comparative elements as such in this type of research. However, the underlying idea was that the cross-national comparison should have happened in the minds of academics. A lot of publications had a very descriptive nature that was not really helpful in moving the field forward. Particular contexts were described but it was not framed by the broader context that provides links or shared starting points for further analysis (universal side was not explored).

The author's personal history of this stage relates to the analysis and description of technology education in Russia. The issues addressed included general description, analysis of the process of change, approaches towards teaching, design as a new concept, etc. For example, a number of limitations had been identified in interpretation and use of a design-based approach towards

teaching technology. These were mainly caused by traditional interpretations of educational process as a systematic approach based on theory (Pavlova and Pitt, 2000; Pavlova, 2002a).

Stage three – this is an issue, let's compare

The dominant approach in comparative education by the end of 1990s was a cross-national comparison. It had been challenged by a number of researchers in comparative education (Welch, 1993; Cowen, 1996). As a result, an important methodological problem was raised: what are the appropriate units for comparative analysis. This challenge was addressed in technology education research by choosing a particular issue (unit of analysis) such as problem solving, students' attitudes, activities and comparing it across a number of countries (e.g. Banks, Barlex, Jarvinen, O'Sullivan, Owen-Jackson, Rutland, 2004; Graube, Dyrenfurth, and Theuerkauf (Eds.), 2004; Rasinen, 2003; Hill, Anning, 2001). Although, the global-local problematic has not been particularly explored, this type of analysis was useful for a number of reasons. Firstly it demonstrated an attempt to focus on a particular issue and to find better solutions that would be appropriate for particular contexts. Secondly, it represented a systematic approach towards comparison using comparison as a method of research. All three stages in the history of comparative education are closely interrelated, each provides knowledge and understanding required for the next stage.

Reflection on research done by the author, on knowledge in technology education provides an example of the study relevant to Stage three. A comparative analysis of educational documents that were directly connected to the policy in technology education was a part of that research. Consistency in choosing documents and their position (the statutory status or the consultative nature of the document) were considered as important issues in achieving a systematic approach towards comparison (Pavlova, 1998, Pavlova, 2001). Among the criteria was the date of publication (before April 1999). Multi-level analysis framed by the global –local considerations provided an appropriate methodology for this comparison. Results of the analysis that related to knowledge in technology education documents is summarised in Table 2.

Table 2. Understanding knowledge in curriculum documents - comparison between four countries

	Australia	UK	USA	Russia
Definition of knowledge	Non-explicit: Information is knowledge generated and used in everyday life	Not stated	Knowledge is interpreted information that can be put to use	Not stated
Source of knowledge for technology education	Not clear, Knowledge is not explicitly stated, the required activities are specified	*Terms of Reference* stated knowledge which students need to have to achieve technological capability	Place and nature of knowledge in technology	Non-justified selection of knowledge – what students have to learn to achieve the aims of the subject
What knowledge is stated?	Technical knowledge about information, systems, materials and process of designing, making, appraising + value judgments connected to those issues	Technical knowledge about materials, systems, structures, products, etc.	Technological knowledge; emphasise on the relationship between technology and society and vice versa	Technical knowledge or particular knowledge (legislation, for example)
Relationship	Not stated	Not stated	Understanding is	Not stated

knowledge/ understanding			knowledge synthesised into new insights	
Structure	Boundaries are not clear	Boundaries are not clear	It is possible to set up boundaries	Boundaries are clear
Is the selected approach justified?	No	Several assumptions have been made, no theoretical justification	Yes	No theoretical justification

This summary highlights that only declarative/conceptual knowledge was stated in the curriculum documents of Russia, the UK and the USA. In those countries procedural knowledge could be implicitly seen through the description of what students should be able to do or skills required. In the latest version of the Australian *Statement* declarative knowledge was not separately specified. The assumption was made that through the specified activities students develop the 'required' knowledge. Thus, the emphasis was on procedural knowledge.

Required knowledge was explicitly described in the UK and the USA documents. In the UK document a list of knowledge was specified from the very first document and then gradually developed throughout the analysed period. In the USA the nature of knowledge in technology had been explored and then used as content for the *Standards*. Through the analysed period a shift had been made from considering technology as a body of knowledge to limiting its place as a part of the structure of technology. Nevertheless, knowledge *per se* remained in a very important place in the USA document.

Technological knowledge is seen as having clear boundaries in the USA and Russia, and without clear boundaries in the UK and Australia. At the end of the analysed period, in the UK the emphasis was on technical knowledge, although values were considered as playing an important role in technology. In Russian documents technical knowledge was seen as important to achieve the aims of technology education and was described in the content modules. In the USA, the philosophical/sociological aspects of the relationship between technology and society were stated as important.

The forms of knowledge and levels of its generalisation (using Mitcham's approach) were used to some extent in the USA documents. In Australia, Russia, and the UK documents they were not discussed. In Australia and the UK the main emphasis was on lower levels of generalisation (artisan skills and technical maxims). In Russia and the USA the higher levels of knowledge were also involved (technological theories and descriptive laws). Knowledge *about* technology (as a general phenomenon) was included in the USA *Standards* and to a very limited extent - in the Australian *Statement*.

These results together with analysis done on the other levels (academic discourse, academic perceptions) provided a basis for the development of a conceptual model of knowledge in technology education that incorporated universal-context-dependant elements.

This research also demonstrates that a different approach towards comparison is required to understand better the nature of technology education in different contexts. There is a need to have a framework that would allow an understanding of technology education not only on the level of educational policy, curriculum theories, academics' perceptions but also on the level of school practice.

Comparison on the basis of two ideological beliefs about the purposes of general education is proposed as a way forward in developing comparative research in technology education. These

beliefs are: whether education is designed to broaden minds and develop all students in the creation of a better society or is it really about training students to live and work in a market-oriented state, to be 'productive' in seizing the opportunities of the market. These two approaches summarize an important issue that divides different social theories in their views on the role of education in society.

Stage four – compare to establish a better society

In the proposed approach a comparison is made between two different rationales, thus cross-national comparison is overwritten by comparison that crosses country borders. In all societies it is possible to identify two major groups of technology educators who have different answers for the question: what is the nature of technology education? Is it instrumental or developmental? Two issues will be used to demonstrate the utility of the proposed approach to comparative research. They are: values in technology education and education for sustainable development.

Values in technology education

The necessity of exploring values in technology education has been argued by a number of authors (Layton, 1991; Barlex, 1993; Prime, 1993; McLaren, 1997; Breckon, 1998; Holdsworth and Conway, 1999) to be a vital aspect of a comprehensive technology curriculum. These researchers highlight the potential of a technology curriculum in enriching students' awareness and appreciation of their responsibility as members of a technological society. Further development of research in this area (Pavlova, 2002b) proposed a framework for addressing values in technology education based on the ideas drawn from philosophy (eg. Habemas, 1974/1963) and psychology (eg. Oser, 1994) and related to the notion of the hierarchical order of values (Schwartz, 1992 cited in Prime, 1993; Rokeach, 1973).

Among technology teachers, values related to competence (technical, economic) have a priority compared to moral values (Holdsworth and Conway, 1999). However, as stated by Habermas (1974/1963) rationality (defined as efficiency and economy) "cannot itself be placed on the *same* level with all the other values"(p.259) or prevail above them. He cited Hans Albert who made the suggestion:

> to place in the foreground … in the establishment of a criterion for the
> validity of ethical systems, the satisfaction of human needs, the fulfilment
> of human desires, the avoidance of unnecessary human suffering. Such a
> criterion would have to be discovered and established, just as this is true
> for the criteria of scientific thought. (Habermas,1974/1963, p.280)

Thus, rationality and effectiveness must be framed by moral considerations. Moral values constitute a part of the person's value system. According to Rokeach (1973) moral values refer to those "that have an interpersonal focus which, when violated, arouse pangs of conscience or feeling of guilt for wrongdoing" (p.8). They refer mainly to modes of behaviour and "do not necessarily include values that concern end-states of existence"(p.8). The moral (morality) is considered as an aspect of the ethical, "namely that which particularly concentrates on obligation, the ought and ought-not, on duty and conscience and human virtues, where the ethical will also include consideration of the good life, happiness, well-being, admirable conduct over and above the call of duty"(Jarrett, 1991, p.14).

Moral values of both students and teachers should be addressed in technology education. In relation to the professional morality of the teacher a concern similar to that expressed by

Habermas provides a basis for the theory that starts from the assumption that no professional action should be guided only by "functional criteria of means and end relations under the perspective of functional success" (Oser, 1994, p.60). As argued by Oser (1994)

> A responsible professional action must be informed by a structure of moral values that enables the actor to estimate positive and negative consequences that concern human beings immediately or indirectly. The relationship between success and care in regard to consequences is the core criterion of this theory. (p.60)

Thus, moral values should be at the top of the teachers' hierarchy of values. It was suggested (Pavlova, 2002b) that in order to provide adequate learning experiences to students, technology teachers need to consider the relationship between effectiveness and responsibility as a starting point for approaching value analysis. The regulative model of professional morality, which 'limiting the aspects of effectiveness by the aspect of responsibility', was proposed as a framework for the development of an appropriate classroom environment in technology education. Teachers should view the classroom environment and the process of designing and making primarily as "a moral enterprise but as serving functional purposes"(Oser, 1994, p.103). It is important that teachers' attention is being focused on moral values and on the inclusion of students as real discourse partners in discussion of ethically problematic situations.

Classroom environments that cultivate responsibility will stimulate students to put moral values first that would not be considered as one category of values among the others but as a reference point for all design decisions. The nature of technology education provides a rich context that can be easily moved beyond the concept of effectiveness. To deal with values effectively the teacher has to develop an appropriate classroom environment that will
- help students to recognise a situation as being ethically problematic,
- enable students to have a voice and express their feelings and thoughts, and
- find a solution that serves the best interests of all parties involved.

Thus, it was suggested that discussion of *values* presented in technology education literature at the moment, should be replaced by discussion of *moral values*. Also three components of values have to be taken into account:
- Cognitive component provides the awareness of different values and demonstrates reasons to put moral values first.
- Affective component establishes links between the technological task and students feeling by putting technology into a meaningful context.
- Behaviour component gives students an opportunity to act in accordance with their moral values.

The third component of values, a behavioral one, is not explicitly presented in technology education literature. However, it is analyzed in the psychological research as an important component of values that may lead to action (Rokeach, 1973).

Thus an argument about moral values that provides a frame for all technological activities strongly supports the importance of 'developmental' rationale for technology education.

Education for sustainable development

The notion of developing students so they are capable of being involved in the creation of a better society, by developing their responsibility is closely related to the concept of sustainability that is concerned about the future of humanity and the quality of life for the

further generations. "Education not only provides the scientific and technical skills required, it also provides the motivation, justification, and social support for pursuing and applying them. Education increases the capacities of people to transform their visions of society into operational realities" (UNESCO, 2001a, p.1)

Education for sustainable development (ESD) has gradually become an important issue for many educators internationally. UNESCO, for example, specifies that since Rio, there has been increasing recognition of the critical role of education in promoting sustainable life patterns in order to "change attitudes and behaviour of people as individuals, including as producers and consumers, and as citizens carrying out their collective activities" (UNESCO, 2001b, p.3).

Technology education as a part of general education can play an important role in promoting sustainable production and consumption. When the concept of sustainability is discussed within technology education it is focused mainly on the ethical aspects of the decisions that students make during design processes and on the sustainable design of products, with a major emphasis on the environmental impacts of these products (Elshof, 2003; Martin, 2003). These impacts can be assessed using such methodologies as Life Cycle Analysis (LCA) (http://www.pre.nl/life_cycle_assessment/default.htm) and Design for Environment (DfE) (http://www.pre.nl/ecodesign/default.htm).

A number of documents were developed to address the issue of education for sustainable development (ESD) at the national/state levels. For example, in the UK, in 2002 the Qualifications and Curriculum Authority produced a curriculum guidance document for schools, identifying the main concepts relating to ESD which provide opportunities to students to learn about ESD (referred to in Office for Standards in Education, 2003). In Australia, different states are developing their vision on ESD (Wooltorton, 2002). However the role of technology education in ESD has not been fully elaborated.

For example, a reference to appropriateness is made in the Queensland Syllabus. Appropriate technologies can be interpreted as 'technologies with a human face' aimed to enable people to earn a sustainable living. Although the 'right' statements are made in the content of technology education for Queensland schools, they are not included in the description of outcomes. Thus no assessment mechanism is proposed to measure to what extent teachers include these concepts in their practice and to what extent students will consider these issues when they are making judgments. In addition, a number of in-service materials have been printed to facilitate the implementation of technology education. However, examples (case studies) that are included in the Source book demonstrate that the meaning of appropriateness is very limited. Appropriateness is considered in terms of the particular local context and only within the current situation (not oriented towards the future). The 'right' examples of design projects do not include the description of how appropriateness/sustainability can be taught.

Thus there are a number of problems in the representation of ESD in technology education. Not all aspects of sustainability (environmental, social, economic, ethical) have been conceptualised within technology education and as a result, guidance for technology education teachers concerning what to teach, how to teach and how to assess student learning is not coherent and comprehensive. Recent research on these issues (Pavlova, 2004) proposed a systematic representation of ESD for technology education and a framework for planning learning activities that can be a useful tool in facilitating discussion.

Although further research is required in developing ESD via technology education, its importance has been clearly stated. Together with an emphasis on moral values these highlight the importance of developing responsibility in technology education students that, in turn,

relates to an identifiable rationale for technology education and teaching practice. Understanding of what rationale for technology education is used, instrumental or developmental, can provide a clear understanding of what technology education is about in a particular setting. Thus this framework for comparative research will help to gain a deeper understanding of technology education on both theoretical and practical levels and to see universal and contextualised elements in approaching the area.

Conclusion

This paper reflects on the history of comparative education research in technology education. Three stages of its development has been identified and analysed using some samples of research done in this area as well as some sample from personal professional history. Two important methodological issues: global trends – local specificities, and appropriate units of analysis were discussed to highlight different approaches adapted at different stages. A move towards the next stage in the development of comparative research in technology education has been argued as essential in moving research forward. Comparison on the basis of two ideological beliefs about the purposes of general education: whether education is designed to broaden minds and develop all students in the creation of a better society or is it really about training students to live and work in a market oriented state, to be 'productive' in seizing the opportunities of the market, was argued as an effective way of gaining an understanding of technology education in a particular setting. The importance of this new framework has been justified through discussion of two research issues – values in technology education and education for sustainable development.

References

Ajeyalemi, D.(Ed.) (1990). *Science and Technology Education in Africa: Focus on Seven Sub-Saharan Countries.* Lagos, Nigeria: University of Lagos.

Ankiewicz, P., van Rensburg, S., Myburgh, C. (2001). Assessing the Attitudinal Technology Profile of South African Learners: A Pilot Study *International Journal of Technology and Design Education* 11(2) pp. 93-109

Australian Educational Council (1991). *K-12 Technology curriculum map: A report to the Australian Education Council, August 1990.* Carlton, Victoria: Curriculum Corporation.

Banks, F., Barlex, D., Jarvinen, E.-M., O'Sullivan, G., Owen-Jackson, G., Rutland, M. (2004). DEPTH – Developing Professional Thinking for Technology Teachers: An International Study. *International Journal of Technology and Design Education,* 14(2), pp. 141-157

Barlex, D. (1993). The Nuffield approach to values in Design and Technology. *Design and Technology Teaching,* vol. 26, no**.**1, pp. 42-45.

Barnett, M. (1992). Technology, within the National Curriculum and elsewhere. In J. Beynon & H. Mackay (Eds.), *Technological literacy and the curriculum* (pp. 84-104). London: Falmer Press.

Becker, K. H. and Maunsaiyat, S. (2002). Thai Students' Attitudes and Concepts of Technology. *Journal of Technology Education* 13(2) 6-20.

Breckon, A. (1998). National Curriculum Review in Design and Technology for the Year 2000. *The Journal of Design and Technology Education,* vol. 3, no.2, pp. 101-105.

Compton, V., Harwood, C. (2003). Enhancing Technological Practice: An Assessment Framework for Technology Education in New Zealand. *International Journal of Technology and Design Education,* 13(1) pp. 1-26

Compton, V. and Harwood, C. (2002). Making Progress: progression and Technology Education in New Zealand. In H Middleton, M. Pavlova and D. Roebuck (Ed), *Learning in Technology Education: Challenges for the 21st Century* (pp. 62-70). Brisbane: Griffith University.

Cowen, R. (1996). Editorial. *Comparative Education*, 32 (2), 149-150.

Curriculum Corporation. (1997). *A statement on technology for Australian schools*. Carlton, Victoria: Author.

Elshof, L. (2003). Teacher's Interpretation of Sustainable Development. In J. Dakers and M.J. de Vries (Eds.) *PATT-13 International Conference on Design and Technology educational Research* (pp. 45-51). Glasgow, UK: Faculty of Education University of Glasgow.

Ginestié, J. (2002). The Industrial Project Method in French Industry and in French Schools. *International Journal of Technology and Design Education*, 12(2), pp. 99-122

Given, N., Barlex, D. (2001) The Role of Published Materials in Curriculum Development and Implementation for Secondary School Design and Technology in England and Wales. *International Journal of Technology and Design Education,* 11(2), pp. 137-161

Gradwell, J. B. (1996). Philosophical and practical differences in the approaches taken to technology education in England, France and the United States. *International Journal of Technology and Design Education*, 6 (3), 239-262.

Graube, G., Dyrenfurth, M.J. and Theuerkauf, W.E. (Eds.) (2004). *Technology Education: International Concepts and Perspectives.* Frankfurt am Main: Peter Lang

Habermas, J. (1974). *Theory and Practice* (J. Viertel, Trans.). Boston: Beacon. (Original work published 1963)

Holdsworth, I. & Conway, B. (1999). Investigating Values in Secondary Design and Technology Education. *The Journal of Design and Technology Education*, vol. 4, no.3, pp. 205-214.

Hill, A.M., Anning, A. (2001) Comparisons and Contrasts Between Elementary/Primary 'School Situated Design' and 'Workplace Design' in Canada and England. *International Journal of Technology and Design Education,* 11(2), pp. 111-136

Huang, C.-S.J. (2002). Educational Reform and the Technology Education Curriculum in Taiwan's Primary Schools. In H Middleton, M. Pavlova and D. Roebuck (Ed), *Learning in Technology Education: Challenges for the 21st Century* (pp. 211-220). Brisbane: Griffith University.

International Technology Education Association (1996). *Technology for All Americans. A Rational and Structure for the study of Technology.* Reston, Virginia: Author.

Jarrett, J I. (1991). *The teaching of values: caring and appreciation.* London: Routledge.

Järvinen, E-M., Twyford, J. (2000). The Influences of Socio-cultural Interaction upon Children's Thinking and Actions in Prescribed and Open-Ended Problem Solving Situations (An Investigation Involving Design and Technology Lessons in English and Finnish Primary Schools). *International Journal of Technology and Design Education* 10(1) pp. 21-41

Jones, A. (2003) The Development of a National Curriculum in Technology for New Zealand *International Journal of Technology and Design Education* 13(1) pp. 83-99.

Jones, A. and Moreland, J. (2002) Technology Education in New Zealand, *Journal of Technology Studies* 28(1/2)130-134

Jones, A., Harlow, A., Cowie, B. (2004) New Zealand Teachers' Experiences in Implementing the Technology Curriculum. *International Journal of Technology and Design Education* 14(2), pp. 101-119

Layton, D. (1991). *Aspects of National Curriculum: Design and Technology.* York: NCC.

Lebeaume, J. (2003). The Place of Technology Education in the Curriculum: The French example of main issues for the middle school. In J. Dakers and M.J. de Vries (Eds) *PATT-13 International Conference on Design and Technology educational Research* (pp. 41-44). Glasgow, UK: Faculty of Education University of Glasgow.

Lewis, T. (1996). Comparing technology education in the U.S. and UK *International Journal of Technology and Design Education*, 6 (3), 221-238.

Martin, M. (2003). Significance of sustainability issues for design and technology education: rhetoric, reality and resources. In J. Dakers and M.J. de Vries (Eds) *PATT-13*

International Conference on Design and Technology educational Research (pp. 165-169). Glasgow, UK: Faculty of Education University of Glasgow.

Masemann, V. L. (1997). Recent directions in comparative education. In C. Kodron (Ed.), *Comparative education: Challenges - intermediation - practice; Essays in honour of Wolfgang Mitter on the occasion of his 70th birthday* (Vol.1, pp. 127-134). Köln: Böhlau Verlag.

McLaren, S. (1997). Value Judgements: Evaluating Design - A Scottish Perspective on a Global Issue. *International Journal of Technology and Design Education*, vol. 3, no.3, pp. 259-278.

Middleton, P. (1996) The development of a technology short course in South Africa. *Journal of Design and Technology education*, 1(2), 130-135.

Mitter, W. (1997). Challenges to comparative education. Between retrospect and expectation. *International Review of Education,* 43 (5-6), 401-412.

Molwane, O.B. (2001). Establishing trends in design and technology teachers' approaches in Botswana. In E.W.L. Norman and P.H. Roberts (Eds.), *IDATER 2001 International Conference on Design and Technology Education Research and Curriculum Development* (pp.84 - 91). Loughborough, UK: Department of Design and Technology, Loughborough University.

Office for Standards in Education (2003). *Taking the first step forward…towards an education for sustainable development: Good practice in primary and secondary schools*. London: the Author.

Oser, F. K. (1994). Moral Pespectives on Teaching. In L. Darling –Hammond, *Review of Research in Education,* vol. 20 (pp**.** 57 – 127). Washington, DC: American Educational Research Association.

Pavlova, M. (1993). *Technology - a new subject at school.* St. Petersburg : Libra.

Pavlova, M. (1998). Concept of knowledge in Technology education: a cross-cultural perspective. In J. J. Smith and E.W.L. Norman (Eds.), *IDATER 98 International Conference on Design and Technology Education Research and Curriculum Development* (pp. 237- 243). Loughborough, UK: Department of Design and Technology, Loughborough University.

Pavlova, M. and Pitt, J. (2000). A design-based approach to technology education - is it acceptable practice in Russia? In P.H. Roberts and E.W.L. Norman (Eds.), *IDATER 2000 International Conference on Design and Technology Education Research and Curriculum Development* (pp. 147 - 154). Loughborough, UK: Department of Design and Technology, Loughborough University.

Pavlova, M. (2001). *Theorizing knowledge in technology education: policy analysis of four countries.* Unpublished PhD thesis. Melbourne: La Trobe University.

Pavlova, M. (2002a). Technology education in Russia: socio-cultural limitations to design-approach. *Science in Vocational and Technical Education*, 15, 15 -39

Pavlova, M. (2002b)."Teaching" values in technology education: a critical approach for the theoretical framework. In H Middleton, M. Pavlova and D. Roebuck (Ed), *Learning in Technology Education: Challenges for the 21st Century* (pp.96 –102). Brisbane: Griffith University.

Pavlova, M (2004) Sustainability: towards systematic approach for its conceptualisation in technology education. Paper for the international conference on *Purposes and assessments within technology education*, Paris, March 2004, http://membres.lycos.fr/aeet/

Potgieter, C. (2004). The Impact of the Implementation of Technology Education on In-Service Teacher Education in South Africa (Impact of Technology Education in the RSA), *International Journal of Technology and Design Education* 14(3) pp. 205-218

Prime, G. M. (1993). Values in Technology: An Approaches to Learning. *Design and Technology Teaching,* 26(1), pp. 30-36.

Putnam, A.R. (1992). Technology Education in the United States: A National Comparison of Philosophy, Implementation, and Organisation, *Journal of Epsilon Pi Tau*, 18(1), 38-44.

Rasinen, A. (2003) An Analysis of the Technology Education Curriculum of Six Countries. *Journal of Technology Education,* 15(1), 31 –47

Robertson, R. (1995). Glocalization: Time-space and homogeneity - heterogeneity. In M. Featherstone, S. Lash, & R. Robertson (Eds.), *Global Modernities* (pp. 25-44). London: SAGE.

Rokeach, M. (1973). *The nature of human values,* Free Press, New York.

Schwartz, S. H. (1992). *Universals in the content and structure of values: theoretical advances and empirical tests in 20 countries, Advances in Experimental Social psychology*, vol.25, Academic Press.

Turnbull, W. (2002). The Place of Authenticity in Technology in the New Zealand Curriculum *International Journal of Technology and Design Education* 12 (1) pp. 23-40

UNESCO (2001a). Education - Key to a Viable Future www.unesco.org/education/esd/english/education/role.shtml

UNESCO (2001b). Beyond Basic education to Education for sustainable development, www.unesco.org/education/esd/english/education/beyond.shtml

Verner, I. M., Betzer, N. (2001). Machine Control – A Design and Technology Discipline in Israel's Senior High Schools *International Journal of Technology and Design Education,* 11(3), pp. 263-272

Volk, K., Yip, W.M. and Lo, T. K. (2003). Hong Kong Pupils' Attitudes Toward Technology: The Impact of Design and Technology Programs *Journal of Technology Education,* 15(1), 48-63

Welch, A. R. (1993). Class, culture and the state in comparative education: Problems, perspectives and prospects. *Comparative Education*, 29 (1), 7-28.

Williams J. P. and Keirl, S. (2001). The status of teaching and learning of technology in primary and secondary schools in Australia. In E.W.L. Norman and P.H. Roberts (Eds.), *IDATER 2001 International Conference on Design and Technology Education Research and Curriculum Development* (pp.153 - 162). Loughborough, UK: Department of Design and Technology, Loughborough University.

Wilson, V. and Harris, M. (2004).Creating Change? A Review of the Impact of Design and Technology in Schools in England *Journal of Technology Education,* 15(2), 46-65

Woooltorton, S. (2002). *Education for sustainability: A Background Paper Prepared for the State Sustainability Strategy*. Perth: Edith Cowan University.