



Project no. 042941

# UPDATE

**Understanding and Providing a Developmental Approach to Technology Education**

Instrument: Specific Support Action

Thematic Priority: Structuring the ERA / FP6-2005-Science-and-society-16

# A final, publishable activity report

1.1.2007–31.12.2009

Period covered: from 1.1.2007 to 31.12.2009
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UPDATE
Understanding & Providing a Developmental Approach to Technology Education

SIXTH FRAMEWORK PROGRAMME

## Executive summary

# UPDATE – Understanding and Providing a Developmental Approach to Technology Education, 1.1.2007–31.12.2009

Project no. 042941
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The project's aim was to examine why girls drop out from Technology Education at different stages of their education, and to create new educational practises to encourage them to continue with technology-enhanced personal curriculum.

The UPDATE **http://update.jyu.fi/** was a multinational European project, in which 16 partners from 11 European countries aimed to improve science and technology teaching in order to appeal young people to technology, especially girls. The acronym UPDATE stands for **U**nderstanding and **P**roviding a **D**evelopmental **A**pproach to **T**echnology **E**ducation. The furthermost aim of the UPDATE was to impact on learners', specifically girls', views about themselves as users and developers of technology. The UPDATE aimed to create a holistic view on technology education and teaching. In addition, concerns were focused on sharing this knowledge, learning and expertise.

In the present information society, technology is built in to a very broad scope of careers. Also at school it is taught in different subject areas. Hence, there is a need to foster understanding that technology is utilised in diverse areas of life, both in working life and in all everyday life areas. Women and girls throughout Europe are constantly dramatically underrepresented in technological education, areas, and jobs. Even in countries with gender balance in the areas of mathematics and science, there is a marked imbalance concerning technology subjects. With new, improved technology education practices it is possible to make technology more attractive for young people, promote their interest, and encourage their critical and creative ways of thinking.

The Update project strength lied in the collaborative network of a complementary set of universities, research institutes, schools, and partners from public, private and third sector. With this network we collaborated to influence curricula structures, teacher training, and teaching practises in means of making the image of technology and technology careers more attractive for young people. Through the project,

teachers and teacher educators have been encouraged to view technology education broadly, not including merely high tech, but as education for problem identifying and solving, as well as design issues related to knowledge of materials and perceptions of the problem to be solved. The project offered a multifaceted view both to technology and technology education.

## Innovative aspect – starting from early on

The UPDATE approach includes strong focus on early childhood and primary education. At these ages most attitudes are shaped sustainably, so it is often too late to start raising interest only at secondary or later stages to attract female students to technology careers. Therefore, the project UPDATE aimed to create a holistic view on technology education and teaching.

The project showed that many activities and themes can be used to promote the aims of technology education already in early childhood education. Educators need to spark children's interest, direct their attention and pitch discussions about technology around. At the same time teachers have to examine and reflect their own attitudes and pedagogical ways to meet both sexes. The more technology increases within our living environments, the more important and possible it becomes to develop interesting and meaningful ways of teaching technological skills to every child.

## Finding good technology education practices

Within European collaboration and interaction, we have the momentum to learn from each other to build the new enhanced European Technology Education to prevent the digital divide between the genders, between the nations, and between different groups of people in Europe.

The project results have been published and are available open access in the project website http://update.jyu.fi/. Additionally, handbooks directed to teachers and teacher educators have been published in several languages. Through active collaboration with teacher training institutes, it was possible also to have a direct impact on teacher training practises.

According to the project results the following general guidelines should be noted while composing the educational curricula:
Technology should be:

1. studied at all educational stages
2. a compulsory subject
3. taught to both sexes in mixed groups
4. the curriculum should be more precise
5. pedagogical aspects should be developed towards gender sensitive direction
6. pupils should be encouraged for creativity, problem solving, inventing, making, constructing

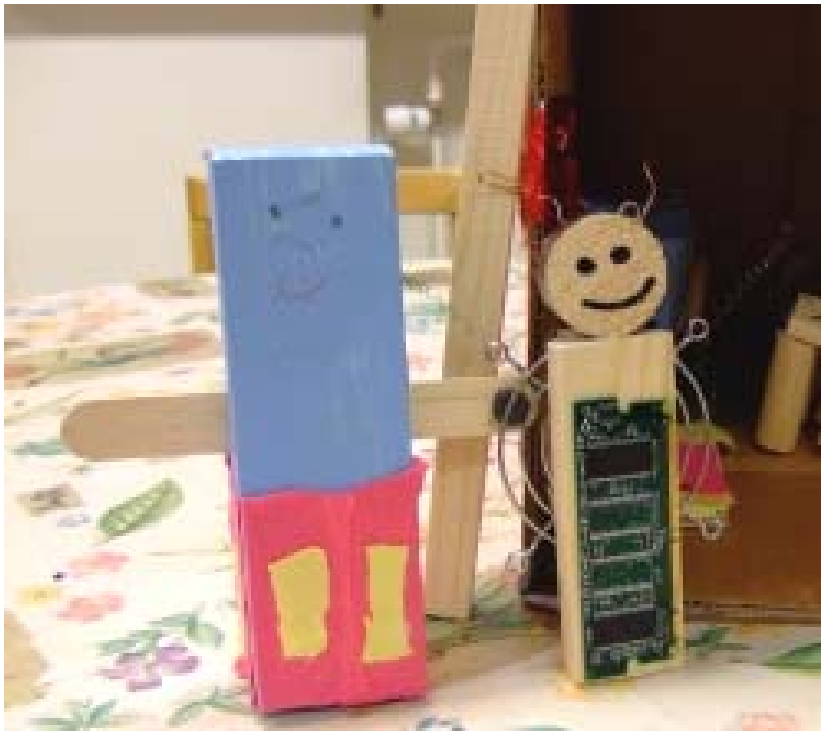
7. ethics of technology – sustainable future

8. information campaigns to decision makers, parents, teachers, and teacher educators are needed

9. better facilities for studying technology (laboratories, workshops, tools & equipment, computers, various materials, etc.)

10. stronger cooperation with outside society (enterprises, museums, factories etc.)

Technology education best practices and interesting case studies were published by the project UPDATE and are open access available through the project's digital platform at web-address: **http://update.jyu.fi/**.



In a kindergarten project a robot got a friend with a contactable magnet-hand
Photo: Leena Turja

# A publishable final activity report
# Project UPDATE – 042941

**Main objectives, aspects of the work,
results and conclusions**

It is important to understand the functions of familiar technological objects
Photo: Riitta Huovila

**Project UPDATE – 042941**
**FINAL ACTIVITY REPORT**

# Contents

# Participants list

| Part. No. | Participant name | Part. short name | Country |
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| 2 | University of Glasgow | GLA | United Kingdom (Scotland) |
| 3 | Teacher Training University Institute of Aix-Marseille | IUFM Aix-Marseille | France |
| 4 | "Alexandru Ioan Cuza" University of Iasi | AI.I.Cuza | Romania |
| 5 | Ovidius University Constanta | UOC | Romania |
| 6 | University of Tallinn | TLU | Estonia |
| 7 | Dortmund University of Applied Science, Ada-Lovelace-Mentoring-Association | FH Dortmund | Germany |
| 8 | University of Koblenz, Ada-Lovelace-Project | UKOLA | Germany |
| 9 | Competence Center Technology, Diversity and Equal Chances | Kompetenzz | Germany |
| 10 | Catalan Foundation for Research and Innovation | FCRI | Spain |
| 11 | Institute of Philosophy of the Slovak Academy of Sciences | IPSAS | Slovakia |
| 12 | State College of Education in Vienna | PABW | Austria |
| 13 | Regional Institute for Educational Research (Years 2007–2008) | IRRE MARCHE | Italy |
| 14 | Aristotle University, Dept. of Mechanical Engineering | AUTH | Greece |
| 15 | Central University of Complutense de Madrid | UCM | Spain |
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# UPDATING EUROPEAN TECHNOLOGY EDUCATION

## 1 Project objectives: tackling technology as the culmination for gender imbalance

Women and girls throughout Europe are dramatically underrepresented in technological education, areas, and jobs. Even in countries with gender balance in the areas of mathematics and science, there is a marked imbalance concerning technology subjects. The Revised Lisbon Strategy (European Council Brussels 22 and 23 March 2005) re-highlighted the need to improve the human capital involvement, specifically women and young people, in the key sectors like HI-Tech, ICT etc. Accordingly, the issue of getting more women in technological or scientific education and career has been approached by numerous EU and national projects. Yet the challenge persists. Even in countries where gender imbalance is not a problem in the areas of mathematics and science, there is a marked imbalance when technology subjects are taken into account. Technology, where the science is put into action, is an area where the gender imbalance culminates.

Within European collaboration and interaction, we have the momentum to learn from each other to build the new enhanced European Technology Education to prevent the digital divide between the genders, between the nations, and between different groups of people in Europe. Educational systems can be changed as recently highlighted in the international SITES study, comparing usage of information technology in education in 22 countries throughout the world. The study revealed that many Asian countries have already awakened to the need to re-evaluate education. The emphasis on technology-enhanced lifelong learning skills was substantially increasing in Asia – while it was alarmingly decreasing in some European education systems. The study defined "21st century skills" as follows: developing the ability to be self-directed, to keep learning throughout their lives, and knowing how to connect and collaborate with others – both their peers and experts – around the world.

As illustrated in Figure 1 below, present technology education in practice differs according to gender. Although first contacts with technology are the same for both genders, their perception and understanding of technology start to differ at a very early stage: the interest in technology diverges, and more and more girls drop out from their Technology Education Path. This continuing phenomenon increases in the upper grades in comprehensive schools, and continues through further studies: the percentile of girls taking part in technology focused education decreases as they grow older. In the end, this distinction of boys' and girls' technology education results in a very small number of women in technology careers.

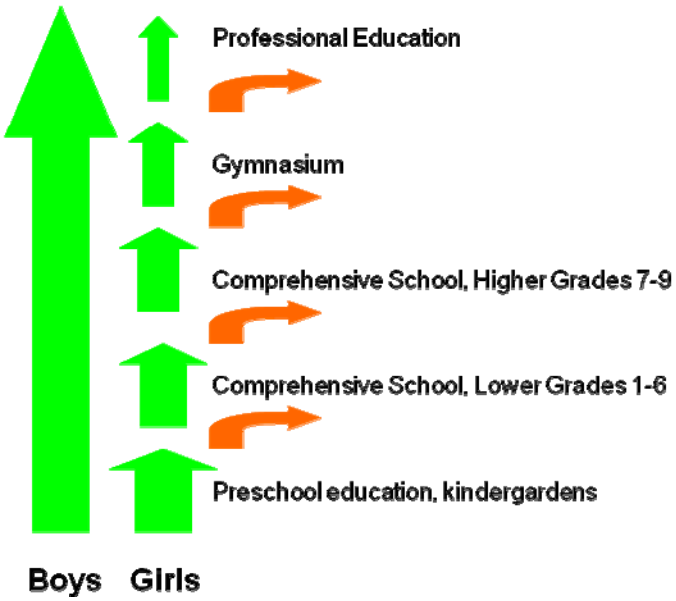



FIGURE 1. The present fragmentation of technology education, with frequent female drop outs

To tackle this challenge, we created a developmental approach for technology education to guarantee improvement and equality in technology education, and collaborated to facilitate this approach with the multinational UPDATE project consortium.

Compared to many other projects that have tried to involve girls in technology, our approach included a strong focus on early childhood and primary education. At these ages most attitudes are shaped quite sustainably. From this understanding, it would be far too late to start to try rising the girls' interest at only at secondary or later stages to attract female students to technology careers. Instead, specific efforts need to be taken throughout girls' whole educational career to foster and maintain their continuous and growing interest in the area. This idea is illustrated in Figure 2 with a spiral that refers to the holistic technology learning path, equal for both genders, starting with early childhood education.

The UPDATE project examined why girls drop out from Technology Education at different stages of their education, and aimed to create new educational practises to encourage them to continue with technology-enhanced personal curriculum. The collaborating partner also aimed at building a European network for continuous Technology Education enhancement, supplemented with national networks. The network members intend to continue different forms of collaboration after the project, collecting both research knowledge and best practises for creating models for innovative technology enhanced learning environments for boy's and girl's technology education. The main focus of the network lays on continuous improvement and change of technology teaching practises.

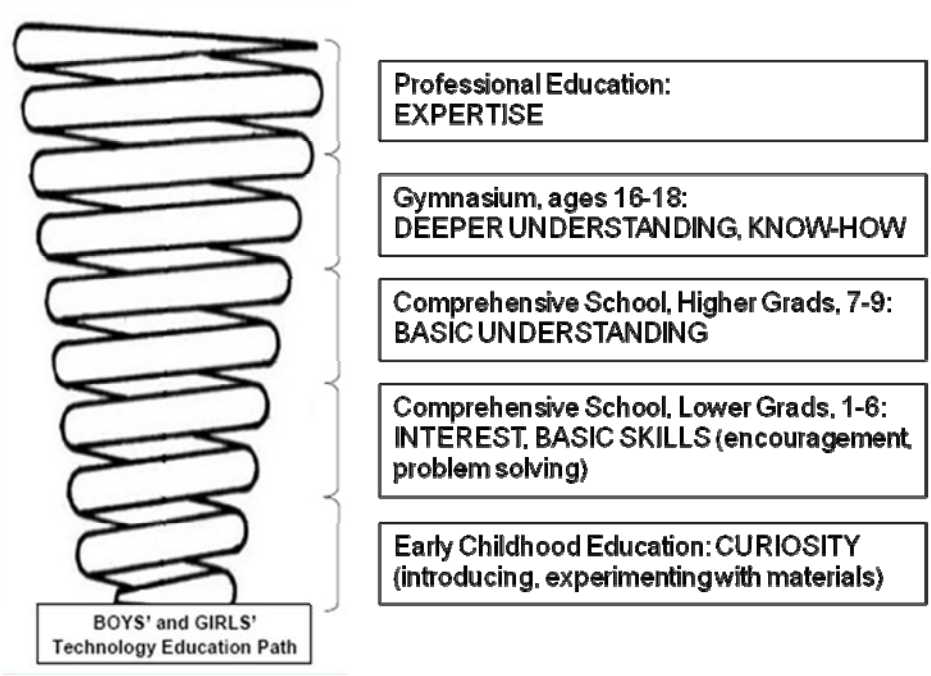



FIGURE 2. The aim should be a holistic, developmental approach to technology education in which the curiosity and interest of both genders is fostered from the beginning

## *The main objectives set for the UPDATE project*

***Objective area 1:*** *Examining why girls drop out from Technology Education at different stages of their education.* The reasons why few women choose technological fields for their further carriers and jobs are rooted in their early years, and continuing through all stages of education. Therefore the problem has to be addressed already at the beginning phases of education.

***Objective area 2:*** *Creating new ways and educational methods to make the image of technology and science more attractive for both boys and girls.* The project offered contents for a holistic and developmental curriculum in technology education. Such a balanced curriculum would provide both boys and girls with continuous interest towards various forms and possibilities of technology, as well as with equally functional understanding of technology, and ability to critical thinking in how to apply the scientific knowledge through technology.

***Objective area 3:*** *Promoting, encouraging and mobilizing especially girls and young women for engineering and technology.* Changes in technology pedagogical practices and new learning environments are requirements for making technology more attractive for girls and women, which again is relevant if women in technological areas, carriers and jobs should be boosted. The UPDATE project will impact on the very core of the gender issue – the girl's/ young woman's self image on her training choices, professional potential and social importance, tailored according to her needs.

# 2 Main aspects of the project work

## Overview

The UPDATE approach was, from the beginning, based on the following principles:

1. Developmental approach to technology education. The analysis and studies will therefore be carried out from early to secondary education and continued to professional education.
2. Technology is seen not only as a career option, but as an essential part of each person's everyday life in the information society. Hence, gender equality is of uttermost importance.
3. Collecting and making use of information on experiences, best practises, and new ideas related to technology education from the participating different European countries and regions.
4. Taking into consideration both visible technology education curricula and various invisible factors that have impact on attitudes towards science and technology.
5. Continuous sharing of new ideas and case studies during the whole project through the shared digital platform.
6. Synergic and continuous collaboration with teacher training in the participating countries. This collaboration will guarantee direct exploitation and dissemination of the project's results.

As Figure 3 demonstrates, the project started by building methodological tools for the project use and for interactive communication. In the following phase, the technology contents of curricula for different school levels + early childhood education were analyzed (structural level). The following Phase 3 (WP5) focused on individual motivating factors and possible gender related barriers to technology education, mainly based on the experiences of girls and young women that had already made their career choises. Phase 2 and 3 results were utilized when designing pilot case studies in Phase 4. Finally, the project ended in Phase 5, structuring of new, developmental and holistic technology education curriculum with guidelines that help the teacher trainers, educators, as well as politicians to build new educational and structural practises to better involve girls in technology. In short, the work packages were titled as follows:

WP1: Creating the methodological tools: Digital Portfolio Platform

WP2: Early Childhood Education (ages up to 6–7)

WP3: Elementary School

WP4: General Education

WP5: Encouraging and recruiting female students: Motivation and Barriers

WP6: Restructuring a Holistic Curriculum

WP7: Dissemination and Exploitation of best practises

WP8: Project Management

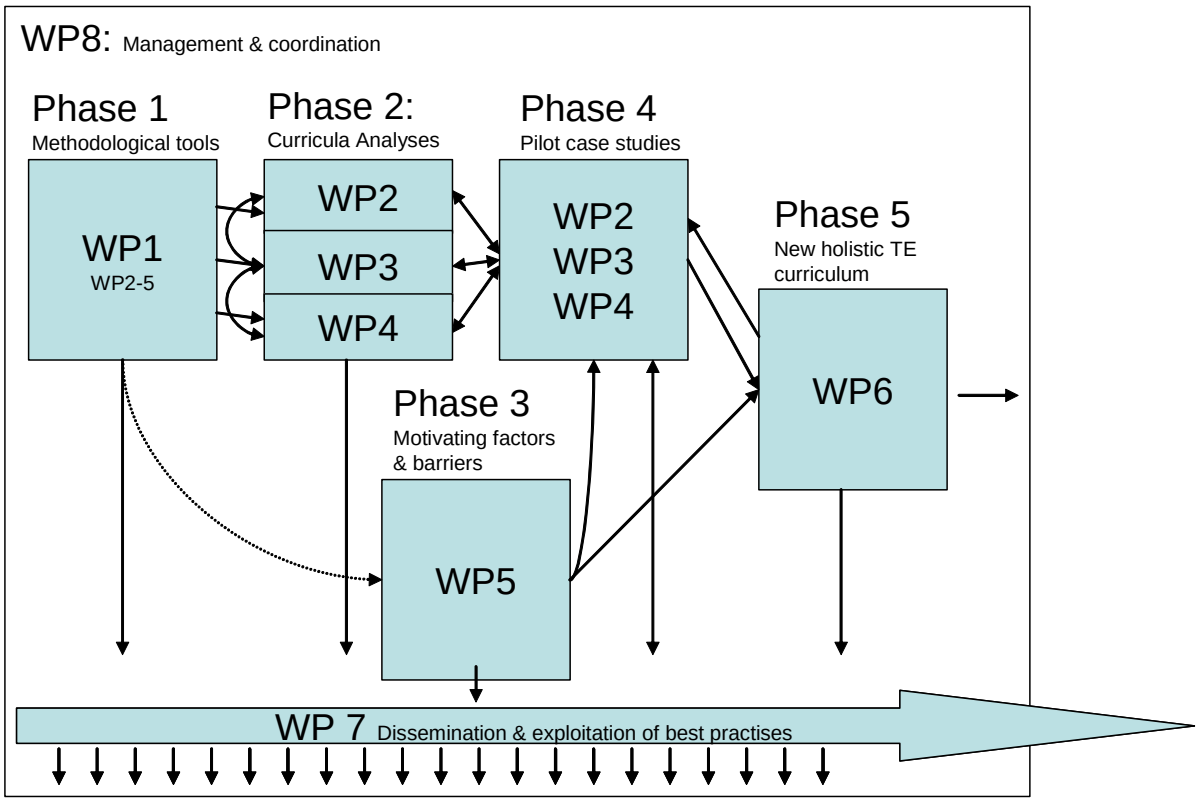



FIGURE 3. The UPDATE project structure

According to this project plan, the main activities during the first project year included building the necessary infrastructure (methodological tools), and analyzing the problem area (curricula at different age levels) and challenges or motivating factors and barriers.

The major milestones of the project were associated with the project objectives.
The major milestone associated with objective area 1 related to **WHY** girls drop out from technology education was a study about both the motivating factors that have led female students in different technology areas, and of possible barriers at different age levels. The milestone was planned to result to a list of possible barriers, a list of motivating and encouraging factors.

The milestones associated with objective area 2, related to **HOW** to generate improved curricula, methods and materials for technology education included:

- Analysis of the technology contents of different school subjects in the participating European countries
- Providing suggestions for an enhanced technology education curriculum and learning environments for early childhood education and different school levels and on an European level
- Providing suggestions for a new enhanced technology education curriculum for teacher training and study counsellor training, also on an European level

The major milestone, associated with objective area 3, was to provide new ways of **ENCOURAGING** and recruiting female students to technology careers.

Finally, through the collaborative dissemination and exploitation process of the project results, the project aimed to build and strengthen a European network for continuous Technology Education enhancement, supplemented with national networks, and to build a knowledge base of best practises and innovative learning material for science and technology teaching on different educational levels.

## Digital Portfolio Platform

The interactive use of web site was essential for the UPDATE project, as the project focused on building informed partnerships in a horizontal structure. The project web site consisted of the web-based digital portfolio and interactive dissemination area. The technical implementation, structure, and contents of the UPDATE project web site were planned and designed in synergy with the project's dissemination activities, and included a public site as well during the project.

The project web site was used as an ongoing tool, which was regularly updated during the project. The UPDATE web site supported the project's key functions, which distinguished it from previously developed web sites:

- a web-based collaborative environment
- collaborative working space for the on-line editing and compilation of questionnaires and texts
- a blog for supporting partner communication, participation of schools, children, and dissemination activities alike
- mailing list
- digital portfolio section

Through the duration of the UPDATE project, the UPDATE website (http://update.jyu.fi) served both as a dissemination platform and as an internal tool supporting the work of the project partners. During the project, the *Pedagogical Practices Portfolio* section of the website developed into a vast collection of good pedagogical practices and empirical experiences of technology education with different age groups.

In the end of the project, the portfolio section was made public and available to everyone interested in concrete practices of technology education. Visitors of the UPDATE website are able to both read the good practices collected by the UPDATE partners during the project and to share their own practices by adding new items to the portfolio section. As the website is wiki-based (built on the MediaWiki platform), it enables the contents to remain dynamic also after the project, as the good practices collection is open to additions made by any educator visiting the website and willing to share his/her practices. To facilitate the addition of items, the portfolio sections include ready-made templates for the descriptions of pedagogical practices.

From the front page of the UPDATE website, the portfolios can be accessed in two ways. The left sidebar contains a link to the main page of the portfolio section

(Pedagogical practices portfolio), through which all portfolios (each targeted to different age group / school level) can be reached. If the visitor is especially interested in technology education practices for a particular school level, he/she can access them directly via the age-group-specific category links at the top of the page (Early Childhood, Elementary School, General Education) which list all content related to this specific age group. In the portfolio sections one can read existing pedagogical practices and add one's own practices.

## Curricula analyses and search for best technology education and teacher training practises in Early Childhood Education, Elementary School, and in General Education

To improve technology education, we had the need to create a holistic view on technology education and teaching. With new, improved technology education practices it is possible to make technology more attractive for young people, promote their interest, and encourage their critical and creative ways of thinking. As noted also by Gerhard Kraetzschmar, the coordinator of the European project Roberta Goes EU, "the crucial factors in motivating girls are not the technical subjects as such but the way in which they are presented using adapted teaching methods" (Research EU, June 2007).

Analyses and studies about the technology contents aimed to single out how technology is introduced to children in different phases of education, whether a gender imbalance already exists at an early age, and how this varies in different countries.

A framework for analysing the curricula in different EU countries was created in co-operation of several EU partners under the UPDATE-project. The structured tool was used in analyzing the curricula of participating countries. The seven aspects taken into account were:

*1 Characteristics of the school system*
*2 Characteristics of the general curriculum*
*3 Position and status of technology education in the curriculum*
*4 Aims of technology education*
*5 Pedagogical means and methods for technology education*
*6 Main themes and structure of curriculum content*
*7 Characteristics of the teachers in charge of technology education*

The curricula comparison is presented in the following table.

| Aspects | Austria | Estonia | Finland | France | Germany |
|---|---|---|---|---|---|
| Characteristics of the school system | compulsory 9 years (6 to 15 years)<br>-<br>comprehensive 1-4 grades<br>-regular secondary<br>-secondary academic | basic education 9 grades (primary 1-6) | comprehensive 1-9 (7-16 years) | national & public schools system, compulsory up to 16 years | each federal sate has it's own curriculum primary1-4 (6-10 years), secondary (16 years):<br>-general<br>-intermediate<br>-grammar |
| Characteristics of the general curriculum | national framework curriculum for all | national core curriculum | national framework curriculum | compulsory national programme | Broadly framed directives from ME, differs from state to state |
| Position and status of technology education in the curriculum | No technology education<br>Technical education<br>Differentiation at later stages boys - girls | No technology education<br>Craft and technology education<br>Differentiation at later stages boys - girls | No technology education<br>Craft, technical work, human being and technology (CC)<br>Differentiation at later stages boys - girls | No technology education<br>Under science in primary, science and technology in secondary schools (11-15 years)<br>Same for girls and boys | No technology education in primary but in secondary<br>During social studies and handicrafts (1-4),<br>Under several subjects mainly in secondary general<br>Differentiation at later stages boys - girls |
| Aims of technology education | General education (no pre-vocational)<br>No standards<br>• substance (issue related) know-how, such as: construction, manufacturing, technical processes, electricity etc.<br>• importance of technology in our daily lives, learning how to deal with technology in a responsible and ethical way, to take one's stand on development of technology, develop the readiness of pupils to live and to work in the world of today and in the quickly changing technological world of tomorrow. | | | | |
| Pedagogical means and methods for technology education | Hands-on activities<br>observation, exploration, experimenting, discovery, analysis, problem solving, design, manufacture and innovation<br>both individual work and co-operative learning<br>In Estonia a handbook for teachers is available and in Austria one book for junior secondary school pupils is available | | | | |
| Main themes and structure of curriculum content | Energy, transport, construction, design, process, communication, manufacturing, transmitting power. Different materials, such as paper, textiles, plastics, wood, metal, electronic components etc. are mentioned in many curricula.<br>Tools, equipment, machines, computers, computer operated machines should be used and studied<br>In Austria architecture, and in Finland the ethical and environmental concerns in technology education are emphasized | | | | |

| | |
|---|---|
| Characteristics of the teachers of technology education | Class-teachers (who may be specialised in teaching technology) teach technology classes in primary schools. In middle/junior secondary schools either class-teachers or specialised teachers take care of the lessons.<br>Most primary sector teachers are female (at least in Finland and Germany). Some teachers have very little if any training in teaching technology.<br>Some in-service training is available in different countries but teachers do not have to enrol if they are not interested.<br>In secondary technology can be taught by subject teachers who represent various school subject, mainly craft (technical or textile), home-economics or technical work. |

In addition, an analysis of the Finnish National Framework Curriculum based on pedagogical approaches was introduced in Figure 4. The higher levels of learning i.e. invention, problem solving and creative thinking were of special interest.

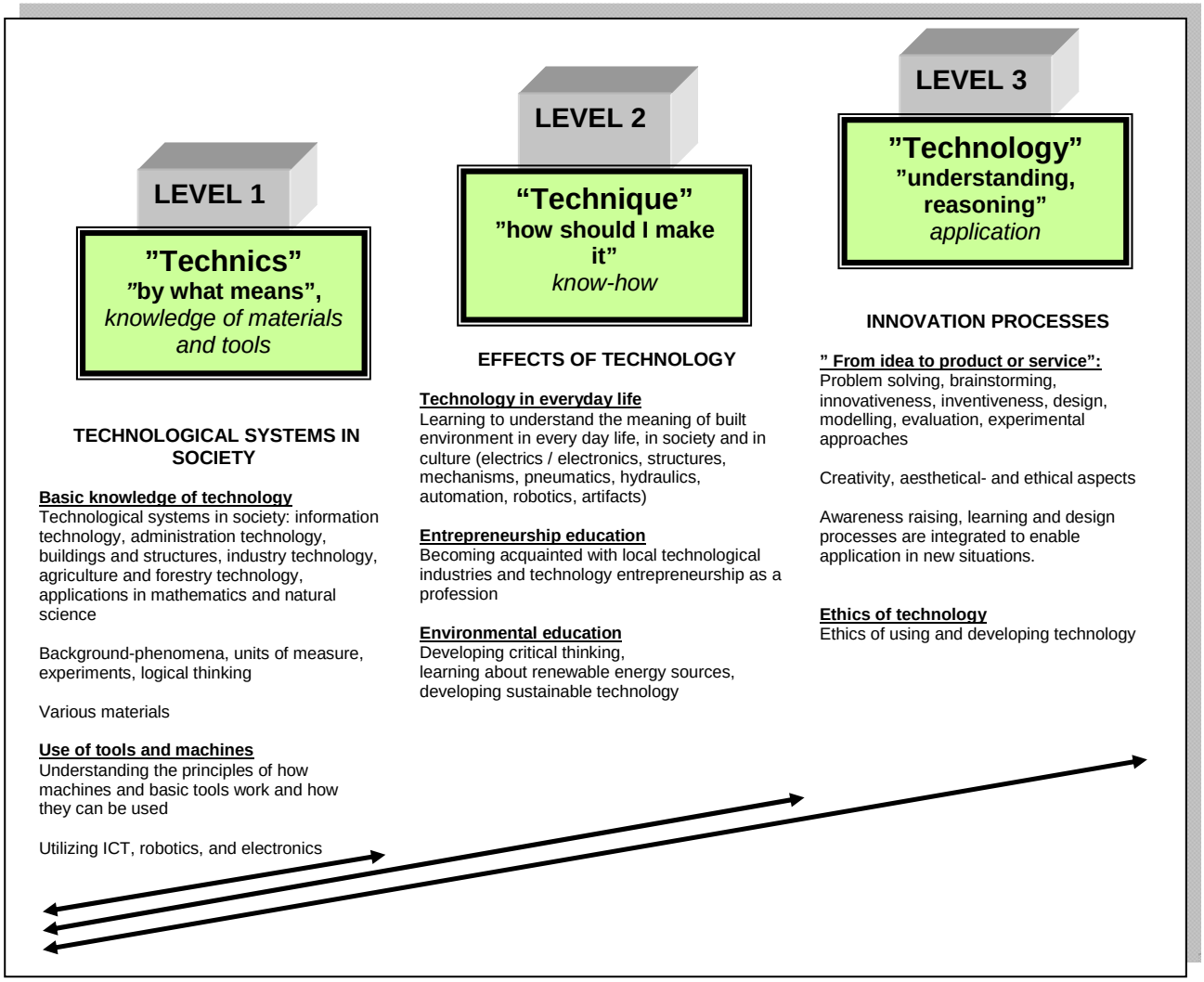



FIGURE 4. Framework for curriculum analysis. Pupils' mental process of understanding and the level of technological competence (modified version Virtanen 2008; Rasinen, Virtanen, & Miyakawa, 2009, 77).

A training module for technology education teacher researchers was originated and piloted at the University of Glasgow. After the pilot phase, the contents and structure of this training module, including material and video presentations, were uploaded on the UPDATE website to be applied by other UPDATE participant teacher training universities, and by other interested universities. The structure of the Training Module and the presentation videos are available for everyone on the project website.

A special UPDATE edition of the 'International Journal of Technology and Design Education', was published by Springer in 2009, edited by John Dakers and Wendy Dow, and including contributions of various project partners. We believe that the publication of this special edition of the journal was of major benefit to the project. The journal is international and the papers that were selected and used gave a good representative view of the project. This special edition explores issues surrounding the perceptions held by young people of technology, technology education and technology related careers. A particular emphasis is given to the perceptions held by young females and a consideration of why they choose to opt out of technology education and technology related careers. The collection of papers is inspired by work carried out during a three-years of work in the UPDATE project. The findings of the UPDATE project suggest that there is a qualitative difference in attitudes between boys' and girls' perceptions about technology, technology education and technology related careers. This difference seems to be most evident between the elementary and secondary sectors. The overwhelming factors that seem to lead to this distinction have little to with ability but much to with the masculine identity that is attached to the concept of technology.
http://www.springerlink.com/content/102912/?Content+Status=Accepted

Additionally, interim teacher guidelines were produced for use and comments to all partners. At the end of the project, the generic teacher guidelines were published as a **"Handbook for Teachers".** This technology education handbook is intended to act as an interim guide for teachers of technology education in all sectors of school. It is hoped that this will serve to guide the shaping of any teaching and learning provided by those who are active in providing a technology education programme. Findings revealed thus far indicate, in line with the hypothesis made in the UPDATE project, that issues related to gender in technology education are embedded at an early age and these should be addressed before, as well as in, the secondary sector.

We have reason to believe that the 'Handbook for teachers' has been very successful. There has been great interest shown in the handbook from partners in the consortium, from colleagues involved in technology education around Europe, from the Scottish Government and from our own university. The book is published and made available open access in the project website. In addition to English, it is translated to other languages: French, German, Spanish, and Catalan. The format of the handbook is new in that it seeks to disseminate the results of the UPDATE project in a more theoretical framework that is supported by extant contemporary educational theory. In other words, a theoretical framework is given together with discussions about actual case study practices. The fact that the handbook will be freely available in four languages is also likely to be a factor in dissemination to a wider audience.

## Recruiting female students: Motivation and Barriers

The *main steps* carried out to find ways of promoting, encouraging and mobilizing especially girls and young women for engineering and technology were planned and agreed among the project the partners at the kick-off meeting in January 2007. The partners decided that in each participating country, surveys and interviews will be carried out with women within the technology track, but also with women, who have obviously had talent in the area of mathematics /science, and hence would have had a good start for a technology career, but have not selected this. The main questions this approach has to answer at were:

a) What are the main motivators that have led female students to technology careers /professional?
b) What are the barriers at different age levels?
c) What reasons have led female students to the decision to drop out from the technological education and career?
d) What support/information etc would have been needed to continue into technology/ engineering?
e) How technological talents or skills are, or could be, used also in careers that traditionally are not seen as technological etc.

The development and/or adaptation of the data collection instruments started from the peculiarity of the UPDATE project approach that includes a strong focus on early childhood and primary education, phases in which the attitudes are often formed. The methodological approach and the working instruments have been specially designed in order to identify the motivators and barriers along with the educational cycles, starting with early education.

A questionnaire with 17 scales was built by Professor Doina Balahur. The questionnaire aimed at identifying the motivators and barriers along with the educational cycles, starting with early education. It was developed and pre-tested by the team from "Alexandru Ioan Cuza" University. During the process, different versions of the questionnaire were circulated among the partners for comments and observations. The final version had twenty-three dimensions and was considered too long to be applied. The applied version was a revised and shortened one. The applied version has also valorized some dimensions and items from the questionnaires prepared in the Womeng project by Päivi Siltanen. In order to be applied it has been translated in the official languages of the partners involved (Greek, Romanian, Spanish/Catalan etc). Some items from Socio-biographical-inventory (ISB/) were also integrated in the applied questionnaires.
The applied version of the questionnaire had the following dimensions:

I. Tradition in family
II. Early gender segregation/ "La vie en rose la vie en bleu" (Nancy Chodorow).
III. Mentorship and role models/ primary school.
IV. Personal achievements.
V. Self-efficacy, closely associated with academic motivation, performance and achievements. (A. Bandura).
VI. Self-image.

VII. The support of the significant others to chose a non-traditional/traditional career /parents support.
VIII. Cognitive styles: intelligence connected to the objects /intelligence connected to persons (H. Gardner).
IX. Curricula / primary education/teacher's attitude.
X. The manuals.
XI. Middle and Secondary education.
XII. Educational career in engineering/other fields.
XIII. Career expectations.
XIV. Decision/motivation to study engineering.
XV. Self-efficacy and the decision to study engineering.
XVI. Curricula/courses content.
XVII. Gender stereotypes and obstacles in engineering/science/ICT employment.

In addition to or instead of these instruments, an adapted version of the drafted questionnaire and 'Womeng' questionnaires were used by some partners. A special questionnaire adapted for women in ICT was built by the Finish project coordinator. Additionally, case studies or semi-structured interviews structured around 'life-histories' of women who had succeeded in an engineering career, and of those who dropped out from technological education/career.

The first results of the possible barriers and motivating factors were published on the project website as a more condensed report in 2008. However, the work to analyse and supplement the results with case studies continued. In April 2009, a workshop on Career Development was organized in Iasi, Romania, to discuss the results and conclusions between the partners.

The project partners were encouraged to disseminate and exploit the work in form of manuscripts and reports directed to different target audiences. One of the results of this work to provide content of a new strategy to attract and encourage female students to careers in SET/technology was the "Teacher's Guide for Science and Technology Educators in Secondary and Higher Education" (2009) prepared by Valentina Pomazan, Nicu Sava, and Lucian Petcu. The material is published in paper and in the UPDATE website
(http://update.jyu.fi/images/0/06/Guide-Partner5-UOC.pdf )

"The content of a new strategy to attract and encourage female students to careers in science and technology" was published at the end of the project. The included recommendations draw on project findings regarding the examination of why girls drop out from technology education at different stages of their education (see project's website) of the project as well as the motivation that has led female students to technology careers /professional technology education, and also the barriers at different age levels. Important conclusions / recommendation for the policy/decision makers also resulted from the operational developmental perspective synthesized in our research on the matrix of cumulative advantages and the matrix of cumulative disadvantages. Profiling method and the case studies complemented the methodological frame of the recommendations regarding the content of a new strategy to attract and encourage female students to education and careers in science and technology.

Starting from our research findings and also from the problematic issues identified – from the why's- the next step was to see 'how' things can be improved; what measures, strategies and policies should be put in motion in order to better motivate women to chose an education/career in science and technology. The proposed recommendations/ directions of action are interconnected and synergic aiming at promoting a different educational environment structured around the general values of gender in development. Their successful implementation needs structural changes identified in our research at several levels of the educational systems: values, management and organizational culture, human resources and partnership.

**The "10 Commands"to policy makers based on UPDATE results:**

I. DEVELOP A PERMANENT PARTNERSHIP ON BEHALF OF YOUNGSTERS' SCIENCE AND TECHNOLOGY EDUCATION
(European/National/Local policy-makers)
II. ENCOURAGE AND SUPPORT THE SETTING UP OF THE PROGRAMMES FOR PARENTS'TRAINING
(National/Local policy makers)
III. DEVELOPING AND DIVERSIFYING THE EARLY CHILDHOOD AND PRIMARY EDUCATION
(National/Local policy makers)
IV. PROMOTE THE RESPONSIVE PEDAGOGY/EDUCATION AIMING AT BETTER PREPARE THE FEMALE AND MALE STUDENTS FOR THE KNOWLEDGE SOCIETY
(European/National/Local policy makers)
V. PROMOTE AND IMPLEMENT NEW STYLES OF INTERACTIVE MANUALS FOCUSED ON SCIENCE AS PROCESS
(National policy makers)
VI. PROMOTE AND SUPPORT NEW MANAGERIAL STRATEGIES OF THE EDUCATIONAL SYSTEMS
(European/National/Local policy makers)
VII. PROMOTE AND SUPPORT A NEW CULTURE OF CAREERS AND PROFESSIONS
(European/National policy makers)
VIII. STIMULATE AND PROMOTE A NEW/FRIENDLY IMAGE OF SCIENCE /TECHNOLOGY IN TEACHING-LEARNING ACTIVITIES
(European/National/Local policy makers)
IX. STIMULATE THE IMPLEMENTATION OF A NEW ORGANIZATIONAL CULTURE (IN ALL EDUCATIONAL BODIES) FOCUSED ON MANAGEMENT OF DIVERSITY AND GENDER SENSITIVITY
(National/Local policy makers)
X. SET UP THE EUROPEAN REWARD FOR YOUNG FEMALE AND MALE SCIENTISTS, ICT AND ENGINEERS
(European policy makers)

## Restructuring Curricula

The objective of the UPDATE project, and the reason for need to restructure and build a holistic curriculum is based on the following sentence: "*the reason why few women choose technological fields for their further carriers and jobs are rooted in the early stage of childhood education continuing through all stages of education*." This problem has to be addressed already at the beginning phases of education, and teacher education has to be greatly involved in this process.

Based on the results of phases 1–4, the project phase 5 was organised with the aim to develop of a developmental, holistic technology education curriculum and a new learning environment for technology education at different school levels. At the end the results of the conducted analysis, studies, pilot case studies, etc and the newly developed holistic curriculum helped to promote, encourage and mobilize especially girls and young women for engineering and technology.

According to the project plan, the third project year consisted of work based on analyses made previously, to develop a developmental, holistic technology education curriculum and new learning environment for technology education at different school levels. By combining curriculum analysis, study on the motivating factors that have led female students to different areas of technology, and possible barriers and case studies, we studied developing new ways of encouraging and recruiting female students for careers in technology. The technology education practices at different school levels had earlier been pinpointed, and the motivating factors analyzed. The aim of phase 5 of the project was to collect the information and look at it from a developmental, holistic perspective, looking for possible bottlenecks.

# 3 Overview to project results and conclusions

The main results are highlighted in this report. The project results have been presented and discussed in more detail in the project deliverables. The public deliverables, including the major results, are open access available on the project website http://update.jyu.fi/

## Collaborating to find and facilitate good technology education practices

It is evident from both the literature and the experiences within the UPDATE project that gender stereotypes in schools are strongly alive. Additionally, many teachers lack confidence about their own competence in technology education. At the same time, children and youth are growing in the knowledge society, learning to use technological devices from each other. As found in the SITES study many teachers still use traditional teaching methods and experience difficulties in positively utilizing and introducing technology in the classroom. It is not enough to provide the schools with the technology equipment, but that the change has to be facilitated with changes in teaching methods. This, in turn, necessitates development and new requirements of teacher training, as well as reforms in the national curricula of different schooling levels.

At the moment, the educational and curricular bottlenecks and barriers for efficient and equal technology education are many (see the report by colleagues from several countries, 2008). In some European countries, no separate curriculum for technology education exist in any of the school levels, not to speak about Early Childhood Education. Concluded by Rasinen and Virtanen, instead of differentiation between crafts domains, technology should be taught for both sexes in mixed groups. This would also mean re-thinking of the learning contents to be gender sensitive. As implied also in the SITES report, craft education could be regenerated toward modern technology, and technological contents should be integrated in different subject areas. Although all teachers should be trained with basic knowhow in technology, an effective way to guarantee technology teaching with trained, devoted teachers would be to develop a new school subject. As pointed out by Dow and Dakers, little can be done without collaboration: there is a need to reformulate the pedagogy in partnership between researchers, teachers, schools and pupils to design and implement new and more radical interventions in the delivery of technology education.

The search of the best practices for technology education demands certain commitments concerning the approach in general educational philosophy. Moreover, the sphere and the aims of technology education have to be defined. These issues may differ from country to country, and from schooling level to another in the adopted official educational thinking. Thus, also the best practices are culturally dependent in nature. Anyhow, some widely accepted pedagogical standpoints in contemporary education as well as the description of main ideas how to approach technology in

education are introduced by the project WP leaders to construct a foundation for best practices.

To sum up in a few words, when we are looking for technology, we are looking for such activities in every areas of human existence where people use and develop tools, machines, materials, techniques and processes for solving problems and reaching set goals in order to fulfil human needs and wants. Specifically in the education of young children we need to define, which are those areas of human existence with needs to be fulfilled and those wants that need to be satisfied that could be interesting, reasonable and meaningful for young children. This refers to the definition of objectives and contents of technology education.

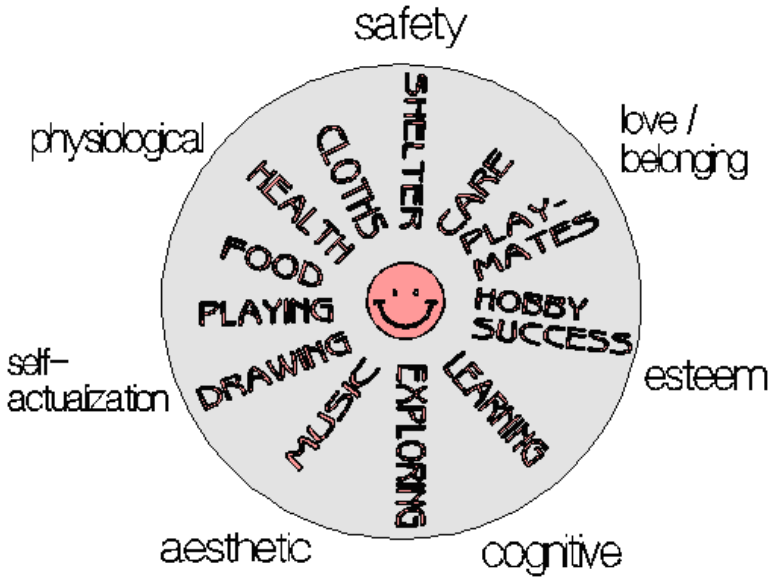



FIGURE 6. A circle of a child's life experiences to recognize the areas of human needs and wants to be satisfied with a help of technology

## Starting from early on

Motivation towards technology develops through technological actions and connects to them. The main actions consist of producing (i.e. inventing, planning, designing, and constructing/fabricating), maintaining and troubleshooting, and using and selecting technology (Mitchham, 1994, p. 209; Standards for technological.... 2000, p. 210). These activities can be transformed into technological roles of a producer, a maintainer and a user, which children observe in their environment and practice in play and in other daily activities. Their understanding of technological agency and their own self-efficacy as a technological agent bases on this kind of activity and interactions with their environment (see Turja, Endepohls-Ulpe & Chatoneu 2009).

According to the UPDATE project findings (report by Doina Balahur, 2008), the females who select study and career paths within technology have a comparably high level of self-efficacy nurtured by persistent accomplishments in math and technological disciplines along the educational cycles, have been featured by early diversity of cognitive interests and the pleasure to play and watch machineries. Additionally, they have been supported, in the key moments, by their parents, both fathers and mothers, as well as by their teachers. The support by parents appears to be more important for girls than for boys.

The developing self-image and motivation of children towards technology in early years needs most of all adults, parents and teachers/ nurses, active and conscious support. They have to be aware of the growing gender identity and the factors impacting on that process. They need to make conscious counter-acts to prevent children of adopting gender stereotypes available in the surrounding society. They have to be critical with their own beliefs concerning gender differences and gender roles. Moreover, mainly female staff in kindergartens/ day-care centres may feel themselves uncertain with technology itself. They need to get more knowledge about technology education as well as increase own technological skills and self-confidence. Hence, the first thing is to take care of the teacher's own education.

The project results showed that many activities and themes can be used to promote the aims of technology education already in early childhood education (A report on pedagogical practices for early childhood by Leena Turja, 2009). Educators need to spark children's interest, direct their attention and pitch discussions about technology around. At the same time teachers have to examine and reflect their own attitudes and pedagogical ways to meet both sexes. The more technology increases within our living environments, the more important and possible it becomes to develop interesting and meaningful ways of teaching technological skills to every child.

Another important issue in the background of children's developing motivation is the official educational policy. National curriculum guidelines are the visible manifestations of this policy. It is important, that objectives of technology education as well as principles of equality in education are written in the curriculum text clearly enough. For example the analysed Early Childhood Education curricula texts of six EU countries did not include any special guidance to ensure equal opportunities for male and female learners to grow and develop according to their potential. Some general statements only were found concerning equal and fair treatment of pupils or, more specifically, treatment of girls and boys with different needs and interests. (See more in Turja, Endpohls-Ulpe & Chatoney 2009).

## Suggestions for a new enhanced curriculum

The curriculum analysis carried out at the beginning of the project reveals several complexities in the various ways that technology education is delivered across different countries in Europe. One distinction relates to the way that technology education is perceived. This was an important area discussed in the project final conference. The subject is generally perceived to be a practical subject more related to the development of skills thought useful in industrial arts. In this sense it is also perceived to be masculine in nature. Another common variant to be revealed was the very strong need to change pedagogy in the delivery of the subject. A change in pedagogy would not only change the way that technology education was perceived, but would also serve to address the problem of the masculine identity that the subject continues to portray. These changes require systemic changes to the technology education curriculum content as major changes in pedagogy. This needs to be addressed at a number of levels including in-service support. However, significant short term improvements could be made manifest by taking action to educate teachers in training across Europe by introducing them to the research findings in this project. We would particularly recommend that the issues relating to pedagogy discussed in the special edition and the handbook should be made available to all teacher training institutions across Europe.

### 1. Technology should be studied at all educational stages as a regular, compulsory subject

The minimum demand is that the terms "**technology "–**not for example only "information technology" - **and "technology education"** are clearly mentioned and also opened - shortly but extensively enough - in the national level curriculum guidelines. This will serve as an official message to promote and take technology education issues into account in the curriculum work on local/ central levels at all educational phases, including the early childhood education, and teacher training contents.

Probably the most effective way to guarantee technology teaching would be to develop a new school subject, together with a massive re-organisation of teacher education (pre- and in-service).

### 2. Technology should be taught to both sexes in mixed groups

- to establish a subject discipline of it's own or
- to develop craft education towards modern technology or
- to integrate different subjects from this point of view

### 3. The Technology Education curriculum should be more precise

- standards for each learning stage

It is extremely important that the pedagogy takes account children's developmental level, individual diversity and cultural variation.

**4. Pedagogical aspects should be developed towards gender sensitive direction**

- cognitive assignments, from "simple" to "complex", planning/designing, pupils own ideas, cooperative learning, ethics of technology, "spiral" model

Craft and technology education has strong gender related dependence. In order to change attitudes it seems that gender-neutral curriculum is insufficient. Therefore gender sensitive approaches should be applied. Whilst several problems were revealed in this project it is also important to note that where case studies undertaken as part of the project involved significant changes in pedagogy, children, both girls and boys, were shown to be much more eagerly involved in learning. There is a significant corpus of literature that supports this style of teaching and learning.

Contents and targets/ objectives of technology education are to be handled within a selected theme, unit or project that makes learning holistic and meaningful for children, also for girls. In addition to the holistic approach, this means that learning should start from the child's immediate experiences and environment. Along the development and growth of knowledge, and experiences they gradually approach the more fine-tuned and abstract concepts and thinking of technology.

**5. The pupils should be encouraged for creativity, problem solving, inventing, making, constructing**

Educational thinking basing on socio-constructivism is increasing. This means that learning should base on concrete, hands-on-technology activities, which permit individual latitude for children and respects children's own initiation, activity, exploration and thinking and problem-solving in a creative way. Learning in social interaction is fundamental. The development especially in the areas of language, communication, and social skills (among others) should be supported and taken into account in the way of working.

**6. Ethics of technology – sustainable future**

**7. Information campaigns**

- decision makers, parents, teachers, teacher educators

**9. Better facilities for studying technology**

- laboratories, workshops, tools & equipment, computers, various materials

**10. Stronger cooperation with outside society**

- enterprises, museums, factories

## Barriers and motivators to a technological career

Our data collection instruments and the strategy of the fact-findings interpretation were designed to seek out how the *escalation* of the educational cycles, including early preschool education, supported in different degrees (or not) the choice for a major in technology/ engineering education and career.

Our assumptions are described in the "model of the 4 Is' in Figure 6- The decision to follow a certain educational/ professional path essentially depends on the:
1) Knowledge and skills for the domain (I know).
2) Accomplishments in the disciplines connected to the technology/engineering field (I can). It operates as the 'social validation' of what 'I think, I know and master'. It might consist in good/very good results at the scholar evaluations, national/ international contests in the field; prizes etc).
3) An optimal level of the intrinsic and extrinsic motivation (I want) (based on what 'I know and I can') and
4) The 'projected identity' or the life and career aspirations and expectations. (I do).

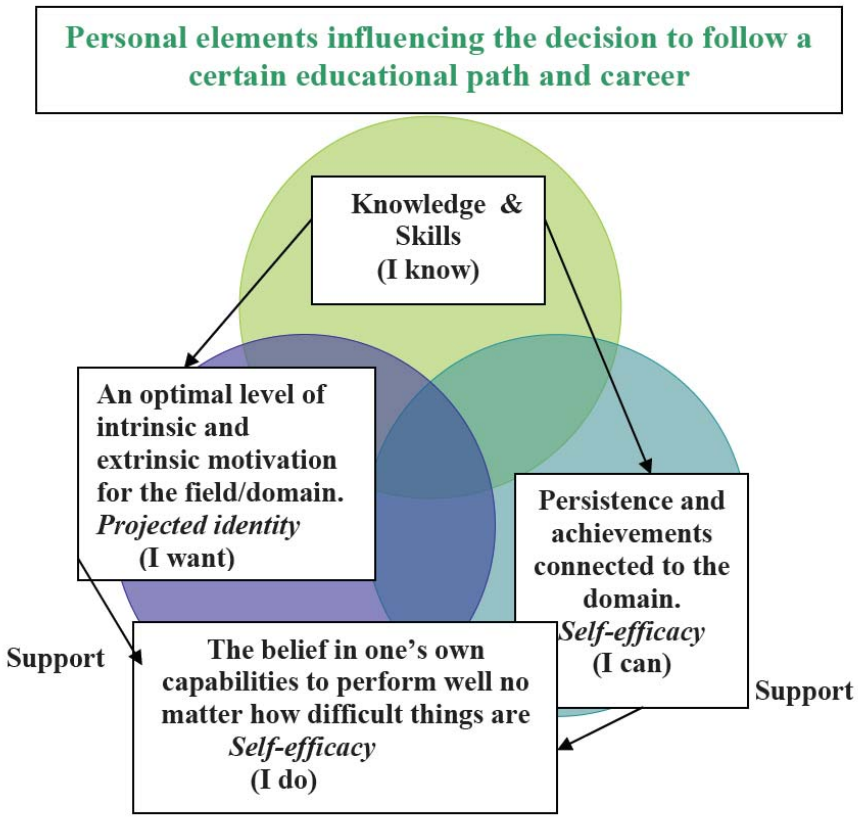



FIGURE 7. Personal elements influencing the decision to follow a certain educational path and career

All these personal traits contribute to what A. Bandura described as 'self-efficacy'. Additionally, the dynamics of each of the four personal traits is strongly influenced by the micro-environment the person is growing up and develops: family, parents'

educational strategies, formal education, the 'significant others', peers, competition, award/evaluation system etc.

The analysis of the data collected shows that there are cases /persons which benefited by an important support along the educational cycles (including self support, self-motivation, self-efficacy etc). They benefited by what we called 'cumulative advantages' and according to our findings they fell within 'the maximal profile'. The opposite situation is represented by the students reporting of having benefited by poor/moderate or no support, along the educational cycles ('cumulative disadvantages'). The presence and the intensity of a certain dimension (role models, tradition in family, reward system, accomplishments, etc) can operate as 'motivators'. By contrary, its absence, or its small values operate as 'de-motivators' and 'a-motivators' (barriers).

The table below presents the summary of the findings in our field researches and case studies.

## *Summary of the research findings: motivators, de-motivators, a-motivators (barriers)*

| **MOTIVATORS**<br><br>***Why female and male choose education /career in Science & Technology*** | **BARRIERS**<br>**DE-MOTIVATORS/ A-MOTIVATORS**<br><br>***Why few female choose education /career in Science & Technology?*** |
|---|---|
| **Level** | **Level** |
| a. ***Parents and early child education***<br><br>-early childhood holistic education;<br>-early stimulation of diversity of cognitive interests<br>-early stimulation through non gender biased games, activities<br>-early manipulation of 'technical' toys<br>-non-gender biased education<br><br>***b. Educational cycles***<br>- early achievements and interest for math/craft etc<br>- experimental, intuitive teaching style<br>- fairness of the evaluation system,<br>-equal emphasis on disciplines taught (math, sport, music<br>- non-gender biased teaching style<br><br>***c. Relationships with significant others***<br>- teachers' /professors support for self-efficacy development;<br>-parents' (both fathers and mothers) support in key moments;<br>-parents' support to chose a non conventional | a. ***Parents and early child education***<br>-moderate or no parents' concern for 'holistic education'<br>- early gender biased education (la vie an rose, la vie an bleu);<br><br>***b. Educational cycles***<br>- theoretical, non-experimental teaching style;<br>-few or no connections with real life,<br>- teachers' gender biased attitudes;<br>- transforming performances at one discipline (math) in standards of general evaluation of the pupils *('if you are not good at math, you are not good at all'*);<br>- unsuccessful and failure experiences;<br>- the pressure of competition;<br><br>***c. Relationships with significant others***<br>-weak support from the significant others –parents and teachers especially in key moments<br>- weak support of teachers for independent thinking , self-confidence and creativity<br>- gender biased attitude of teachers from natural and technological disciplines; |

| | |
|---|---|
| career<br><br>***d. Role models*** **(***teachers and parents )*<br><br>***d. Life events*** as curiosity stimulators (the death of a parent, relative )<br><br>**e.** ***Personal qualities- high level of self-efficacy:***<br>***- competence (knowledge and skills) for the domain:*** persistence of achievements in natural sciences along the educational cycles;<br>***- attitude in front of difficulties:*** *difficulties are taken mainly as challenges and less as failures*<br>***-high level of intrinsic motivation*** supported by the desire to do something original, unconventional; to use all my potential; to achieve something;<br>***- high level of extrinsic motivation:*** 'to make a good living'; to be 'well considered'; 'to have promotion possibilities'; to have enough vacation etc.<br>***- behavioral traits***: hardworking, ambitious, assertive, team player etc | ***d. Institutional(educational) barriers***<br>- Premature close of the selection possibilities for educational path<br>- Conditional relationship within the university admission and the type of grades in secondary school<br>-For some educational systems –late start of the study of technological disciplines (middle education and sometimes even later)<br><br>e. ***Persistent public / mass media stereotypes on gender and engineering*** (public image of the engineer is associated in media with 'men')<br><br>**f) Perceived difficulties regarding the engineering work** (too much work, too many technical responsibilities, too many managerial responsibilities)<br><br>g) ***Perceived difficulties regarding the possibility to conciliate***: career and child bringing up; professional obligations and private life; the conciliation of both partners' professional and private obligations etc<br><br>h) ***Decision making style: '****based on the choice that maximizes effects with the smallest effort* ('instead of engineering I preferred economics –because I can gat the same social status with less effort than a career in technology/engineering (male, 17 years old Romania). |

## Contents for an enhanced, holistic technology education curriculum and learning environments

Considerable disparity exists between curricular structures in the European countries involved in the project.

Two ideas seem to be in evidence: one is based on manual/practical tasks using home life or even craftsmanship as a reference point, with the other using an industrial model. The first of these models prevailed for many years in some countries which now implement it into the industrial model. Hence in France, the current model was only put into place in 1985. Its implementation actually justified a plan to reconvert teacher training, so that they had to be trained in this new discipline and abandon their previous practices of manual labour, a move which led to the teaching body for new technology teachers becoming increasingly masculine.

A more significant homogeneity underpins the first and the final teaching grades. Amongst young children, the general trend is to encourage technology teaching whilst

also giving teachers the choice of whether or not to use it, based on methods available to them and in which the position of learning is not paramount. The trend in secondary schooling is to have optional education. Pupils have to choose whether their studies will involve technology or not. In other words, as soon as the system for making study choices is in place, technology marks out its own path and becomes segregational for girls, who prefer to choose options that appear more attractive to them. Teachers are not always aware that they tend to allow gender stereotypes to persist; allowing them to become aware of this and helping them to act differently would be a step in the right direction.

What measures could be taken to allow progress from a gender point of view? Many of these measures hinge upon theoretical analysis which can be done, but also upon facing the reality highlighted in the case studies. One would have to be able to envisage, most importantly:

- Curricula incorporating more study areas that are enticing to girls. A balancing out of areas of activity used in teaching. Feminine and masculine sectors should be represented in the same way.
- Re-evaluation of the intellectual characteristics of industrial sectors in which women are in the majority (textiles, clothing, for example).
- Equality of vocational qualifications.
- Information about jobs and help with making choices, within the school building and not in separate organisations.
- Training teachers to encourage girls.
- Moving away from an image of technology which automatically emphasises the importance of mechanics, electronics and information technology. If, on the contrary, technology looked more at cosmetics and clothing, it would attract more girls than boys.
- Favouring technologies which rely less upon gender difference, particularly those that are going to be important in the future, such as information and communication technologies.

All these points go far beyond a curricular context, and are based on political choices. Among these choices, instilling equality would perhaps be a satisfactory finishing point.

# 4. Summary of the major project achievements

Setting up the MediaWiki –based, interactive project portfolio website http://update.jyu.fi/. Good pedagogical practises for technology education were collected and presented on the website for different stages of education starting from Early Childhood Education.

The project carried out curriculum content analyses on Early Childhood Education, Elementary School education, and General school education, and produced suggestions for curriculum development for enhanced technology education. The project proposed how to develop an enhanced, holistic technology education curriculum and learning environments for different school levels at national and European levels. In addition, suggestions for enhancing TE educational elements in early childhood education teacher training, and in elementary school teacher training were brought up.

Reports on factors that have impact on self-image related to technology were produced for early phases of education, (in Early Childhood and Elementary School education). The project produced a report on possible barriers, motivating and encouraging factors for a career in technology, based on national surveys. As a result and recommendation to the policy makers, the content of a new strategy to attract and encourage female students to careers in Science and technology was developed.

Based on the analyses and studies within the project, new teacher guidelines for enhanced TE education were written as a Handbook for Teachers. The Handbook, originally written in English, was translated in several other languages, including German, French, Spanish, and Catalan. In addition, other publications for enhanced technology education training was produced.

All these documents, as well as other products of the project and material for teachers were disclosed to the public and are available on http://update.jyu.fi

The project was productive also in scientific dissemination. The major conferences participated also with specific UPDATE symposiums were the International Design & Technology Education Conference held in Glasgow, Scotland in June 2007, the International Conference on the Efficiency and Equity of Education in Rennes in November 2008, and the ECER Conference (Theory and Evidence in European Educational Research) in Vienna, Austria in September 2009. In addition, numerous conferences were attended by one to three UPDATE members. The project held its public final UPDATE international conference on the results in Madrid, Spain. The conference was online broadcasted in the web. The project produced a special UPDATE edition of the ‘International Journal of Technology and Design Education’, published by Springer as the last issue of 2009.

# Dissemination and use

## Strategic Dissemination Plan

The dissemination activities of the project UPDATE were coordinated by the main dissemination partners Competence Center - Technology, Diversity and Equal Chances (Kompetenzz), Germany; the Catalan Foundation for Research and Innovation (FCRI), Spain; and the project coordinator University of Jyväskylä (JYU), Finland.

All UPDATE partners were responsible for the publication of information on the project in their countries, e.g., through their own websites and printed material. A detailed strategic dissemination plan with a task and time schedule for all project partners was developed in the first four months of the project in cooperation with the project consortium. The plan was valid throughout the project duration and was flexible enough to allow necessary adjustments required by the dynamic process of dissemination.

## Section 1 - Exploitable Knowledge and its Use

The project did not create such exploitable results that would have a potential for industrial or commercial application in research activities or for developing, creating or marketing a product or process or for creating or providing a service. No patents or other Intellectual Property Rights were applied for in the project.

However, the project produced **a publicly open access digital platform demonstrating the project findings and results**. This is exploitable knowledge suited for educational use throughout Europe. Through the duration of the UPDATE project, the UPDATE website (http://update.jyu.fi) served both as a dissemination platform and as an internal tool supporting the work of the project partners. During the project, the *Pedagogical Practices Portfolio* section of the website developed into a vast collection of good pedagogical practices and empirical experiences of technology education with different age groups. As the Portfolio was one of the major ways of disseminating the project results, all UPDATE partner took part in producing the knowledge in the Portfolio by producing the best practise or case study examples, and by offering national information to the WP leaders. The major responsibility lied on the respective WP leaders: Partner 1, JYU, Leena Turja, for Early Childhood Education, Partner 1, JYU, Aki Rasinen, for Elementary Education, and Partner 2, GLA, John Dakers, for General Education.

As planned, the portfolio section was made public and available to everyone interested in concrete practices of technology education as a final result of the project. Visitors of the UPDATE website are able both to read the good practices collected by the UPDATE partners during the project, and to share their own practices by adding new items to the portfolio section. As the website is wiki-based (built on the MediaWiki platform), it enables the contents to remain dynamic also after the project, as the good practices collection is open to additions made by any educator visiting the website and willing to share his/her practices. To facilitate the addition of items, the portfolio sections include ready-made templates for the descriptions of pedagogical practices.

**Overview table**

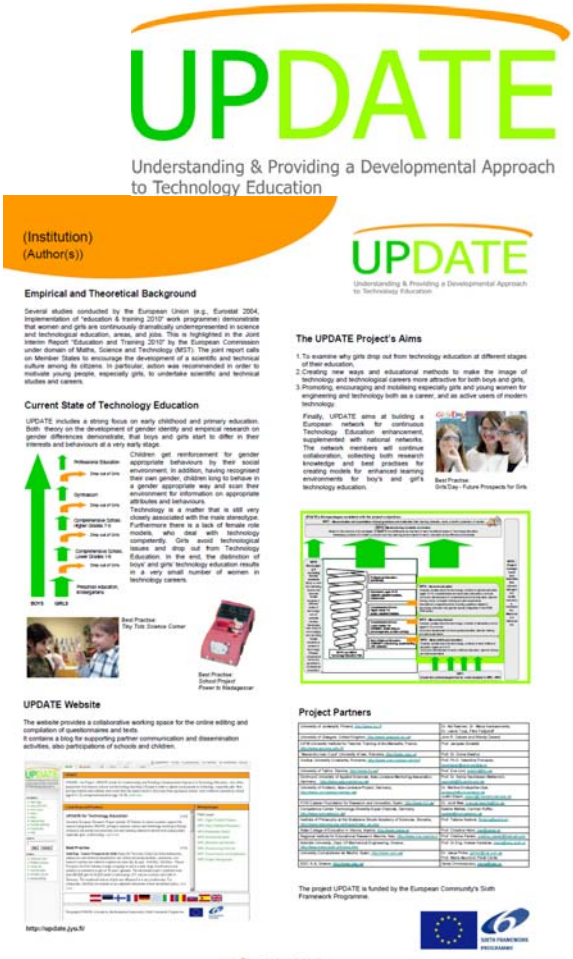
| **Exploitable Knowledge** (description) | **Exploitable product(s) or measure(s)** | **Sector(s)** of application | Timetable for educational use | Patents or other IPR protection | Partner(s) involved |
|---|---|---|---|---|---|
| *1. Technology Education principles and best practises* | *Open Access digital portfolio, website: update.jyu.fi* | *1.Early Childhood Education 2.Elementary Education 3.General Education 4.Teacher Training for each of these educational levels* | *2010 →* | *Patents are not relevant. The knowledge is scientific and educational and is agreed to be available open access. The Authors of each text and practise are clearly stated.* | *The portfolio is a central result of the project, all partners took part in producing the knowledge.* *The website is owned and maintained by Partner 1 (JYU)* |

From the front page of the UPDATE website, the portfolios can be accessed in two ways. The left sidebar contains a link to the main page of the portfolio section (Pedagogical practices portfolio), through which all portfolios (each targeted to different age group / school level) can be reached. If the visitor is especially interested in technology education practices for a particular school level, he/she can access them directly via the age-group-specific category links at the top of the page (Early Childhood, Elementary School, General Education) which list all content related to this specific age group (picture 3). In the portfolio sections one can read existing pedagogical practices (picture 4) and add one's own practices.

Through the available knowledge, we hope that we encourage educators in all levels for innovative technology education that facilitates interest in both boys and girls.

## Section 2 – Dissemination of knowledge

The UPDATE logo and a PowerPoint template were available as presentation materials from the beginning of the project. The language of the joint information material was English; and each project partner has been responsible for translations to national languages. The power point template has been provided for the use of all partners to present UPDATE at conferences and other occasions. The one-sided information handout is available as a pdf version and can thus easily be copied by each project partner on demand. All materials are available for download on the project websites. Each project partner was requested to distribute the presentation material to their own networks and key contacts.




The project dissemination has addressed scientific media, science journalists, national and regional newspapers, television, radio and online-media. The project partners are provided with the current press releases to distribute them in their country. Press releases were published on special events like e.g. the project's start, the launch of the web platform, the project workshops, and with regard to the presentation and publication of results. As a lot of results were dated at the end of the project, the project partners intend to continue national dissemination of the results through press releases also after the project.

Along with the public part of the project's digital platform, the project newsletter specifically composed for all target groups, has been an important way to disseminate the ongoing activities and the outcomes of UPDATE. The UPDATE newsletter contained current information on best practises, research data, upcoming events, and further news. The newsletter does not continue after the project, but the contents are available at the project website.

Important target groups in the education system were, e.g.,

- teachers of different school subjects and levels / teachers' associations

- teacher training and study counsellor training institutions,
- universities,
- research centres,
- ministries of education and other education authorities and agencies, whose aim it is to enhance the quality of education.

Furthermore,

- technical enterprises,
- companies with technical departments and technical training facilities, and
- vocational training institutions

have been important target groups and collaborators for the project's aims, e.g. to facilitate the access of girls and young women into these professional fields.

The project has been throughout carried out in synergic collaboration with teacher education in the participating countries. The participating universities provide additional resources that will help achieving the project's goals and objectives, as well as guarantee full exploitation and dissemination of the project results in the teacher training and later everyday pedagogical practises in schools. During the project, a European network for continuous technology education enhancement, supplemented with national networks, has been strengthened.

Presentations of the project at national and international conferences, meetings and visits were scheduled from month 7 to 36 of the project's duration. For the UPDATE project consortium it has been important to attend key events on national and European basis to make the project known and the results discussed by the relevant networks. From the beginning, these events guaranteed a sustainable dialog with the target groups.

Throughout the three years the UPDATE gas been presented on several national and international conferences and in meetings. These events which were attended regularly by the UPDATE consortium, helped to develop a sustainable dialog with the target groups. The attended events are documented in the project deliverables.

**Overview table**

| Planned /actual Dates | Type | Type of audience | Countries addressed | Size of audience (estimate) | Partner responsible /involved |
|---|---|---|---|---|---|
| *2007: January, June, November 2008: August, December 2009: November, December* | *Press release(press/radio /TV)* | *General public* | *Europe wide* | *3000* | *Main responsible Partner 9 Kompetenzz* |
| *April 2008, November 2009* | *Media briefing* | *Educators, decision makers* | *Romania, Spain (related to* | *10 000* | *Main responsibles Partner 15,* |

| Planned /actual Dates | Type | Type of audience | Countries addressed | Size of audience (estimate) | Partner responsible /involved |
|---|---|---|---|---|---|
| | | | *UPDATE conferences)* | | *UCM+ Partner 4, A.I.I. Cuza* |
| *Throughout the project* | *Conference (for details, see the list below)* | *Research* | *Austria, Finland, France, Germany, Greece, Great Britain, Latvia, Lithuania, Romania, Spain, etc.* | *Europe and world wide audiences* | *All partners* |
| | *Publications (for details, see the list below)* | *Research, Teacher Trainers* | *Europe-wide* | *5000* | *All partners* |
| | *Project web-site (described in Section 1)* | *Educators, policy makers* | *Europe wide, site maintained in Finland* | *58 000 (visitors counted)* | *Main responsibles Partner 1 JYU + other WP leaders* |
| | *Posters* | *Research* | *Presented, e.g., in the meetings + events* | *2000* | *Main responsible Partner 9 Kompetenzz* |
| | *Project Newsletter + other direct e-mailing + contacts* | *Research, Educators, decision makers* | *Europe wide* | *29 000*<br><br>*See the list of European contacts below* | *Main responsible Partner 9 Kompetenzz + All partners* |
| | *Film/video* | *Educators, Teacher Trainers* | *Europe wide through the open access platform* | *900* | *Partner 2 (GLA)* |

Relevant European meetings and events where UPDATE was presented

| Name of event | Date | Description |
|---|---|---|
| **Girls and Technology, University of Jyväskylä** | January 13, 2009 | Open national workshop concerning girls in technology (organized by the local UPDATE team) |
| **Center of Space, Technology and Gender; Aristotle University, Greece** | February 14, 2009 | workshop concerning engineering |
| **Women and Technology: Career Development, Iasi/** | April 23 -26, 2009 | Planning future activities, dissemination, evaluation |

| | | |
|---|---|---|
| **Romania** | | |
| 4th INTERNATIONAL CONFERENCE ON INTERDISCIPLINARITY IN EDUCATION | May 21-22 2009, VILNIUS, LITHUANIA | Presentation: Doina Balahur, P.Dobrescu-Balahur Gender and Technological Education. An European Comparative Analysis of Motivators and Barriers |
| **ICAPM 2009** | Nanyang University, Singapore, may 2009 | Presentation by Partner 5 (UOC)<br>Participants: researchers internationally |
| **Technology Day 2009, Düsseldorf/ Germany** | June 18 - 19, 2009<br>Düsseldorf/ Germany | Presentations of active technology education<br>Participants / Target group: teachers and pupils from all levels, multipliers<br>http://www.tag-der-technik.org/ |
| **First conference on gender and diversity in engineering and science** | September 11-13, 2009<br>Düsseldorf/ Germany | Symposium on women in engineering,<br>Participants / Target group: Engineering professionals, multipliers<br>http://www.vdi.de/40565.0.html |
| **Int. Conference of Balcan Phisycs** | Alexandropuolis, Greece, September 2009 | Presentation by Partner 5 (UOC)<br>Participants: researchers internationally |
| **IHEPI 2009 Conference** | Budapest, 2-4 September 2009 | Presentation by Partner 5 (UOC)<br>Participants: researchers internationally |
| **UPDATE final conference, Madrid/ Spain** | November 23 – 24, 2009 | Presenting project outcomes/ Target groups: members and interested parties<br>http://update.jyu.fi/index.php/UPDATE_Conference_Madrid |
| **ECER 2009 Conference, Vienna/ Austria** | November 25 – 30, 2009 | New pedagogies, educational and research theory**,** theory and evidence in European educational Research<br>http://ecer2009.univie.ac.at/ |
| **MOTIVATION – Final Conference 10th -12th December 2009, University of Wuppertal/ Germany** | December 10 – 12, 2009 | Gender perspectives in technology and nature sciences; image of MINT - subjects |

| | | |
|---|---|---|
| **IMST (Innovations in Mathematics, Science and Technology), Klagenfurt/ Austria** | September 23 – 25, 2009 | technical didactics conference |
| **REEP (Rural Environment. Education. Personality), Jelgava/Latvia** | May 29 – 30, 2009 | international scientific conference |
| **ECER 2009 Vienna: The European Conference on Educational Research. Austria, Vienna** | 25-26th September 2009 | international scientific conference |
| **"Design and Technology Education at School - the Platform of Life Skills, relevant Issues and Solutions of Problems", Vilnius/Lithuania** | October 22-23,2009 | international scientific conference |
| **International Summer Conference of Technology Education Evo/Finland** | June, 04, 2008 | international scientific conference |
| **Kon Te Xis - Meeting, Germany** | September 25, 2008 | Technology in education, Participants / Target group: stakeholders of educational system, researchers, (kindergarten) teachers and others http://www.kontexis.de/ |
| **VDI Congress of German Female Engineers, Germany** | September 19, 2008 | Symposium on women in engineering, Participants / Target group: Engineering professionals, multipliers http://www.vdi.de/40565.0.html |
| **Technology Day 2008, Germany** | June 13 - 14, 2008 | Presentations of active technology education Participants / Target group: teachers and pupils from all levels, multipliers http://www.tag-der-technik.org/ |
| **XXIX International Congress of Psychology 2008, Berlin** | July 20 - 25, 2008 | Most important international congress of all fields of psychology (more than 10.000 participants) Participants/ target group: researchers http://www.icp2008.de/ |
| **JIES, Chamonix - Les 29es Journées Internationales sur la Communication, l'Éducation et** | May 5 - 7, 2008 | Communication and education within scientific culture, colloquium on challenges for science and technology |

| | | |
|---|---|---|
| **la Culture Scientifiques et Industrielles, France** | | Participants / Target group: researchers, others http://www.stef.ens-cachan.fr/manifs/jies/jies.htm |
| **International Conference on the Efficiency and Equity of Education**<br>**Université Rennes 2, Campus Villejean** | 19th, 20th and 21st of November 2008 | Conference on education<br>Participants: researchers, teachers, others<br>http://ent.bretagne.iufm.fr/efficacite_et_equite_en_education/index.jsp?locale=en-US |
| **ECGBL - The European Conference on Games Based Learning, Great Britain** | October 25 – 26, 2007 | Conference on Games Based Learning held in Scotland. http://www.academic-conferences.org/ecgbl/ecgbl2007/ecgbl07-home.htm<br>Target group: Researchers, Others |
| **Empowering Women Engineers in Industrial and Academic Research, France** | October 26-27, 2007 | Gender issues in technological research careers are to be discussed; experts are gathered to bring new perspectives on engineering and technology research in itself.<br>http://www.prometea.info/conference2007/ held in Paris, F.<br>Target group: Researchers, Others |
| **Partner für Schule NRW** | October 13, 2007 | Professional convention on individual learning programs and gender fairness.<br>www.partner-fuer-schule.nrw.de/fsf_jungenundmaedchen.php<br>held in Cologne, Germany.<br>Target group: Teachers and other stakeholders of educational system, representatives from business, academia and politics. |
| **18. Tagung der Fachgruppe Entwicklungspsychologie der Deutschen Gesellschaft für Psychologie** | September 24-27, 2007 | Most important German conference on developmental psychology.<br>http://www.fachtagung-entwicklung07.de<br>Held in Heidelberg, Germany<br>Target group: Researchers, Others |
| **Partner für Schule NRW** | September 1, 2007 | Annual kongress of the foundation "Partner für Schule NRW" and the regional education ministry.<br>www.partner-fuer-schule.nrw.de<br>held in Bochum, Germany.<br>Target group: Teachers and other stakeholders of educational system, representatives from business, academia and politics. |
| **13th European Conference on Developmental Psychology** | August 21-25, 2007 | http://www.esdp2007.de<br>held in Jena, Germany<br>Target group: Researchers, Others |

| | | |
|---|---|---|
| 6th International Primary School D&T Conference | June 29 – July 3, 2007 | Conference on design and technology education in primary school,<br>held in Birmingham, UK<br>Target group: Teachers, Researchers |
| **PATT 18 conference: Pupils' Attitudes Towards Technology** | June 21-27, 2007 | International Design & Technology Education Conference<br>held in Glasgow, Scotland<br>Target group: Researchers, Others |
| **Global Summit of Women 2007** | June 14-16, 2007 | Meeting of women in business globally.<br>http://www.globewomen.com<br>held in Berlin, Germany.<br>Target group: Women leaders in politics, industry and research from 95 countries. |
| **Kongress Zukunft durch Innovation.NRW - Förderung des naturwissenschaftlich-technischen Nachwuchses** | May 16, 2007 | Congress on education in science and technology<br>http://www.zukunft-durch-innovation.nrw.de<br>held in Düsseldorf, Germany<br>Target group: Stakeholders of educational system, industry, research, politics |
| **eur-future:**<br>**Future European Researchers of Tomorrow - Crossing the Borders of Academia and Industry** | May 13-15, 2007 | International conference that aims at the promotion of young scientists.<br>www.eur-future.eu<br>held in Stuttgart, Germany. |
| **Didacta** | February 27 – March 3, 2007 | Education fair (early childhood, elementary school, general education, higher education, further education).<br>ww.Didacta.de<br>held in Cologne,Germany.<br>Target group: Teachers and other stakeholders of educational system. |

According to our possibilities to follow up, the press released attracted interest and were referred to in the European media. The Cordis database was very useful in delivering the information. Some reports found in the internet-based media:

http://www.alphagalileo.org/ViewItem.aspx?ItemId=62973&CultureCode=en

http://www.nanowerk.com/news/newsid=13625.php

http://www.aede.eu/Newsdetails/article/update-programme-1667//nbp/1.html

http://socato.org/?p=495

During the UPDATE project, the partners have been ambitious and productive in attempting for high level of publication of the project results. The below list of publications on the UPDATE results demonstrates this activity. Specifically scientific publication, partially due to its high standards and hence slow processes, will continue after the project.

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## List of project publications


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the final conference of the European project MOTIVATION, Wuppertal, Germany, Dec. 10 – 12 2009.

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C. Andreucci, H. Armand, P. Brandt-Pomares, M. Chatoney: Shedding light upon obstacles in selecting technological study courses. International Journal of Technology and Design Education, http://www.springerlink.com/content/102912/, 2009

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J. Seiter: A Survey of technical education in Austria. International Journal of Technology and Design Education, http://www.springerlink.com/content/102912/, 2009

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Valentina M. Pomazan, Lucian C. Petcu: Techniques In Computer Aided Science And Engineering Teaching, proceedings of IATED conference. Barcelona, July 2009

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Neuhäuser-Metternich, Sylvia & Krummacher, Sybille (2007): Girls' and Boys' Perceptions of Science and of Science Teaching Practice. UPDATE Progress Report Germany, WP 5, Partner 7, http://update.jyu.fi; www.ada-mentoring.de <http://www.ada-mentoring.de/>

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**List of Project's European contacts**

| **Kind of institution** | **Example** | Number of **contacts** |
|---|---|---|
| Ministries / Education authorities | e.g. European Centre for the Development of Vocational Training (Greece) | 330 |
| Teachers' and other associations | e.g. German Teachers' Association (Deutscher Lehrerverband) | 542 |
| Teachers | Through teacher training institutes | 8,000 |
| Universities | e.g. RWTH Aachen | 877 |
| Research centres | e.g. The Copenhagen Institute for Futures Studies (CIFS) | 356 |
| Networks | e.g. European Science Events Association (EUSCEA) | 29 |
| Media / information platforms | e.g. European Schoolnet | 2,913 |
| Projects / extracurricular education / others | e.g. Girlguiding UK, Federation of Finnish Technology Industries | 604 |
| Job agencies / counsellors | e.g. the German federal labour office | 825 |
| Study counsellor and teacher training institutions | e.g. Staatsinstitut für Schulpädagogik und Bildungsforschung (Germany) | 69 |
| Vocational training institutions | e.g. IAWM, Belgium (Institut für Aus- und Weiterbildung im Mittelstand und in kleinen mittelständischen Unternehmen) | 31 |
| Companies | e.g. Siemens AG | 14,447 |
| **Total** | | **29,025** |

## Section 3 - Publishable results

We trust that the project has been able to achieve sustainable results that will continue to facilitate gender-balanced, enhanced technology education in Europe. The public deliverables of the project, as well as the numerous best practise and case study examples, are continuously available on the project open access, wiki-based website. The project publications have reached wide interest.

**The project publications with believed major impacts are described below.**


UPDATE project data has been presented in the following book in German:

Josef Seiter (red.): **Technik – weiblich!** Analysen zu mädchen- und frauenzentrierten Fördermaßnahmen im Bereich von Technik und Naturwissenschaft, Schulheft 128, StudienVerlag, Innsbruck 2007, ISBN: 978-3-7065-4446-7

http://www.studienverlag.at/titel.php3?TITNR=4446


**Defining Technological Literacy: Towards an Epistemological Framework** (Dakers Ed.)

John R Dakers and Wendy Dow (University of Glasgow, WP4 leader) organised and Guest Edited a special UPDATE edition of the '*International Journal of Technology and Design Education*' published by Springer, the Netherlands. Several UPDATE partners co-authored articles for this special issue.

New Solutions for European Technology Teaching The European Union insists that young people need to understand technology, but do Europe's curricula and teachers meet these demands sufficiently? The European project UPDATE has recently published peer reviewed research papers on the current situation of technology and science education in European schools. The International Journal of Technology and Design Education presents noticeable outcomes: perceptions about technology are still strongly aligned with the concept of masculinity. The research also highlights a need for more in-service and pre-service training for teachers. The UPDATE members and their partners recommend holistic, child-centred and creative technology teaching concepts that will satisfy both the needs of girls and boys and claim for technology education as a binding component of curricula. Here, as the UPDATE members state, policy makers need to recognise that technology education is an essential aspect of any modern curriculum. Then the UPDATE recommendations could be realised more efficiently.

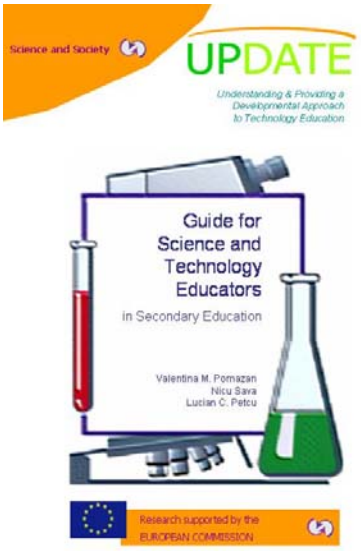
Detailed information on this issue is available at
http://www.springerlink.com/content/102912/ (John Dakers, Wendy Dow).
On-Line version available at:
http://www.springerlink.com/content/v22q24202044/?p=f1eac87d459440c0bb68c903064a1a06&pi=1

**Dakers, J., Dow, W** (2009). Handbook for Teachers. University of Glasgow. Scotland.

Available in English, French, German and Spanish, and Catalan on the project open access portfolio website:
http://update.jyu.fi/index.php/Category:General_Education

The handbook for teachers to several universities around Europe. We will continue to make these resources available to other universities in the future. We have also arranged to have the handbook made available to all technology education teachers through the 'Design and Technology Education Association" (DATA) in England and the Technology Teachers' Association in Scotland. DATA represents a considerable number of technology teachers across all sectors of schools in the UK and they have a diverse set of communication means such as a website, a scholarly journal and a regular newsletter.


**A Teacher's Guide for**
**Science and Technology Educators**
Pomazan, V., Sava, N., Petcu, L.C.,
Ovidius University, 2009.




This guide is a schematic synthesis of barriers and practical recommendations. It is intended to help professors and policy makers to promote scientific engineering and technological education to render technology and technological carriers more attractive for young people.

The complete paper may be viewed here:
http://update.jyu.fi/images/0/06/Guide-Partner5-UOC.pdf

**Let's Invent More!**

Collaborative result of the Finnish team and its national networks.
Available in English, Spanish, and Catalan on the project open access portfolio website:
http://update.jyu.fi/index.php/Category:Elementary_School


The "Inventing more" material focuses on the built environment by examining, for example, its basic structures, such as triangular structures. The skills learned are applied to various problem solving exercises or are used to develop solutions to own needs. In the manual, exercises are grouped together according to different themes, but it is also possible to choose individual exercises and form units that are appropriate to your needs. You can start by learning the basics or by generating ideas for future environments with the help of structures and circuit switches. The pupils' designs for future houses with intelligent functions and forms may surprise even the most experienced instructor!