Is the whole more than the sum of its components? An analysis of Technology Education in ORT schools around the world

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Abstract

The aim of this paper is to analyze and compare the development of technology education in ORT schools in three different countries – Argentina, Israel and Russia – during the last twenty years, in order to establish a framework for future research and collaboration.

This paper comprises three main parts:

i. in the first part we will present World ORT as an organization;
ii. in the second, we will present the changes in the technology education in the three different countries: Argentina, Israel and Russia;
iii. in the third part, we will compare the processes that took place in the three countries, in order to reach conclusions about the main aim of World ORT.

We will show that even if every ORT center is unique and works independently, collaboration between the centers, under World ORT's guidance, contributes to the generation of a new "whole" system that is much more than the sum of its components.

Keywords: technology education, design, problem solving, system approach, secondary school, high school

I. Introduction – what is World ORT?

ORT, the largest non-governmental international Jewish education network, provides technology education and training all over the world. Its global network now teaches over 270,000 students in five continents (as detailed in table 1) with highly-acclaimed, cutting-edge technology training. One of ORT's main aims is to promote technology education in its schools, as a means to its ultimate goal of providing its students with economic self-sufficiency.

Table 1: The number of young and adult students in ORT schools all over the world (Dec. 2003)

	Young Students (up to age 18)	Adult Students (aged 18+)	total
Argentina	4787	1951	6738
Brazil	291	48	339
Bulgaria	652	0	652
Chile	1493	0	1493
Cuba	95	311	406
France	2740	2181	4921
Hungary	0	1700	1700
India	309	64	373
Israel	74863	18749	93612
Italy	990	152	1142
Mexico	2974	1229	4203
South Africa	120	1157	1277
Switzerland (IC*)	10920	31100	42020
USA	16357	2648	19005
USA (IC*)	9555	43900	53455
UK	1137	833	1970
Uruguay	192	7078	7270
Venezuela	1769	1203	2972
Russia	6678	10039	16717
Kyrgyzstan	73	0	73
Ukraine	4316	4091	8407
Belarus	583	1348	1931
Moldova	499	144	643
Latvia	365	240	605
Lithuania	290	130	420
Total	142048	130296	272344

**IC = International Cooperation*

In every country, each ORT school follows the requirements of the local National Curriculum. Within their countries, these schools are technology education leaders. However, as part of a global organization, ORT schools play an important role as leaders of innovation in technology studies. World ORT supports the development and translation of instructional materials and collaboration with colleagues through seminars, e-forums and in-house publications, which in turn enables it to promote technology education its own ORT schools and, moreover, to contribute on a national and international level.

During the past twenty years, new concepts of technology literacy, such as Design and System Approach, have become accepted in many countries. ORT schools implement this process (moving from “Hands on” towards “Minds on”) as an integral part of their educational system.

In this paper we will describe the processes of change and development in technology education that have taken place during the last twenty years in each of the three ORT centers (Argentina, Israel and Russia) and relate them to the changes that have occurred in technology education within those countries.

We are going to focus on identifying the changes in technology education that have occurred since 1985 in the three countries’ ORT schools, and we would like to show the advantages of belonging to a worldwide educational network such as World ORT.

II. The changes in technology education in ORT schools in Argentina, Israel and Russia

The changes in technology education at the ORT school in Argentina

1. The Argentine education system: structural changes during the 1990s

In order to analyze what has happened in technology education during the last twenty years, it is necessary to mention the implementation of a new Federal Law on Education which, since 1995, has modified both the Educative National System structure and the teaching contents. Until that moment, except for a few pilot projects, technology as a subject only existed at Technical Schools (for children aged 13 to 18 years) and their goal was to train technicians in various paths (electronics, building, chemistry, computing science, etc.) in order to prepare them to enter the workplace. In all other schools, which produced graduates in arts, humanities, sciences or business orientation, technology was almost absent. Furthermore, there was no technological component to the curriculum of compulsory education at primary level (up to 12 years old). There were some subjects, such as hands-on activities, which were geared towards the development of manual abilities.

The new law regarding Education Reform had resulted in 10 years of compulsory education, starting at Elementary Level (i.e. aged five – preschool) and nine years of Basic General Education. Amongst the changes in the curriculum, the topic of technology, also called Technology Education, was integrated into the general education for every student.

High school and secondary school curricula also changed according to this Law. Following international trends, specialized training is given in the last three (non-compulsory) years of school, known as “Polymodal”, for those students who elect to stay on. Students choose one orientation from several options: humanistic, health, technical, artistic, etc. Technology is given its own place and every orientation, be it technical or humanistic, has technological aspects to its curriculum. Of course in technical orientations where the focus is on the training of future technicians, technology is therefore taught for a greater proportion of the week (as described in table 2).

Table 2: The technology education structure before and after the new Federal Law

Before 1995

Compulsory	Primary School	Age 6-12
	Secondary School	Age 13-17

After 1995

Age 5	Pre school	
First Cycle Age 6-8	Basic General Education	Compulsory
Second Cycle Age 9-11		Compulsory
Third Cycle Age 12-14		Compulsory
Age15-17	Polymodal	

How the State facilitated the integration of technology subjects

Within the Federal Law, the desire is declared to integrate "socially meaningful knowledge" to schools, which includes technology and informatics.

There is a list of basic common technology contents that have to be taught at schools all over the country. Each province authority has the responsibility to decide on the instructional methods of those contents and whether they should have a specific curricular space, or even whether to integrate these contents across the curriculum in different subjects.

There is no National Curriculum on technology or indeed on any other subject. Every province develops its own curriculum, on the basis of these basic common contents, and thus the level of implementation of technology education varies widely. There are some provinces where technology is entirely absent from the classroom, due to lack of teacher training or lack of curriculum materials. In places where technology is taught, there is a tension between the various curricular approaches: teaching technology concepts versus teaching hands-on activities.

We would like to present two examples of possible ways to implement technology education:

- The province of Buenos Aires (more than 30% of the total population) took the decision that the technology content would appear across the curriculum, in every subject. There are no specific curriculum materials for technology education, but there are some elements of technology within other subjects. Moreover, there is no specific teacher training, but teachers of other subjects are taught how to teach the technology contents. We can say that, apart from some minor activities, the teaching of technology is absent in that province.

  From 2003 on, as a pilot project, some schools have been chosen to dedicate a few hours to teaching technology as a specific field to children aged 12 to 14 years old.

- The city of Buenos Aires, the capital city of Argentina, decided that technology should be part of an integrated subject called "Knowledge of the World", in the curriculum for 6- to 8-year-olds. The technology aspects are the responsibility of a special teacher (formerly the skilled handcraft teacher), who has to plan the teaching in cooperation with the Social Studies teacher. The local authority produces the curriculum materials and the training for both types of teacher.

  For children aged 9 to 12 years old, technology has its own space, with a trained teacher (also a skilled handcraft teacher). For this, it is necessary to have a teacher with a higher level of technical training. Therefore, there are teacher training sessions whose goal is to fill some of the gaps in the knowledge in this subject. Most of the technology teachers are women, upon whom this change has been imposed, assuming they would teach something that they were not trained for. The main problem was the shift from hands-on activities to design and innovation activities. The training, which was intensive and initially compulsory, has now become optional, as a support to the teachers' task.

Integrating technology into the school curriculum

The proposal to include technology subjects into the school curriculum was not an isolated process, but rather was part of the structure of curriculum changes that were being implemented throughout the National Education system.

Each school community (parents, students, teachers and head-teachers) has different perceptions about technology education. These various perceptions can generate many varying expectations from a new subject which is only in its infancy.

Today, interest and enthusiasm are decreasing and we are witnessing a new stage, where technology holds a more critical, logical and considered place within schools.

At the national level of technical education, or the training for the labor market, the technical education reforms are currently being critically analyzed. Technicians are perceived as not fulfilling the expectations of society or of the market. The debate is whether it is necessary to go back to traditional technical education, or if it would be possible to improve the model of technician-training that has been proposed by the reform.

2. Technology at the ORT school in Argentina

The ORT Technical School is one of the most important technical schools in the country. It was established in 1943 by World ORT with the mission of giving assistance to Jewish immigrants, most of them countrymen from Europe, through the teaching of arts and manual trades.

By the beginning of the 1980s, the school had a curricular structure similar to the rest of the technical schools in the country:

- three years of Secondary School, when science and humanities were taught and some practical abilities were developed through workshops oriented towards technical training in many subjects including electrics, mechanics and carpentry;
- three years of High School, designed to impart techniques in different paths (for example: electronics, construction and chemistry).

At that time, the ORT school was considered highly innovative, due to its structure, and the teaching of informatics as both a medium for training technicians and as a didactic resource for teaching other curriculum subjects.

The new curricular space called Science Workshop was created with the aim of finding answers to certain questions: Do we provide students with situations involving the design and analysis of technological devices? Will they achieve a better understanding of some scientific abstract concepts?

From these experiences, teachers realized that the knowledge put into practice by students does not come only from the field of science. There appear to be different kinds of knowledge, processes and thinking in relation to the activity of design. The Science Workshop therefore changed its name and it is now called the Science & Technology Workshop. Two main routes emerged – “the process of design” and “the system approach”. The design activities focus on the building of technological devices such as scales, bridges, or articulated arms; the system analysis activities focus on hydraulic systems and the “black box”. All these activities were focused on the developing of general skills of design and analysis. In parallel, students continued learning about technologies in workshops on many subjects including electrics, carpentry and mechanics. These traditional workshops were built around the teaching of concepts, techniques and procedures from “expert management”.

Thus, in the new school, the independent field of “Technology Education” has arisen, with the primary aim of integrating system analysis skills development with knowledge of specific technologies, e.g. teaching Electricity during the same workshop as Design, or teaching Electricity and Mechanics with a system approach. The system approach is also used to find a set of general concepts, which relate to energy, materials and information.

Landmark

During 1989, the donation of didactic materials from World ORT was an important milestone in the development of Technology subject matter at the ORT school. These didactic materials were appointed for training professionals in subjects such as automation and robotics, and could be adapted to students aged 14 years old. These materials were considered an innovating factor in the development of system analysis and technological problem-solving. So, cultural adaptations were made (in addition to the translation to Spanish), and student work guides, teacher guides and software, hardware and didactic kits were designed.

This Project had a large impact beyond its pedagogical goals in two aspects: Firstly, it increased students’ motivation, which had a direct positive influence on the quality and the quantity of learning. Secondly, the prestige of technology as a curriculum subject increased, both within the school and outside in the educative community, official bodies and government ministries.

The chance of seeing such young children solving technological problems related to artificial vision systems, logical and programming controllers, robotic arms, flexible production cells or exploring robots, became a very good reason to visit ORT schools and take an interest in technology education. As a result, requests and demands came from schools and public bodies for external counseling. There is now a new challenge: to transfer the model and the strategies to other contexts.

3. Sharing our expertise

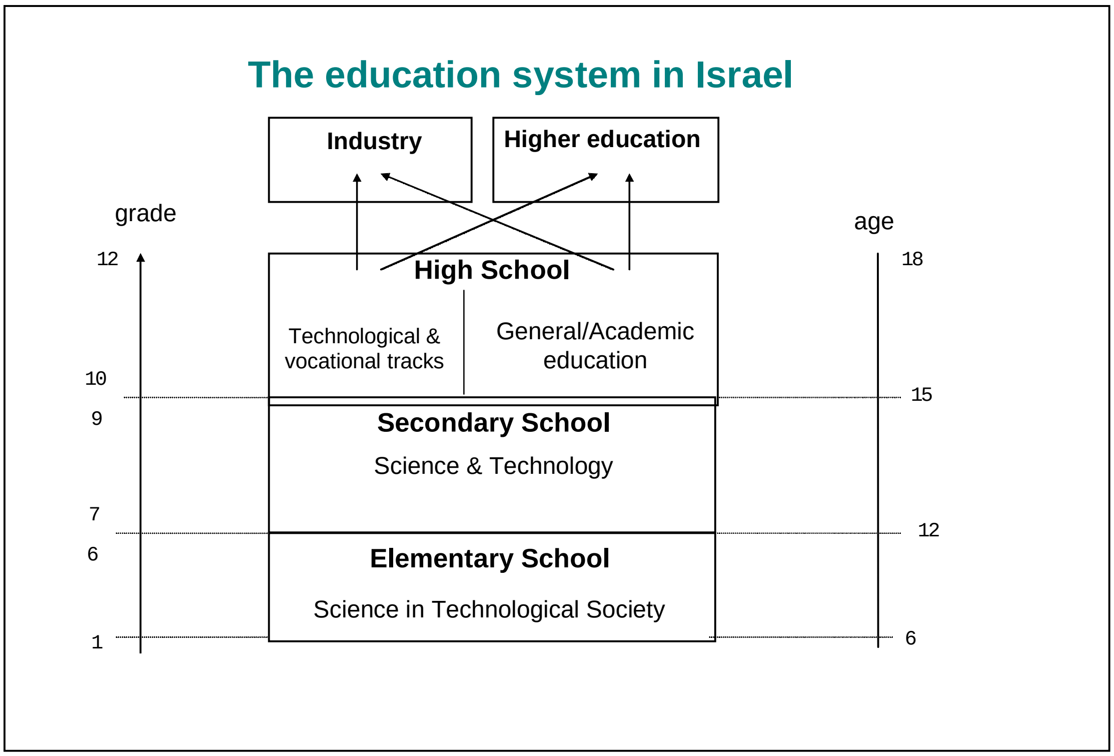
During the last twenty years, different organizations and private institutions have recognized the expertise of the ORT Technical School in technology education, and requested their advice while considering implementation themselves – e.g., in pilot projects on a small scale, using curriculum materials developed at ORT School; some ORT technology teachers began writing and planning programs in collaboration with teams from the National Ministry of Education at provincial level. Over the years there has been a cooperation agreement between the ORT Argentina Association and certain local government officials, whereby these administrative bodies can benefit from ORT's capacity and potential in design, and implement, manage and control training planning and curriculum development in technology education. For example, in an agreement between the province of Buenos Aires, the local Ministry of Education, and the ORT Argentina Association, it was decided that ORT Argentina specialists would work on a project paid for by the World Bank about the extension of school hours for children ages 12 to 14 in 200 schools, technology education being one of the chosen subjects. In addition, specialists from ORT Argentina are spearheading a process to change the subject of technology at "polymodal" level (i.e. for 14-17 year-olds).

Changes in technology education at an ORT school in Israel

1. An Overall View of theTechnology Education Frameworks in Israel

Technological studies in Israel take place in two frameworks (as described in figure 1): 1. Technology literacy for all (in elementary, secondary high school and in higher education) and 2. Technical and vocational tracks in high school and higher education.

Figure 1: The education system in Israel



Technological literacy for all

In 1993, the Israeli government established a commission, chaired by Professor Harari of the Weizman Institute. The resulting report declared:

"We call upon the Government of Israel to announce a national program for strengthening, deepening and improving the study of mathematics, natural science and technology in all sections of the education system, in order to prepare the next generation of citizens of Israel for life in a scientific-technological era."

With regard to Science & Technology, the report recommended:

"Combining science and technology in secondary school (grades 7-9) into one subject, namely Science & Technology, which will be studied at least six hours per week over three years."

Based on these recommendations, new national curricula were developed and implemented. The secondary school Science & Technology curriculum (created in 1996) consists of seven main subjects: Materials, Energy, Technological Systems and Products, Information & Communication, Earth and Universe, Creatures and Life, and Ecological Systems.

Technical and vocational education in high school (grades 10-12)

The aim of technology education in Israeli high schools is to prepare students who specialize in technology/pre-engineering related disciplines for employment and for further higher education.

One third of all Israeli high school students are studying within this framework. A technology-based matriculation is needed in order to pursue a degree in Engineering.

About 20% of students who study technology in grades 10 to 12 either go on to higher education in colleges for technicians (grade 13) and practical engineers (grade 14), or to university faculties of technology (which entails four years of study).

2. Changes that have been made in terms of curriculum rationale and content in Israeli schools

Technological literacy for all

In the last two decades, three new national curricula have been developed and implemented, from elementary school ("Science in Technology Society", 1985) to secondary school ("Science & Technology",1996), up to high school ("Technology Sciences", 2000: "Science & Technology in Society, 2000).

Two main trends characterize the changes in these curicula:

a) Emphasizing the system approach and problem solving (design processes) as central concepts in the curriculum (as is done in other countries);
b) Those new curricula focus on the relationships (cordination/ collaboration/integration) between science and technology within a social context (which is a different approach to that adopted by most countries).

Technical and vocational education in high school (grades 10-12)

In the last four years, the Israeli Ministry of Education and ORT Israel have focused on developing and implementing new innovative science and technology/pre-engineering disciplines and subjects, such as:

- Mechatronics,
- Engineering Sciences,
- Biotechnology,
- Environmental Sciences
- Bio-medical Engineering.

3. The Status of Technology Education in Israel

Technology literacy for all

From a technology education point of view, the new curriculum was a milestone. It served as a lever to enable a shift from technical education (industrial art and hands-on activities) to technology education which emphasizes thinking skills such problem solving and a system approach.

On the other hand, on the way to becoming more "academic" by focusing on thinking skills and less using of practical skills (such as sketching), we might risk losing some of the significant instructional features of technology education. In the last four years, due to the declining hours devoted to science and technology in secondary schools, a situation has arisen where although the science & technology is compulsory, some schools don't have a technology department; and in some other schools, technology is taught by science teachers.

Technology Education in High Schools

The current status of Technology Education in high school can be characterized by the following features:

- a variety of disciplines – from "low tech" disciplines (e.g. tourism) through traditional discipline (e.g. mechanics and electronics) up to "high-tech" disciplines (e.g. biotechnology and software engineering).
- the technology education system provides a solution for students according with varying interests and abilities, in that different diplomas can be obtained, from vocational diplomas and partial matriculation right up to full matriculation.

However, uniting all the disciplines together under the umbrella of "technology education", combined with the poor image of technology education in the eyes of many students and parents (compared to science) does not help to promote technology education as something that provides important skills for life, as well as being a vehicle for a future career.

Technology Education provision in high school is under public criticism – with some even questioning whether we need to teach technology in high school at all. The criticisms that are leveled include:

- the lack of clarity between various disciplines within technology education.
- the high cost, compared to other subjects (e.g. social studies and even science).
- technology education does not relate to real life.

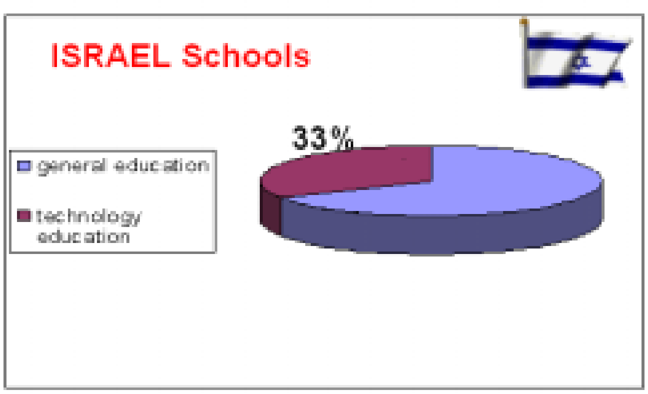
Curriculum programs are not often updated; however, were they to be, on a regular basis, many teachers would not able to cope with the reforms that would consequently need to be implemented.

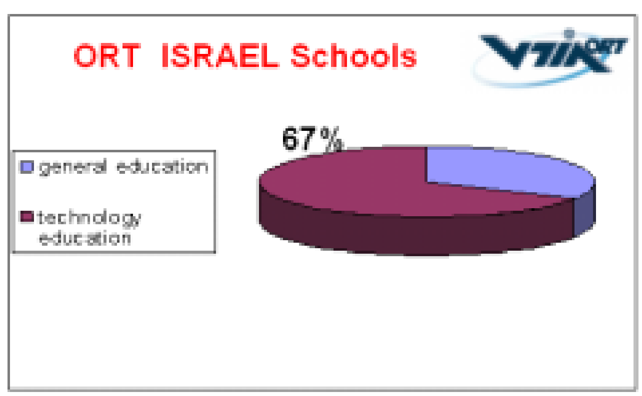
4. ORT Israel within the educational framework

Technology education in ORT schools

ORT Israel is the largest non governmental educational network in Israel, with more than 150 schools all over the country (including secondary, high schools, industrial colleges and academic colleges). It serves 11% of all the secondary-school students in the country. Figure 2 indicates the importance of technology education within ORT schools compared to other schools in the country.

Figure 2: Distribution of Students in ORT secondary schools





R&D Center

The ORT Israel Moshinsky R&D and Training Center in Tel Aviv fulfils a number of functions:

- ORT Israel plays a leading role in developing curriculum materials (e.g. textbooks, websites, lab activities and multimedia CDs) for all secondary schools in Israel, focusing on the technology aspects of the unified curriculum for Science and Technology (Dagan & Kipperman, 2001).
  Each school is allocated a tutor to work with the science and technology teachers, helping them to implement the new curriculum and its materials (Shemla & Soffer, 2000).

- In the last four years, the Israeli Ministry of Education and ORT Israel have focused on developing and implementing new science and technology/pre-engineering curricula, in order to attract more capable students (especially females) to the technology education framework, and to update and adapt new technologies from industry to the school curriculum.

The main concepts driving the development of the new technology curriculum are:

- inter-relationships between science and technology
- inter-disciplinary and multi-disciplinary topics
- attractiveness generally, and to female students in particular
- creating a learning community, i.e. students and teachers
- project-based learning

The series of new science and technology curricula based on the rationale above, previously listed in this report, was in fact developed at the ORT Israel Moshinsky R&D Center.

Changes in technology education in the ORT network of schools in Russia

1. Technology education in Russian school

The twenty-year period chosen by the PATT 15 Conference for review was a very significant time for Russia and the other countries of the former Soviet Union. Twenty years ago, great changes emerged in these countries; the evolving educational system reflected the transformations in economics and society. The change from focusing solely on traditional and old-fashioned “labor education” towards integrating technology education was a prominent feature of the educational reform.

Early Technology Curriculum

In 1993 a new educational topic appeared in the Russian National Curriculum, entitled “Technology”. This field included three subjects: Labor Education, Graphics (Technical Drawing) and Technology. Altogether, 808 compulsory hours of technology were taught in all Russian schools from the academic year of 1993.

According to the national “compulsory minimum content” there were several compulsory items, which all school students in Russia had to study (known as the “General Technology Component”):

- Technology in modern society
- Technological culture and its components
- Culture of labour: organization of work process, and preparation for the work place.
- Modern energy saving and material saving technologies
- Graphical modelling
- Artisan handicraft and home-craft
- Impact of technology on society and environment

- Social needs
- Design
- Entrepreneurship
- Budgeting
- Advertising

In addition to the “general technology component”, each school could teach a special technology component in a particular “direction” or “area” of labour.

The optional directions included:

- Technology of materials
- Manual and machine manufacturing
- Art work with materials
- Textile manufacturing and food production or domestic culture
- Agricultural technologies

Within these optional areas were:

- industry
- economics
- education
- medicine
- building
- transport
- office work
- informational technologies
- applied art
- agriculture
- cattle breeding
- the service sector.

After meeting the demands of the national curricula, regional and school educational authorities could then introduce their own technology items.

“What is to be done?” – This long-standing question for the Russian intelligentsia appeared again before technology educators and teachers. Most schools continued to teach woodwork to the boys and domestic science to the girls; some decided to replace engineering tools with computers. The rest simply removed technology from the school timetable. But in general, no technology revolution took place in school.

At the same time there was one innovation – *design* as a core idea, which allowed the new subject “Technology” to be distinguished from the old topic of “Labor”. Students continued making the same chairs and pies that their grandfathers and grandmothers had, but now they did it as part of the design process. The idea of needs analysis as the start of the *design circle* had been brought from English and Wales’s concept of *Design and Technology*, and was successfully applied in many Russian schools.

But we have to acknowledge that the first decade of “Technology” at school did not fully justify society’s hopes.

New Technology Curriculum

After several years of experimentation, new educational standards and national curricula were designed in 2004, which included three curriculum components:

- national (which must take up at least 75% of the total teaching time),
- regional (to be taught in not less than 10% of total teaching time)
- the school’s own (which must be taught in not less than 10% of total teaching time).

The national component now accounts for <u>only 448 academic hours of compulsory teaching technology from grades 1 to 8.</u> There is the option to choose technology education from grades 9 to 11.

In elementary school (grades from 1 to 9) “compulsory minimum content” takes into consideration students’ interests and abilities, the school’s capabilities, and local social and economical circumstances. It can be studied in 1 of 3 trends:

1. Technology as a Technical skill.
2. Technology in the Service sector.
3. Technology in Agricultural.

After 8 years of education, in grade 9 the school can add technology as a “taster”, prior to students committing to specific subjects for matriculation.

In high school (in grades 10-11) technology is not a compulsory subject within the national component. It can be studied for 70 - 280 hours at matriculation level.

In addition to general subjects, students can select one area for special technology training.

While comparing the two technology curricula, we can see that technology as a school subject became more flexible and less restrictive.

2. Technology education in ORT Russia

Established in Russia 125 years ago, ORT returned to its origins after a fifty-year absence in 1991. The opening of the ORT Technology School in Moscow, inaugurated in 1995, was quickly followed by other schools and technology centres in Moscow, St. Petersburg, Kiev and other cities of the former Soviet Union. In the current academic year 2004-2005, thirteen ORT school and technology centres are operating in Russia, Ukraine, Moldova, Belarus, Latvia and Lithuania.

In general, ORT technology curricula correspond with National Curriculum requirements, but are based on different principles, with the concepts of design and technological literacy as a system approach being the core for teaching technology in ORT's technology centres.

Bearing in mind the National Curriculum, ORT suggested a three-step structure for its "Technology for All" program (Gorinskiy, 2003):

- In grade 5, pupils study the module "Introduction to Technology" that deals with the questions: What is the purpose of technology? In the future, what will be the influence of technology on the environment and on society? And what are the social aspects of technological development? Pupils study several applications of technology, e.g. telecommunications, transportation and food technology. One of the most important parts in the 5th grade technology curriculum is the introduction to technological modelling based on LEGO Dacta "Simple Mechanisms" sets.
- In grades 6-9, pupils study Technology Education modules and ICT supporting materials, based on the system approach. The main modules are Design Process, Technological Systems, Materials and Products, and Energy and Information.
- In grades 10-11 some high schools give their pupils elements of initial vocational training in certain technological domains (e.g. ICT, CNC and Video Technology).

Technology courses are studied in parallel with ICT, which is used from the first year of the program (grade 5, age 10) as a practical tool for studying technology.

Since 2003, ORT students have had the option of studying specialized technology courses using ORT's e-learning system.

As it embarked upon technology education programs, ORT Russia faced a problem concerning its teachers: most pedagogical university graduates do not have enough experience to teach technology according to the technology literacy paradigm. ORT invited not only professional teachers to its schools, but also a number of engineers and scientists. In order to prepare teachers with different backgrounds to teach technology, ORT has developed its *continual professional development* (CPD) system. Teacher training is an important element of this system and includes periodical teacher training seminars as well as other formal and informal activities.

III. Comparison and conclusions

Comparison:

In this part of the paper, we would like to compare the Technology Education in ORT schools in Argentina, Israel and Russia over the last 20 years, specifically in the following aspects:

1. the changes in terms of curriculum rationale and content.
2. the changes in the role of teachers.
3. the formal status of technology education.

Firstly, we have to point out that in Argentina there are two ORT schools, each featuring both a secondary and a high school; in Russia there are 13 technology centers (grades 5 to 11) and in Israel there are 40 secondary schools (grade 7-9) and 65 high schools (grade 10-12).

1. The changes in terms of curriculum rationale and content

In the early 1990s, reform took place in all of the three countries (Russia and Israel in 1993, and Argentina in 1995); in Russia there was further reform in 2004.

In the 1990s reforms, we see that each of the countries decided to add some element of technology education to their curriculum; since the second reform occurred in Russia, we see acceptance in all three countries of technology as a literacy. However, there are differences in their aims, their subject matter, their level of importance and their significance. In Israel, this reform led to the National Curriculum including Science and Technology as a compulsory subject matter (as literacy for k-12); in Argentina this reform led to certain compulsory concepts (even though it is not included in every region and province); in Russia, technology education is compulsory and has been taught over many hours, but prior to the last change (in 2004) most of it was “hands on” manual activities.

Whilst noting the differences in what had developed in the ORT schools in these countries, we can see there are also wide similarities. Around the same year, the ORT schools in the three countries had separately (but after some collaboration) reached the conclusion that technology literacy had to be taught based on two main concepts: Design Process and System Approach.

Curriculum materials were therefore developed for these two main subjects. There was contact between the three centers, and exchanges of knowledge, with World ORT providing both leadership and funding.

Even if there are similarities of Design and System Approach in the main concepts and in technology knowledge in secondary schools (material, energy and information) in the ORT schools of the three countries, there are disparities in the instructional methods which reflect their cultural differences. If we compare technology knowledge aspects of the ORT high school in Argentina for example, we would be looking at professional technical education such as electronics, computer science, biotechnology, chemistry, design, musical production, mass media communication, business administration and master building (all of them leading to a technical degree). In Israel there are two paths: technology sciences (at literacy level), and biotechnology, engineering sciences, environmental sciences and bio-medical engineering as vocational paths/tracks. In Russia, it is professional training.

All of the three ORT centers had led the way within their own country in technology literacy (or “technology for all”, as it is called in Russia). In Israel, the ORT R&D center developed the curriculum materials for the Israeli Ministry of Education; the Argentinean team cooperates with the Ministry of Education and influences the curriculum of the province of Buenos Aires among others; the Russian Centers, who work with institutes of higher education and local authorities, are considered to be the best technology centers in Russia.

2. The changes in role of teachers

From the beginning of the 1990s, when the technology curricula were changed in all three countries from “hands on” to an integrating thinking process for problem solving, design process and system approach, teachers’ roles began to change too.

There was a lack of suitable teachers in all three of these countries. In Argentina and Israel, most of the teachers were not included in the process of change, and consequently it was difficult for them to become accustomed to it. In Russia the teachers had no literacy knowledge at all. ORT Argentina, ORT Israel and ORT Russia introduced wide-scale teacher training programs in order to teach them the new concepts and to help them along the instructional process, through seminars and personal tutoring.

International seminars for technology teachers from ORT school around the world take place in London every year (e.g. the Hatter Technology Seminar and the Wingate IT Seminar), with the goal of sharing new concepts and new teaching methods.

3. The formal status of technology education

We all feel that in the school community (teachers, principles, students and parents) the word ‘technology’ can generate many interpretations, explanations and expectations, which in turn can create an element of confusion in defining what technology is. This lack of clarity can cause further difficulties when it comes to actually teaching the subject.

Technology education does not enjoy a particularly high status in the countries we have discussed. In Israel, when they combine technology with science, one hopes that the status of technology education will become equal to that of science; and indeed, for a few years, it was. In the last two years there has been a reduction in the number of teaching hours and, due to the low status of technology as a subject, these teachers were the first to be dismissed.

In Russia, most parents and students are not especially conscious of "technology" at school and continue to think in terms of traditional "labor". As a result, the status of both the subject and its teachers is very low. But in ORT Russia schools, students can study technology as a modern subject that is connected to the hi-tech world. Thus, technology has evolved into one of the students' favorite subjects.

Generally, there are more similarities than differences in most of the compared aspects between the three ORT centers. Some of these similarities are a result of the cooperation over the last eight years between the teachers and the curriculum developers, where ideas, concepts and knowledge have been exchanged between the various countries.

Conclusions on the main role of World ORT

Being part of a worldwide educational network such as World ORT enables us to exchange ideas, methods, knowledge, curriculum materials and experience from all over the world. These collaborations take place in a number of ways:

During 1999, World ORT organized a delegation of Israeli developers to Argentina, and Russian teachers and developers delegation to Israel, whilst ORT Israel's curriculum materials were being translated to other languages and being used as the basis for teacher training.

During recent years, World ORT has organized seminars for teachers and developers in technology education (Hatter Technology Seminar). In these seminars, teachers share their knowledge, studying with and learning from their colleagues from around the globe and learning from expert guest speakers. Above all, these seminars have established a community of technology educators, resulting in strong professional and personal relationships. These relationships have formed the basis for cooperation and sharing knowledge, and have led to consultations and the translation of teaching materials.

A multi-lingual website for technology education is now being developed. This website will contain all the abstracts of curriculum materials that have been developed in ORT centers all across the world, as well as recording the teachers' in-class experiences. There will also be forums to discuss technology teaching dilemmas and for sharing knowledge; competitions; and the facility to request and provide guidance where it is needed. This website will be the technology resource, forum and virtual meeting place for ORT technology educators.

The World ORT "Design for Sustainability" competition has been organized and was recently launched. Its aim is to enhance the teaching and studying of design by integrating the focus on environmental and sustainability aspects at different ages, across ORT schools around the world.

World ORT, as a large education network that emphasises technology education, does a lot in order to promote this subject in its schools around the world; however, it could do even more by facilitating further collaboration between curriculum developers and teachers – for example, through jointly developing curriculum materials, and by researching the parallels and differences between ORT schools.

Nonetheless, we can see that affiliation to the World ORT network is vital for ORT schools and centres worldwide. Not only is every component of technology education in these three countries well structured, productive, and contributory to ORT's students and the World ORT organization; but furthermore, the whole system is much more than the sum of all its parts.

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