kompetenzzentrum
TECHNIK • DIVERSITY • CHANCENGLEICHHEIT

10

Updating technology education from the start

Selected research results of the European project UPDATE

Journal Series Volume 10

Journal Series Volume 10

Updating technology education from the start

Selected research results of the European project UPDATE

Editors: Carmen Ruffer, Barbara Schwarze | Kompetenzzentrum Technik-Diversity-Chancengleichheit

Volume 9 and 10 were compiled by Carmen Ruffer, Lynn Bisotto und Andrea Brinkmann.

Consulting: Sabine Mellies

Further information on projects and activities: www.kompetenzz.de

Download under: www.kompetenzz.de/vk06/download_center/schriftenreihe

Bielefeld in July 2011

ISBN 978-3-933476-18-0

The project UPDATE is funded by the European Community's Sixth Framework Programme.

Project partners and contact persons:

University of Jyväskylä, Finland, http://www.jyu.fi/ Dr. Aki Rasinen, Dr. Marja Kankaanranta, Dr. Leena Turja, PhD Päivi Fadjukoff

University of Glasgow, United Kingdom, http://www.glasgow.ac.uk/ John R. Dakers and Wendy Dow

IUFM University Institute for Teacher Training of Aix-Marseille, France, http://www.aix-mrs.iufm.fr/ Prof. Jacques Ginestié, Pascale Brandt-Pomares, p.brandt@aix-mrs.iufm.fr

"Alexandru Ioan Cuza" University of Iasi, Romania, http://www.uaic.ro/ Prof. Dr. Doina Balahur

Ovidius University Constanta, Romania, http://www.univ-ovidius.ro/imim/ Prof. PhD Valentina Pomazan, vpomazan@umv-ovidius.ro

University of Tallinn, Estonia, http://www.tlu.ee/ Ene Lind, enelind@tlu.ee

Dortmund University of Applied Sciences, Ada-Lovelace-Mentoring-Association, Germany, http://www.fh-dortmund.de/ Prof. Dr. Sylvia Neuhäuser-Metternich, neumett@fh-dortmund.de

University of Koblenz, Ada-Lovelace-Project, Germany, http://www.uni-koblenz-landau.de/ Dr. Martina Endepohls-Ulpe, endepohl@uni-koblenz.de

FCRI Catalan Foundation for Research and Innovation, Spain, http://www.fcri.es/ Dr. Jordi Mas, Dr. Dolors Grillo, dolors.grillo@fcri.cat and Marc Martínez marc.martinez@fcri.cat

Competence Center Technology-Diversity-Equal Chances, Germany, http://www.kompetenzz.de/ Sabine Mellies, Carmen Ruffer, update@kompetenzz.de

Institute of Philosophy at the Bratislava Slovak Academy of Sciences, Slovakia, http://www.klemens.sav.sk/fiusav/index_en.php Prof. Tatiana Sedová, filotana@savla.sk

University of Education, Vienna, Austria, http://www.phwien.ac.at Prof. Dr. Josef Seiter, josef.seiter@phwien.ac.at

Technical Institute for Social Activities Galileo Galilei, Italy, http://www.itasgalileijesi.it Prof. Cristina Pavisic, cristina.pavisic@itasgalileijesi.it

Aristotle University, Dept. Of Mechanical Engineering, Greece, http://isag.meng.auth.gr/home.html Prof. Dr.Eng. Kostas Karatzas, kkara@eng.auth.gr

University Complutense de Madrid, Spain, http://www.ucm.es/ Dr. Jesus Pintor, jpintor@vet.ucm.es, Basilio Colligris bcolligr@opt.ucm.es, Prof. Maria Asuncion Peral Cerda

IDEC S.A, Greece, http://www.idec.gr/ Xenia Chronopoulou, xenia@idec.gr

CONTENTS

Barbara Schwarze, Kompetenzzentrum Technik-Diversity-Chancengleichheit

Preface

The European project UPDATE - funded by the sixth research framework programme of the European Union - has set itself the task to develop new concepts and measures that help to improve the technology education for students in Europe.

Therefore public and private international research studies and curriculum analysis were started. To promote the technology interests of children and adolescents - especially girls - best practice examples and new teaching and learning materials were newly developed and collected throughout Europe.

The aim of this publication in the series of the Kompetenzzentrum Technik-Diversity-Chancengleichheit e.V is to present selected research results of the UPDATE partners along different educational stages from early childhood education through to secondary school. For this purpose we have provided the article both in German (Volume 9) and in English (Volume 10).

How to design a successful technology education? How should curricula be designed to encourage more students for mathematical, scientifical and IT-subjects? What exactly is innovative technology education that fulfills the needs of students, both male and female? To these and other queries, the research project UPDATE has found new answers, which are presented in this volume.

An important issue of UPDATE project is to raise attention for the importance of early childhood education for girls and boys. To achieve this goal UPDATE provides a gender-sensitive developmental approach for technology education. These central aspects for UPDATE are presented in Päivi Fadjukoff's introductory article "Updating technology education from the start".

A Basis of technology education for a continuing interest in science and technology is the application of creative, playful teaching concepts in childhood. Leena Turja and Kristi Paas describe a recommended survey method in their article "Young children's views on technology and technology agency" to obtain better access to individual needs of children related to technology. They question what children know about technology and investigate whether there are already gender prejudices in early childhood.

In the article "The development of gender roles and technology education in primary schools - dangers and chances" Martina Endepohls-Ulpe gives a brief overview on psychology's current state of discussion about the development of gender-typical behavior. Subsequently, the significance of these findings for the development of gender differences in the area of technology is demonstrated. Already in primary school behavioral differences are obviously evolved or reinforce in such an instant that at the end of primary school boys and girls show a gender-typical performance behavior and ways of making choices concerning technical and science topics. Finally, possible implications for a gender-appropriate and effective technology education are discussed.

Sonja Virtanen, Pasi Ikonen and Aki Rasinen deal with the topic "Girls' motivation towards technology education" and refer both to the field of primary school and to secondary school. The project partners have studied European curricula. It is interesting to note that despite of different school systems many countries face similar problems. In most schools the students are still forced to choose between technical and textile handicrafts. As a result of this division girls are excluded from a variety of technology-related lessons. On the other hand, technical contents are usually characterized by male stereotypes.

The research on Girls'Day, which takes place annually in Germany and ten other European countries, are presented by Carmen Ruffer and Wenka Wentzel in the article - "Girls'Day - Vocational orientation in technology, ICT, science and crafts". Evaluation and survey results show that girls are quite interested in technology, ICT, science and crafts if they get adequate access such as at Girls'Day. New positive experiences are often used as an initial factor to enter into technical professions, stereotypes are uncovered and skills are strengthened.

Thanks to all who have contributed to this volume of our series. I wish all readers a pleasant reading, many interesting insights and useful impetus for technology education in practice.

Päivi Fadjukoff, UPDATE Project Coordinator

Introduction: Updating technology education from the start

Tackling technology as the culmination of gender imbalance

Since a long time women and girls throughout Europe are dramatically underrepresented in technological education, areas, and jobs, as well as in decision-making bodies concerned with scientific issues. This is true even though there are presently more female than male graduates under the age of thirty in most European countries. The Lisbon Strategy (European Parliament, 2000) highlighted the need to improve the human capital involvement, specifically women and young people, in the key sectors such as high technology and information and communication technology (ICT). Accordingly, the issue of getting more women in technological or scientific education and career paths 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. Reflecting this, women with science or technology education work most frequently in services while the lack of female workers is most remarkable in the manufacturing sector (Meri, 2008). Technology, where the science is put into action, is thus an area where the educational and occupational gender imbalance culminates.

As illustrated in Figure 1, technology education presently differs according to gender in most European countries. Although the first contacts with technology are the same for both of the sexes, 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 during the course of further studies: the percentile of girls taking part in technology focused education decreases when 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. To improve technology education, there is a need to create a holistic view on technology education and teaching, strongly starting from early childhood and primary education on. 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" (Pâques, 2007).

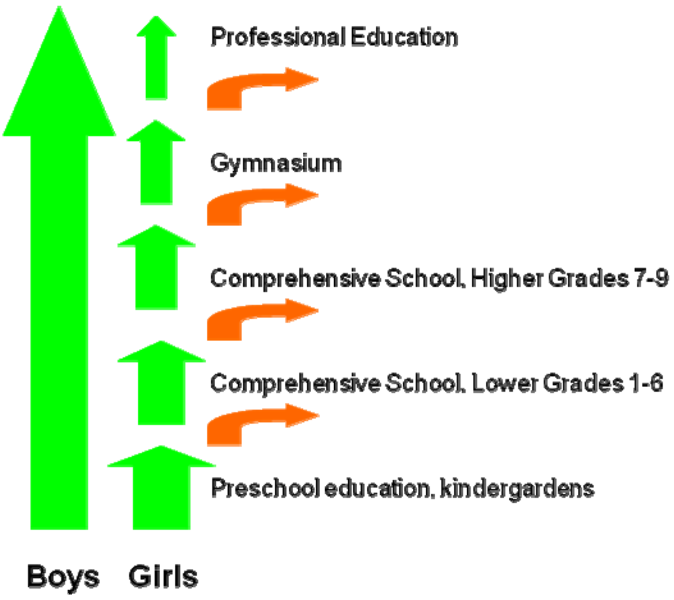


FIGURE 1 *The present fragmentation of technology education, with frequent female drop outs*

The Project UPDATE (Understanding and Providing a Developmental Approach to Technology Education) was established in 2007–2009 as a joint effort of 16 partners from eleven European countries to tackle this challenge. The UPDATE- researchers created a developmental approach for technology education to guarantee improvement and equality in technology education, and collaborated to facilitate this approach with the multinational project consortium. The project UPDATE examined why girls drop out from Technology Education at different stages of their education, and aimed to create new educational practices to encourage them to continue with technology-enhanced personal curriculum. The main focus was in facilitating continuous improvement and change of technology teaching practises.

Compared to many other projects that have tried to involve girls in technology, the UPDATE approach includes a strong focus on early childhood and primary education. At these ages most attitudes are shaped quite sustainably. From this understanding, it is far too late to try rising the girls' interest 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.

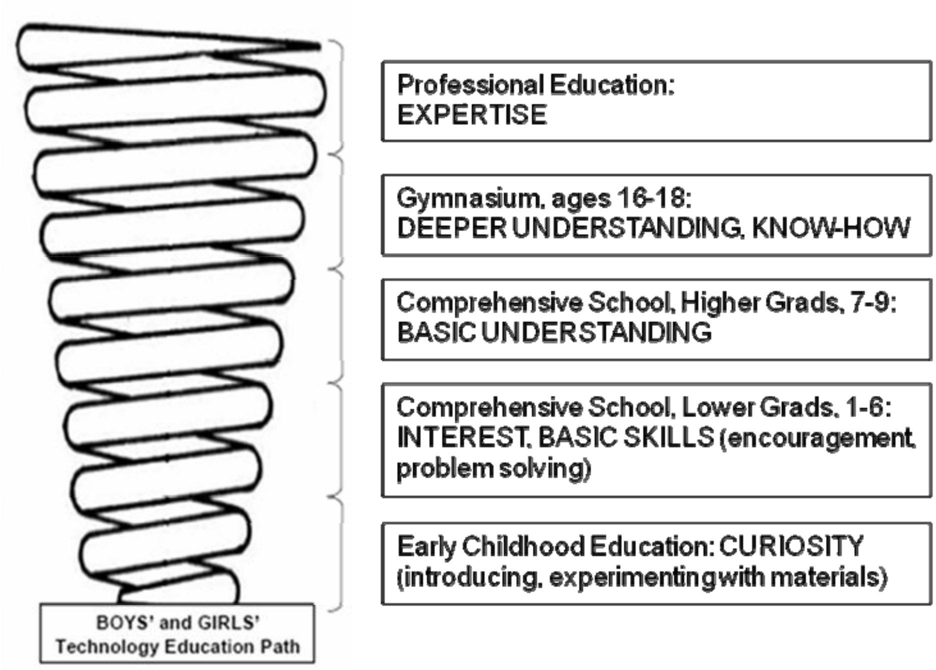


FIGURE 2 *The aim should be a holistic, developmental approach to technology education in which the curiosity and interest of both genders is fostered from the beginning*

Within European collaboration and interaction, we have the momentum to learn from each other to build a 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 in which usage of information technology in education was compared in 22 countries throughout the world (Law, Pelgrum, & Plomp, 2008). 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.

Collaborating for enhanced technology education

The joint aim of the project UPDATE was to promote young people's interest (especially girls' interest) in science and technology, and to boost cooperation on the European level to collaboratively create new pedagogical practices for technology education in kindergarten, elementary school, comprehensive school and gymnasium. The partners agreed that novel ways for changing people's attitudes toward science and technology as well as teachers and researchers were needed, and therefore new means for providing children and students with more balanced views on women and technology were required. We wanted to encourage critical and creative ways of thinking among educators, decision makers, children and young people.

The UPDATE approach is 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 practices, 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 an 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.

The project showed that many activities and themes can be used to promote the aims of technology education already in early childhood education. 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. According to the UPDATE findings, the boys' and girls' perceptions and attitudes about technology, technology education and technology related careers are qualitatively different in boys and girls. This difference is evident already at the elementary level, and is not related to personal abilities but with the masculine identity that is attached to the concept of technology. Gender stereotypes in schools are strongly alive, as Dakers and Dow (2009) point out.

According to the UPDATE project findings (Balahur, 2008), the girls who select study and career paths within technology have a comparably high level of self-efficacy, supported by continuous accomplishments in mathematics and technological disciplines throughout earlier educational levels. 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. To develop self-image and motivation of children towards technology in early years, active and conscious support is thus needed not only from the teachers but from all adults, specifically family members. They should be aware of the child's growing gender identity, and the factors impacting that process. All adults in the growing environments have to be critical with their own beliefs concerning gender differences and gender roles. Without support from the larger society and families, it is difficult for schools to make conscious counteracts to prevent children of adopting gender stereotypes from their surrounding environment.

While the knowledge society is the natural growing environment for our children and youth, and they easily learn to use technological devices from each other, many teachers lack confidence about their own competence in technology education. As found in the international SITES study, many teachers use traditional teaching methods and experience difficulties in positively utilizing and introducing technology in the classroom (Law et al., 2008). It is not enough to provide the schools with technology equipment. The change has to be facilitated with deliberate changes in teaching methods and aims for learning. This, in turn, necessitates development and new requirements of teacher training, as well as reforms in the national curricula of different schooling levels. The challenge culminates in kindergartens or day-care centres where mainly female staff may feel uncertain with technology itself, and few models exist for how to introduce technology and experiment with it among children at early age. They need to get more knowledge about technology education as well as increase their own technological skills and self-confidence. Hence, the first thing is to take care of the teachers training.

Another important issue in the background of children's developing motivation is the official educational policy of which the national curriculum guidelines are the visible manifestations (Balahur, 2008). The objectives of technology education as well as principles of equality in education should be articulated in the curricula clearly. However, the educational and curricular bottlenecks and barriers for efficient and equal technology education remain to be many (Ginestié & Brandt-Pomares, 2008). In some European countries, no separate curriculum for technology education exists in any of the school levels, not to speak about the mostly neglected Early Childhood Education. 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 (Law et al., 2008). All teachers should be trained with basic knowhow in technology, and an effective way to guarantee technology teaching with trained, devoted teachers would be to develop a new school subject. Rasinen and Virtanen (2008) justifiably argue that instead of differentiation between crafts domains (such as technical vs. textile work), technology should be taught for both sexes in mixed groups. This would also mean a re-thinking of the learning contents to be gender sensitive. As pointed out by Dow and Dakers (2008), 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.

Conclusion

The project UPDATE highlighted conceptual and practical challenges in the background of persisting gender imbalance in technology education and occupations with a technological focus. Within the project, the partners were also able to demonstrate that many activities and themes can be used to promote the aims of technology education, and that this work should be started already in early childhood education. Handbooks directed at teachers and teacher educators were published in several languages. Through active collaboration with teacher training institutes, the project also had a direct impact on teacher training practices. The handbooks, project results, as well as numerous technology education practice examples, have been published and are available open access in the project website http://update.jyu.fi/. We hope that the findings and practical examples encourage for further discussion, collaboration, and new developments of technology education at different age levels both in schools and extracurricular contexts.

References

Balahur, D. (2008).
Report of the results: a list of possible barriers, a list of motivating and encouraging factors (national and cross-national levels). *UPDATE project deliverable 5.1.* Available online at: http://update.jyu.fi/images/c/c4/Deliverable_5.1_SHORT_VERSION.pdf

Dakers, J. R. & Dow, W. (2009).
Editorial to Special Issue: Understanding and Provideing a Developmental Approach to Technology Education. *International Journal of Technology and Design Education 19, 347–351.*

Dow, W. & Dakers, J. (2008).
Exploring Issues Related to Gender in Technology Education. Paper presented at the Colloque International Efficacité et équité en education, 19–21 November, 2008, Rennes, France.

European Parliament (2000).
Lisbon European Council 23 and 24 March 2000 Presidency Conclusions. Available online at**:** http://www.europarl.europa.eu/summits/lis1_en.htm

Meri, T. (2008).
Women employed in science and technology. *Statistics in Focus, Science and Technology*. Eurostat 10/2008.

Ginestié, J. & Brandt-Pomares, P. (eds.) (2008).
Analysis on regional/ national status of the girls drop-out issue in transitional educational stages. *UPDATE project deliverable 6.1.* Available online at: http://update.jyu.fi/images/f/f0/Deliverable_6.1_UPDATE_042941.pdf

Law, N., Pelgrum, W. J. & Plomp, T. (eds.) (2008).
Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study. Hong Kong: CERC-Springer.

Pâques, C. (2007).
Robots and girls. Research EU. The magazine of the European research area, June 2007. Available online at: http://ec.europa.eu/research/research-eu/pdf/research-specedu_en.pdf

Rasinen, A. & Virtanen, S. (2008).
Analysis of elementary school curricula. Paper presented at the Colloque International Efficacité et équité en education, 19–21 November, 2008, Rennes, France.

Rasinen, A., Virtanen, S., Endepohls-Ulpe, M., Ikonen, P., Ebach, J. & Stahl-von Zabern, J. (2009).
Technology education for children in primary schools in Finland and Germany: different school systems, similar problems and how to overcome them. International Journal of Technology and Design Education *19,* 367–379.

Turja, L., Endepohls-Ulpe, M. & Chatoney, M. (2009).
Conceptual Framework for Developing Curriculum and Practices of Technology Education in Early Childhood. *International Journal of Technology and Design Education, 19,* 353–365.

Leena Turja and Kristi Paas

Early Childhood Education:
Young children's views on technology and technological agency

Abstract

Young children become skilful technology users in contemporary daily living before school-age. In early years they start to adopt ideas of gender-adequate behaviour consisting also stereotypes which may restrict their development in technological agency. Young children are neglected as technological citizens as well as research informants. This article introduces a child friendly interview method to listen to children's own ideas about technology and technological agency. According to results, the children had many gender-biased thoughts concerning technological roles and their own orientation to technological activities. Only every third of the children knew the word technology. In practice, however, they knew a lot of technology. This pilot interview method is critically examined for a revision. The interview form is suggested to be utilised also by early childhood teachers to inspire discussions with children about technology and gender-fair attitudes and practices.

Introduction

The strengthening opinion of the need to start conscious technology education already in early childhood is supported by several aspects. Technology is one of the most powerful forces shaping our society; life in the contemporary technological society requires from all citizens a good technological literacy i.e. a general ability to use, manage, understand and evaluate technology (Standards for technological literacy, 2000/2007). Moreover, nowadays ordinary citizens ought to be counted as valuable partners even within technological innovations, which traditionally have been seen to belong to professionals alone. According to the new Finnish innovation strategy, (Demand and user-driven innovation policy, 2010) the emphasis should be put on enhancing a creative atmosphere in the whole society and basing innovations on peoples' needs as well as involving ordinary citizens in recognising these needs and launching innovations. Children come in touch with technology from the first years of their life and develop into skilful technology users in daily living far before the start of school. Young children inherently are also open-minded, explorative and curious towards their environment with usually an unshakeable self-confidence in doing, inventing and creating things. Hence, they are to be regarded as technological citizens worthy for an adequate early technology education.

Moreover, at the early age of two children start to adopt views of both sexes and gender-typed behaviours and build their own self-concept and gender identity. Consequently, they also start to figure out males and females as technological agents and develop perceptions of gender appropriate behaviours and interests in the field of technology. Identity development and socialisation to gender roles – including also stereotypical views of gender – are influenced by the surrounding society via a child's interactions with family members, peers, media (e.g. television, books, commercials, movies) and marketing as well as teachers and cultures of schools and day-care (Pardhan, 2010; Pope Edwards & Wang, 2009; Witt, 2000). Certain gender-related ways of being and acting receive greater social recognition and appreciation than others.

Our Western European cultures hold many gender-biased beliefs and gender-ordered practices. Technology especially is highly categorised into male issues, and the females are under-represented in most technological education areas and jobs in Europe (Education and training 2004). This is more likely due to lack of motivation than lack of potential abilities of girls and women. Presumably the process of females turning away from the field of technology begins at the same time as gender identity starts to develop. According to Leaper (2009) by the age of two to three children begin to show preferences for toys earmarked for their own gender in their culture. Boys show more interest in playing with construction materials and vehicles, while girls prefer playing with dolls and soft toys. By the age of four to five children show preferences for gender-typed vocational and domestic activities.

Kåreland (2005a) referring contemporary Swedish studies continues that at the age of five to seven years children become aware of a range of activities which are concerned as female or male ones. There is a clear tendency both with girls and boys to undervalue female characteristics and activities and appreciate male activities. Further, it is more socially accepted and easier for girls than for boys to cross the gender-borderlines (Golombock & Hines 2002). This imbalance reflects the existing gender order in Western societies, where the male sex is in power in politics, economy and even family life. From the technology point of view, the real working-life offers nowadays also female role-models with technological abilities, while the role-models transmitted by media are far more traditional and stereotypical. According to Kåreland (2005b) for example books read mostly by boys are likely to be situated in modern time with modern technology used by male characters, while books read mostly by girls tend to be situated in a timeless context or in old, nostalgic times without any modern technology.

One task of early technology education is to prevent the development of gender-biased identity and enhance motivation towards technology for boys and girls, equally (Turja, Endepohls-Ulpe & Chatoney, 2009). This is easier than attempting to dismantle already developed stereotypes later in school years.

The study

The research body concerning the development of young children's self-image and gender identity within technological orientation is still quite small. This article is based on a reworking of a report of a study (Turja 2009) carried out and published within the UPDATE-project. It examines children's own views on technology and technological agency in general and in relation to gender. It is, for many reasons, challenging to catch young children's own thoughts and opinions and involve them in the research process (see e.g., Punch 2002), and therefore their voice is scarce in many research areas, concerning also the technology field. However, contemporary childhood research indicates that children can be heard by valuing them as important informants and participators and by using methods which are based on children's skills and ways of acting (e.g., picture-communication, drawing, story-telling, imagination, play). These techniques do not automatically guarantee success, thus researches should critically reflect their methods and take care of the ethical issues and power-balance between adults and children during the research process (e.g., Clark, 2005; Punch, 2002). Accordingly, besides the results, special attention is paid in this article on the methodology in order to evaluate this piloting child interview in detail.

Method

Interview supported by pictures and narratives

A structured interview was designed in order to let children's own voice to be heard concerning technological agency. Pictures and narratives were used to support the interview. A playful, narrative approach is supposed to activate and motivate children to participate in the research and the pictures help children to focus on the theme at hand, to understand verbal utterances and to answer by pointing out pictures (e.g., Clark, 2005; Punch, 2002). The interview form (appendix) aimed to gather children's views concerning three main research questions:

- How do children understand the term technology? [Question 1 in the interview form]

- How do children see technological agency[1] in the light of gender-order and generation-order? In other words, how equally are males and females seen in the various technological roles of an ordinary citizen – user (customer, professional) maintainer/repairer, and how are children seen as competent actors alongside with the adults? [Q2, Q6, Q7, Q8a]

- What kind of interests and orientation do the children have themselves, as girls and boys, towards technology and technological activities? [Q3, Q4, Q5, Q8b]

The items of the interview form were designed, reflected and tested together in the team of the researcher and the two research assistants. All had a kindergarten teacher background and further studies in early childhood education and early technology education. The first and the third research questions were approached by asking children directly about their experiences and preferences, whereas the second research question was approached in an indirect, narrative way by using imaginative characters and inviting children to continue with narrated the story that creates experiential and emotional distance between the phenomenon and the interviewee (comp. vignette method[2], Barter & Renold, 1999).

Participants and procedures

Altogether 39 children were interviewed during this project. 23 of them were Finnish and 16 Estonian. Children were at the age of four to six years (Table 1). In Finland the interviews were carried out in two day-care centres by a research assistant who was a qualified kindergarten-teacher and doing her master studies. She visited beforehand in the centres to become familiar with the children. In Estonia the interview form, translated to English, was given to mothers capable of translating it Estonian for interviewing their own children. The data was collected during autumn 2009. A more detailed description of the interview process is given in the appendix.

[1] Producing, maintaining and using technology are the main activities (see Standards for technological literacy, 2000/2007; Turja, Endepohls-Ulpe & Chatoney, 2009).

[2] Vignette method involves an imaginary scenario of problematic situations and requests participants to indicate what kind of solutions they experience as most appropriate.

Table 1 *The age and the gender of the participated children*

	Age			
Gender	*4 years*	*5 years*	*6 years*	**All**
Girl	6	8	7	21
Boy	4	6 (4) [1]	8	18 (16)
All	10	14 (12)	15	39 (37) [1]

[1]Two boys at the age of five years suspended the interview session

Data analysis

The data consisted of qualitative text produced by open-ended questions as well as answers to structured questions with offered response alternatives. Qualitative data was first coded and classified with the help of existing topic-relevant research literature. The data was analyzed mainly descriptively with PASW Statistics 18.0. Frequencies, percentages and cross tabulations were computed for describing the distributions in the studied variables. Differences between boys and girls were examined with Pearson chi square analysis. The small sample size and the level of measurements, however, limited any further statistical analyses. Children's original comments and explanations were kept in reporting to let their voice to be heard.

Ethical considerations

The participating daycare centres had co-operation with the UPDATE-project, and thus were willing to co-operate in organizing this child interview. Ethical approval was obtained through the University of Jyväskylä's ethics review office. Informed consent was obtained from the office of Jyväskylä municipal day-care department and from the parents of the children. Also the children were asked for assent for interview. In the beginning of the interview the children were once again told about the nature and the purpose of the interview and their right to suspend or totally stop the interview – without any explanations – just by letting the adult know (see Alderson & Morrow, 2004). All the children invited to participate were willing to do so, but two of the children discontinued the interview half-way. The Estonian parents and children willing to participate were reached via personal contacts of the local UPDATE-project partners.

Findings and discussion

Understanding the term technology

First the children were asked to tell what technology is in their opinion. Half of the children thought that they had never heard the word technology, and some children said that they didn't remember. Only one third (13) of the children (n=39) could give some kind of own description of the word technology. These children's thoughts of the meaning of technology included nearly all of the important parts of technological activities. They spoke about researching, problem solving, mathematical operations and technological activities such as inventing, constructing, and using technology or referred to technological apparatus. For some children it meant some kind of work, creativity or playful activities. In children's own words technology is ...

- *a want to know; thinking of something; numbers and calculations;* (5–6 years old)
- *building, constructing; planning cars; handling remote controlled cars* (4–6 years old)
- *computers, TV, washing machines etc*.(4–6 years old)
- *some kind of work; handiwork; playing* (4–5 years old)

The ability to explain increased with the age: only 1/3 of four–five years olds, but even 2/3 of six years olds could give an explanation. Six years olds were able to think also the academic or scientific side of technology while younger ones more likely connected technology with their own concrete bustles. Particularly boys' understanding of technology increased with age: with all the boys at the age of six years, but under half or the girls at the same age having an idea about the concept of technology.

Mawson (2010) has concluded similar results in his follow-up study concerning children's developing understanding of technology from the age of five to ten years. Only one boy out of seven children was able to articulate a view of technology at the age of five years by answering "You can make stuff". At the age of six years the children's responses were still limited. Two of the children couldn't give any explanation. "Computers" were the objects most often chosen to represent technology at this age.

It is understandable that the ability to understand and explain technology as a concept is dependent on language ability and thus, on age. However, also children's technological experiences in their home environment and in school are meaningful factors (e.g., Mawson

2010; Moreland, 2004). Moreland found that when a teacher presented a limited view of technology, it was difficult for children to build up an overview of the subject. Kindergarten teachers, who are dominantly female, have expressed their uncertainty with technology issues (Alamäki 1999, Vuoristo 2007). When teachers do not feel themselves comfortable in this area it is obvious that they do not discuss about technology with children, regardless of the existence of technology in their daily environments. Even the printed material used in early education is limited from a technological point of view. Poikolainen (2010) studied 100 most popular children's picture books from the year 2008 in one Finnish central city library. 17 of them were handling technology somehow but the word 'technology' was mentioned only in two of the studied books. Although the sample consisted also a couple of books with aims to break the traditional gender roles by presenting females as technological agents, the main characters connected with technology were usually male ones.

Technological agency in the light of gender-order and generation-order

Concerning the questions of technological roles and technological agency the children were presented an imaginary family with mom, dad, daughter and son. They were asked to choose those family members who will take the roles of a consumer and a repair-person in various cases (Q2, Q6). The answers were examined according to gender order and generation order (Table 2).

Table 2 *Children's views on technological agency according to gender order and generation order*

	GENDER ORDER (n=39/37)			GENERATION ORDER (n=39/37)		
Tasks	**Males only[1]** ♂	**Both genders equally[2]**	**Females only[1]** ♀	**Adults only[1]**	**Both generations equally[2]**	**Children only[1]**
Shopping						(N=39)
Computer	28	7	4	28	8	2
Car	18	8	13	26	11	2
Bicycle[3]	19	13	7	10	15	14
Mobile[3]	2	11	26	11	15	13
Repairing						(N=37)
Lamp	31	3	3	25	11	1
Bicycle[3]	27	6	4	18	13	6
Picture	8	11	18	21	11	5

1 A hint for reading the table: *In ... cases the children thought that only the male ones of the family will take care of shopping .... or repairing .... (Includes the combinations where the dad and the boy were together or acted alone.) Read similarly all the other sections concerning females, adults and children.*

2 Categories "Both genders" and "Both generations" include all the cross-gender or gross-generation combinations of the family members.

3 a bicycle for the son and the mobile phone for the girl; the boy's broken bicycle

The boys and the girls had adopted similar gender-biased beliefs concerning females and males as competent technological agents. Generally, male ones were seen more often technologically competent than females, with computers and repair-tasks in particular. The following children's arguments describe the adopted stereotypical gender views:

> *"The father knows the cool cars [girl] ", "The father knows techniques [boy]" , "The father and the son are repairing the bicycle, because they are men [girl]", "They fix [the lamp] because they are boys, and girls are not so eager [girl]", "The father fixes the lamp, because the mother does not know how to do it [girl]" and "The father is better at using the hammer [in hanging the picture on the wall] [girl]".*

Females were good with selecting a mobile phone – *"The mother knows best about mobile phones* [boy]*"* – especially, because the mobile was meant for the daughter. Hanging pictures on the wall was also seen as a female case supposedly belonging to furniture and "homing" tasks typical for women. Mostly the dad and the son worked together and so did the mom and the daughter: "*The mother and the daughter [will buy the new car]. We, my mother and I, always go shopping together for all kind of things* [girl]*".* The results also indicated a tendency to value the technological capacity of the own gender. The girls found more often than the boys the mother as competent with technology, especially in buying a car (twice as often as the boys, i.e., 2:1) and the daughter of the family as competent in buying a computer (2:1) and a car (3:1). The boys, correspondingly, thought more often than the interviewed girls that the son (3:1) was competent in hanging pictures.

According to the generation order the technological tasks presented here were mainly seen as adults' affairs. The children's comments confirm the perceived power position of the adults: *"The adults always go to shopping* [boy]*", "They are adults, and children cannot buy* [girl]*" or "Because they have the most money and they also give money to each other* [boy]*".* Some of the children, however, advocated the competence of children: *"Also the boys know how to pump air* [boy]*", "Also girls know how to do it [hang the picture on the wall]* [boy]*" or " The son, because he is already so big, he is five years old* [boy]*".* The son's and the girl's ownership of the things in focus increased the children's participation and technological agency: *"The boy [goes shopping]. He knows best what kind of bicycle he needs* [girl]*".* The items concerning repairing tasks were biased from this viewpoint: there was only the boy's bicycle to repair, and nothing similar belonging to the girl.

The comments given by the children reveal that they have various arguments, other than gender differences, to justify their choices. Some arguments based purely on practical reasons and own life experiences, e.g., the following:

> *"The father owns the tools (and thus does the job)* [girl]*", "The mother is taller and will do it* [boy]*", "The daughter will do it, because all the others are at work* [girl]*" , "The mother has more money (and will go car shopping)* [boy]*" , "The mother goes alone (car shopping) because the children might start to act up there* [boy]*", "The mother, who works most at the computer* [girl]*" or "The father, who drives the car the most* [girl]*".*

Many of the children's arguments attempted to create cooperation, solidarity and equality, e.g.,

> *"The whole family! [will go shopping]* [boy]*", "The mother holds the ladder and the father hangs the picture* [boy]*", "The mother repairs the bicycle because the father and the son are fixing the lamp* [girl]*", "The father fixes, and the mother and the girl will help him* [boy]*",*

> *"Mothers always fix things, and so do fathers too [boy]" or "The mother and the father have the joint tools for fixing (and they do it together) [girl]".*

To examine how children see both genders related to work and play which includes a technological orientation the interviewees first were asked to select birthday presents for the son and the daughter of Smith family, two for both, out of a list of 12 photos presenting all kind of toys (Q7). According to results the children had already adopted quite a stereotypical way to earmark toys only for one sex, as the following list of the most popular and totally rejected toys according to gender indicates (in parentheses are choices of the girls/ boys).

The most popular toys	***The totally rejected toys***
for the girl:	*for the girl:*
a baby doll (17/13)	a car
a soft toy (11/7)	a dragon
a kitchen stove (8/7)	a construction toy set,
	a parking house
for the boy:	*for the boy:*
a car (15/9)	a baby doll
a dragon (12/7)	a soft toy
a Lego set (6/8)	a kitchen stove

The most popular toys for the girl were those toys rejected in regard to the boy and vice versa, and the girl was left without construction toys which are seen as important for the development of early technological thinking. Some of the boys selected for the girl electric and board games, which the girls rejected. Some of the girls on the other hand selected Legos also for the girl, but the boys reserved them only for boys. In their comments the children brought out also their own toy preferences which differed from their birthday present choices. Some of the girls for example told that the board game in the list was their favourite. This suggests that in the reality children are not as categorical as in this imaginary task where they probably tried to act according to learned social expectations.

Finally, the children were asked to name and complete by drawing pictures of androgyny adult professionals (Q8a) in order to point out their gender. Both the girls and the boys followed the traditional way in defining the professions (Table 3). Police are men and doctors/nurses are women. Boys, however, defined more often than the girls the computer-worker as a female one. The teaching profession was in most cases coded according to the child's own gender.

Table 3 *The gender of the professions according to the boys (n=16) and the girls (n=21)*

	According to the boys		**According to the girls**		*Difference between boys and girls*	
Profession	*Male*	*Female*	*Male*	*Female*	$\chi^{2(1)}$	*sig.*
Computer worker	12 (75%)	4 (25%)	9 (24%)	12 (57%)	3.823	*.05**
Police	15 (94%)	1 (6%)	18 (86%)	3 (14%)	0.608	*ns.*
Doctor/nurse	4 (25%)	12 (75%)	3 (14%)	18 (86%)	0.567	*ns.*
Teacher	11 (69%)	5 (31%)	3 (14%)	18 (86%)	11.453	*.001****

Children's own interests as girls and boys towards technology and technological activities

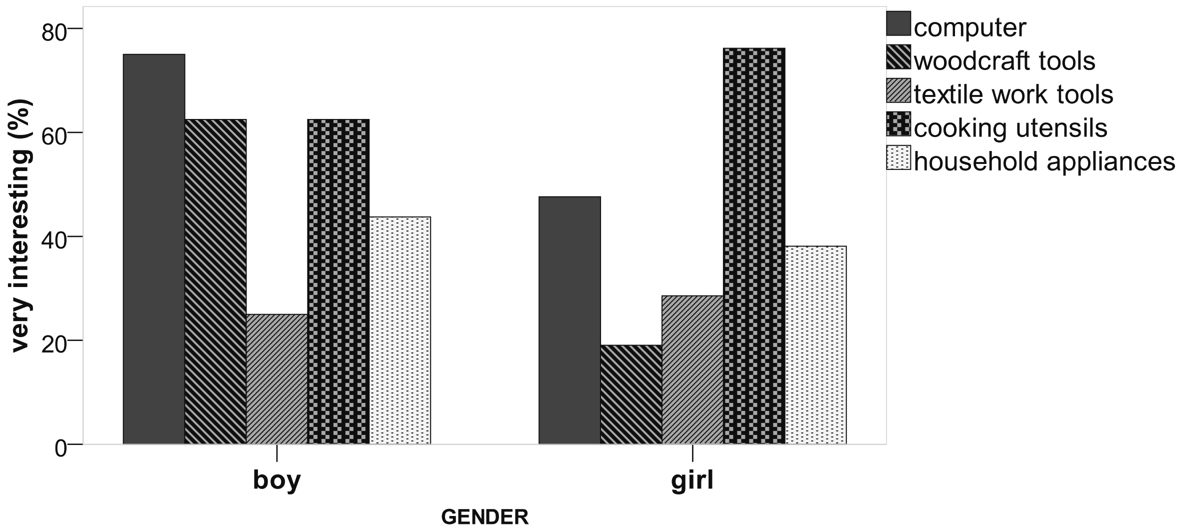
Children were asked directly about their preferences concerning various activities consisting of technology. According to the results, the girls and the boys had somewhat differing interest towards technology. Concerning construction play activities (Q5) the girls were keener on fine arts and crafts, and the boys on the contrary were keener on building big objects like huts, as the following preference list reveals.

Girls' preference order:	*Boys' preference order:*
Crafts, fine arts	Building a hut
Building with Legos	Building with Legos
Building a hut	Crafts, fine arts

Concerning the children's innovative mind and interests to problem solving, they were presented short stories of two innovative child-book characters to motivate the children to think about their own inventions (Q4). 75% of the boys and 55% of the girls gave examples of their own inventive actions. The meaning of the concept of invention was experienced as somewhat difficult to understand for part of the children. Most of the children's answers concerned some kind of construction or building made usually for play purposes (e.g., *a hut inside my room, a German airplane out of bricks, a trick-place with slides and stairs, things for dolls, a Lego tractor, a pirate ship, a mask, a police uniform out of paper*). Inventions for entertaining were also made: *a new dance, a new game –a tag play – with ghosts and candies*. Inventions of future represented various fantasy objects or plans of them (e.g., *a miracle machine, an inventor robot, a special aquarium, a dinosaur bike in my mind, a new Lego model drawn in the paper, a movie camera to play with*). A couple of inventions aimed to make things work better (e.g*., how to listen radio from mobile phone, how to touch iron with rubber cloves and avoid the rusty hands, how to make the little brother eat faster by using hands instead of a spoon, a transport vehicle that helps to transport water bottles and fancy dresses from children's room to living room*). The answers indicate that also young children have grasped the idea of inventive actions. They think about needs to fulfil with the invention, make plans and models, and also create real things and systems to use in play and other activities.

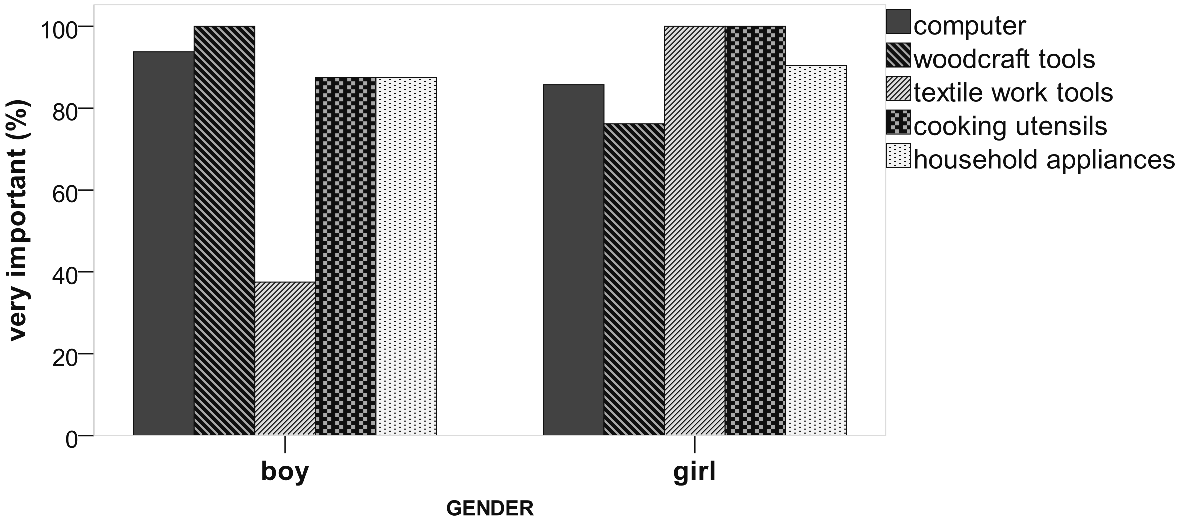
Further, the children were asked to evaluate how much they like to use different kind of domestic technological appliances (textile work utensils, woodcraft tools, household appliances, cooking utensils, and computers), and how useful they find it to learn to use these in the future (Q3). The most favourite and important selections are presented in the Pictures 2 and 3 indicating, that the children's answers differed somewhat according to the gender. The boys seemed to be more interested in those traditionally male-typed appliances, i.e. computers and woodcraft tools but also household appliances (washing machines, vacuum cleaners) which traditionally are classified to female technology. Textile work equipment and cooking utensils were slightly more often in the girls' special interests. Statistically significant difference, however, was found only in the use of wood craft tools ($\chi^2_{(1)}$ = 7.29, p = .01**).

Picture 2 *Technological appliances most valued by the boys (n=16) and the girls (n =21)*



Most of the introduced appliances were seen as very important to learn to use in the future both by the girls and the boys (Picture 3). The boys, however, didn't see textile work useful to learn as often as the girls ($\chi^{2\,(1)}$ = 17.99, p = .000***). This, alike several earlier study findings, confirms, that it is more difficult for boys to cross the traditional gender roles.

Picture 3 *Technological appliances which the girls (n =21) and the boys (n =16) preferred as very important to learn to use in the future.*



The last question (Q8b) concerned children's dreams of their own future jobs and professions. The answers varied from a "dinosaur's bone digger" to a fisherman and an ice-skater. Mainly the wishes, however, conformed to the traditional gender order. The most popular professions were situated in the human orientation: the girls wanted to teach and nurture people and animals (doctor, kindergarten and school teachers, and vet) and the boys to take care of the social order (police). Creative, artistic and entertaining jobs including certain social orientation (hair dresser, singer, and dancer) were more in the girls' interests. The boys' creativity, investigativity and innovativity were mostly directed to "things" (archaeologist, chemist, constructor, Lego-manufacturer, furnishing architect, and florist). Jobs of a realistic character oriented in the boys' wishes working to machines (drivers of various vehicles) and in the girls' wishes working to consuming domains (shop assistant). This classification of the children's answers is interpretative and based loosely on Holland's six personality types referred by Kapwijk and Rommes (2009). The more profound understanding of the factors behind children's choices requires wider discussions with children about the things which make that particular profession or job attractive for the child. This was not preferred in this study context but is warmly recommended in the future.

Conclusion

This pilot study aimed to develop a tool to listen to young children's own thoughts of activities associated with the technological field and gender approach. The analysis of the collected data and interviewers own perceptions raised some ideas for revising the original interview form.

In the narrative vignette-tasks the technological roles as a consumer/user and a maintainer/repairer could be completed with a role of producer (inventor, designer and constructor). Moreover, the item concerning a task to fix the tube of the boy's bicycle was too much associated with the boy's ownership of the bicycle. The form should include a similar item about fixing something belonging to the girl, or the bicycle could be replaced with something belonging both to the boy and the girl, alike. Some ethical considerations concerning the relationship between technology, nature and human beings should be added in the interview items, as well. The question about the gender of the introduced professions (Q8a) should, instead of selecting one of the genders, offer also a possibility to connect both genders to a profession, which would indicate an anti-bias gender role thinking (comp. Kim & Lewis, 1999).

Although children usually are brief within their verbal responses and their attention span may be quite short, it would be important to extend the discussions by prompting interviewees to tell their opinions and understandings beyond the immediate answers. However, the interviewer ought also to be aware of children's gradually developing meta-cognitive abilities, which may limit their possibilities to think of their own meaning-making and reflect in-depth their responses. Moreover, the interview can be divided into parts and carry out in several days. The used narrative approach with vignettes operated well with the children and they were emphasised with the family members. They also associated narrations with their own life experiences. Researchers, however, have warned not to rely too much on this kind of connection, and to use also other methods along the vignettes (Barter & Renold, 1999). Children's real life behavior may differ from their imaginative stories. The narrative approach is useful for opening discussions of the topic. Consequently, this interview form may serve not just researchers but also teachers to inspire discussions with children around technological issues in preschools and child-care centres. As the results indicated, technology probably is a neglected concept in early childhood.

According to the results, stereotypical, gender-biased thinking concerning toys, play activities and domestic technology was evident in some extent in the children's answers, though there were seen also attempts to resist the existing gender order and generation order, i.e. power relations between genders and between adults and children. Early childhood is a promising starting point for educating technologically literate citizens and promoting gender equality in terms of technological competence and motivation. Children are yet quite flexible with their developing identity. Positive results may be achieved with an anti-bias pedagogy (see Kim & Lewis, 1999) and gender-sensitive practices based on teachers' growing awareness of existing gender-biases both in educational organisations and in other institutions such as in media, which is an increasingly powerful but weakly controlled area in the society. It is essential to recognise that first of all boys and girls are individuals and members of the same sex differ from each other. Additionally, young children proved to be interested in activities connected to the field of technology, and they should be provided more consciously with an early technology education.

Acknowledgements

Sincere thanks to research assistant, kindergarten teacher Outi Heikintalo, who collected the Finnish data, and UPDATE-project colleague Kristi Paas, who organised data collection in Estonia and translated the children's answers to English.

References

Alamäki, A. 1999.
How to educate students for a technological future: Technology education in early childhood and primary education. Doctoral dissertation. University of Turku.

Alderson, P. & Morrow, V. 2004.
Ethics, social research and consulting with children and young people. Essex: Barnado's

Barter, C. & Renold, E. 1999.
The use of vignettes in qualitative research. In N. Gilbert (Ed.) Social Research Update. Issue 25. University of Surrey. Available at http://sru.soc.surrey.ac.uk/SRU25.html.

Clark, A. 2005.
Listening to and involving young children: a review of research and practice. Early Child Development and Care 175(6), pp. 489–505.

Demand and user-driven innovation policy. Framework and action plan. 2010. Publications 48/2010.Helsinki: Finnish Ministry of Employment and the Economy.

Education and training 2010.
The success of the Lisbon strategy hinges on urgent reforms. 2004. Joint interim report of the Council and the Commission on the implementation of the detailed work programme on the follow-up of the objectives of education and training systems in Europe. 6905/04. Council of the European Union.

Golombock, S. & Hines, M. 2002.
Sex differences in social behavior. In P.K. Smith & C.H. Hart (Eds.) Blackwell handbook of childhood social development. Cornwall: Blackwell Publishing, pp. 115–136.

Kim, S-K & Lewis, G. 1999.
Children's gender role stereotyping: the effect on Asian and Non-Asian Australian pre-school children of an Anti-bias Curriculum. Early Child Development and Care 159. pp. 121–134.

Klapwijk, R. & Rommes, E. 2009.
Career orientation of secondary schools student (m/f) in the Netherlands. International Journal of Technology and Design Education 19(4), pp. 403–418.

Kåreland, L. 2005a.
Inledning [Introduction]. In L. Kåreland (Ed.) Modig och stark – eller ligga lågt. Skönlitteratur och genus I skola och förskola [Brave and strong – or undervalued. Literature and gender in school and in kindergarten]. Skrifter av Svenska Barnboksinstitutet nr. 87. Stockholm: Natur och Kultur, pp. 9–21.

Kåreland, L. 2005b.
Frihet elle närhet? Om Benny och Malla [Fridom or closeness? About Benny and Malla]. In L. Kåreland (Ed.) Modig och stark – eller ligga lågt. Skönlitteratur och genus I skola och förskola [Brave and strong – or undervalued. Literature and gender in school and in kindergarten]. Skrifter av Svenska Barnboksinstitutet nr. 87. Stockholm: Natur och Kultur, pp. 25–51.

Leaper, C. 2009.
Gender development. In Shweder, R.A., Bidell, T., Dailey, A., Dixon, S. Miller, P. & Modell, J. (Eds.) The child. An Encyclopaedic Companion. Chicago and London: The University of Chicago, pp. 398–402.

Mawson, B. 2010.
Children’s developing understanding of technology. International Journal of Technology and Design Education 20(1), pp. 1–13.

Pardhan, A. 2010.
Influence of teacher-student interactions on kindergarten children’s developing gender identity within the Pakistani urban classroom culture. Early Child Development and Care 172, pp. 1–20.

Poikolainen, H. 2010.
”Teknologia ja sukupuolikehyksessä tarkasteltu teknologinen toimijuus lasten kuvakirjoissa. [Technology and in gender-frames studied technological agency in children’s picture books]. Master thesis involved in UPDATE-project. Department of Education. Early Childhood Education Unit. University of Jyväskylä.

Pope Edwards, C. & Wang, C. 2009.
Gender. Historical and cultural perspectives. In Shweder, R.A., Bidell, T., Dailey, A., Dixon, S. Miller, P. & Modell, J. (Eds.) The child. An Encyclopaedic Companion. Chicago: The University of Chicago, pp. 393–398.

Punch, S. 2002.
Research with children: The same or different from research with adults? Childhood 9(3), pp. 321–341.

Standards for technological literacy. Content for the study of technology. **2000/2007.**
Reston, Virginia: International Technology Education Association, ITEA. Third edition.

Turja, L. 2009.
Report on factors that have impact on self image related to technology (Deliverable 2.3). Early childhood education – Workpackage 2, UPDATE – Understanding and Providing a Developmental Approach to Technology Education, EU-project no. 042941, 2007–2009. Available at http://update.jyu.fi.

Turja, L. Endepohls-Ulpe, M. & Chatoney, M., **2009.**
A conceptual framework for developing the curriculum and delivery of technology education in early childhood. International Journal of Technology and Design Education 19(4), pp. 353–365.

Vuoristo, J. 2007.
”Jo päiväkodissa on mahdollisuus saada kokemuksia teknologiasta.” Tytöt, pojat ja varhaislapsuuden teknologiakasvatus..[It is possible to get experiences of technology already in child care centre. Girls, boys and technology education in early childhood.]. Master thesis involved in UPDATE-project. Department of Education. Early Childhood Education Unit. University of Jyväskylä.

Witt, S.D. 2000.
The influence of peers on children’s socialization to gender roles. Early Child Development and Care 162, pp. 1–7.

APPENDIX

Children's thoughts about technology and technological agency – a picture and narration supported child interview for children at the age of four to seven years

Information for the interviewer: Each of the 8 questions is followed by an own picture card, which helps the child to focus on the theme and think of the question as well as to answer by pointing out the pictures. The child's answer is written down by the interviewer. In question 3 the child is given a picture of a scale (1–3) to show how much s/he likes or appreciates the issue in question. The child can point out from the scale the choice corresponding to his/her opinion. Within the last question the child can draw complete unfinished pictures of androgyny persons representing selected professions and tell the persons names or indicate in another way if it is male or a female. If the child wants to give more explanations for his/her answers or comment on the subject, they are to be written down as well. If the child likes, you can use the invented names of the imaginary family members represented in the picture cards.

Information about the interview for the child: "Researchers would like to know what children think about technology, and about using different equipment. Children's thoughts are important and that is why we hope that also you would help us with this research. Would you like to look at and discuss with me about these picture cards?"[3]

Background information of the child: Respondent's age in years and sex.

Questions:

1) You have probably sometimes heard people talking about technology. What do you think technology is? *(Picture of a thinking child –an androgyny one)*

[3] The researchers need permission from both the parents and the child concerning the child's participation in the interview (informed consent). The child is told also in the beginning of the interview that s/he is allowed to discontinue – momentarily or totally – the ongoing interview at any time just by telling the adult. According to the child's attention the interviewer may split half this interview for two separate times.

2) This is the Smith *(choose a culture relevant surname)* family. First, you can give names for the Smith family mom, dad, son and daughter. (*Pictures of a family, a car, a bicycle and a phone on the same sheet; the child can use all combinations of family members, who may participate in shopping)*

   a) The Smith family needs a new computer. Who will go shopping to choose the right computer?
   b) The Smiths' car is pretty old. Who will go shopping to choose a new car?
   c) The boy needs a new bicycle. Who will go shopping to choose it?
   d) The girl needs a mobile phone. Who will go shopping to choose it?

3) Here is a list of various equipment people use at home and at work. (*Pictures of a computer, woodcraft tools, textile work tools, cooking utensils and household appliances, e.g., a hoover, a washing machine)*

   How much do you like using the equipment presented here? (*Self-assessment scale:* ☺ *= not that much,* ☺☺ *= pretty much,* ☺☺☺ *= a lot)*
   How important is it for you, in your opinion, to learn to use this equipment when you grow up? *(Self-assessment scale:*
   👍 *= not that important,* 👍👍 *= pretty important,* 👍👍👍 *= very important)*

4) I read what Gyro Gearloose and Christopher Robin have invented.[4] *(Two self-narrated short stories – containing about 60–100 words each – of these famous children's picture-book characters acting as inventors and problem-solvers; pictures of them)* Every one of us can be an inventor like Gyro Gearloose or Christopher Robin. Tell me about something that you have invented by yourself or together with mom or dad or someone else.

5) Which of these activities are your favorites? You can pick one or more of these: building with Legos, building a hut, doing crafts/ fine arts. *(Pictures of Legos, a hut in a tree, and utensils for handicrafts, e.g., scissors, pencils, papers, glue)*

6) Here is the Smith family again. *(Pictures of the family, a floor lamp, a bicycle, and a fallen painting and a nail on the same sheet)*

   a) The light bulb in the Smith family's lamp has burned out and needs to be changed. Who will change the light bulb?
   b) The boy's new bike has blown a tire. Who will fix the tire?
   c) A painting has fallen off the Smiths' living room wall and a nail dropped on the floor. Who will put the picture back on the wall?
   d) Have you ever fixed something by yourself or with your parents or with someone else? What did you fix?

---

4 You may read only one story according to the child's attention-span. Ask him/her which one s/he prefers.

7) Both of the Smith children are having a birthday soon. Here are photos of different toys. *(12 photos on the same sheet representing a traditional game, a electric game, a car, a train, three different construction series, a big soft toy, a doll, a dragon, a woodcraft table, a stove)*

a) Pick out two toys which, you think, the girl wants for her birthday.
b) Pick out two toys which, you think, the boy wants for his birthday.

8) Here are four people having different kind of jobs/professions. *(Unfinished and as androgyny pictures as possible of a computer worker, a police, a doctor, a teacher; write down what is the sex of each professional seen by the child)*

a) You can make up the first name of the worker and make the picture ready by drawing (and coloring). For example, the person has neither face nor hair.
b) What kind of work would you like to do when you grow up?

Martina Endepohls-Ulpe

Elementary School:

The development of gender roles and technology education in primary schools – dangers and chances

Cultivating a gender-related identity is a major task for children which they need to master during the course of their development. Gender is one of the central social categories that are relevant for the perception and the assessment of other people and the individual person as well. Therefore, the expectations of a person's social environment connected to gender play a significant role regarding the emergence of numerous traits and behavior patterns.

In western industrial societies, rethinking processes on gender roles have been initiated by – among others – the women's movement during the last centuries. The range of socially accepted behavior patterns for boys and girls, men and women, has expanded considerably. Opportunities for girls' and women's participation in educational and vocational systems in western societies increased considerably especially during the last century, or were principally adapted to the opportunities of boys and men.

The participation in job trainings and occupations in the MINT area – the subjects mathematics, informatics, sciences and technology – is one of the behavioral areas where great differences in attitudes and behavior between female and male persons occur – despite almost equal legal conditions (see Quaiser-Pohl & Endepohls-Ulpe, 2010). Particularly women are strongly underrepresented in technical job trainings and professions. This reinforces the deplorable lack of qualified personnel in these fields – and the lack still remains despite the economic crisis and a tensed labor market (for current figures and projections in Germany see Bonin et al., 2007; Becker, 2009).

The question in how far congenital differences between both genders (e.g. differences in division capabilities of space concepts or verbal division capabilities) play a part in this issue remains unresolved despite numerous empirical studies (Beermann, Heller, Menacher, 1992; Quaiser-Pohl & Jordan, 2004).

So far international comparative school performance studies have shown that the achievements of boys and girls continue to equalize, particularly in the fields of technology and science (see Endepohls-Ulpe, 2008). As a result, now the conditions of socialization have become the focus of research. But as a countermove, the very fields of technology and science turn out to be a comparatively difficult area when wanting to support girls and women. The increased pedagogical efforts during the eighties that tried to attract girls to technology and sciences and tried to simplify access to these fields, only had modest success (see Ziegler, Schirner, Schimke & Stoeger, 2010). Obviously, the mechanisms of the emergence and maintenance of behavioral differences seem to be more complex than was previously assumed.

During the last two decades cognitive psychological views on the development of gender differences have become more important within the psychological literature (see Eckes & Trautner, 2000; Ruble, Martin & Berenbaum, 2006). These views emphasize the activity of the individual himself in developing gender-typical skills and behavior, starting already in childhood. Science and particularly technology seem to be subjects that are classified by children –already at early ages – as part of the behavioral areas and fields of interests of boys and men. This in turn leads to corresponding consequences in the way they make their choices and in their performances.

The European project UPDATE[1], which is probably the origin of most of the articles collected in this edition, consequently regards the area of primary education as one focal point of research and intervention, aiming at creating a gender-adequate pedagogy in the field of sciences and technology. Within the scope of this project, studies on what hinders especially girls from starting technical job trainings and occupations were conducted by the participating countries. Furthermore, prototypical measures that aim at making technology education more attractive and effective were also developed.

Firstly, a short overview on psychology's current state of discussion about the development of gender-typical behavior shall be given. Then the significance of these findings for the development of gender differences in the area of technology will be exposed. Results of the UPDATE project on some aspects of this complex process will illustrate these fundamental observations. Here the focus is on early ages when the observed behavioral differences obviously evolve or increase. They lead to the fact that at the end of primary school boys and girls show a gender-typical performance behavior and ways of making choices concerning technical and science topics. Finally, possible consequences for a gender-appropriate and effective technology education will be discussed.

The development of gender differences

The biological sex of the human being is already determined before birth. As a result the human being during his development forms a range of gender-specific anatomic and physiological characteristics (this means characteristics only observable in one of the genders). But gender is also a social category and is next to age the most important feature that is used to describe and "classify" the human being. All human societies associate a

variety of expectations with gender, which may vary between different social environments, and they associate certain characteristics and behavior patterns with the term “gender”.
On the one hand, psychology is interested in kinds and dimensions of differences between both genders from a differential-psychological perspective. On the other hand, it is interested in the principles of acquisition and in alterations of differences from a developmental-psychological perspective (an extensive presentation of the current state of research in psychology concerning gender typing is described by Trautner, 1997 and Hannover, 2008).
Differences between females and males consist in various dimensions that clearly go beyond the commonly accepted differences in observable behavior or outlasting personality features. Huston (1983) in line with Ruble, Martin and Berenbaum (2006) differentiates between the following sections, resp. between psychological features that reveal gender-typical differences:

1. Concepts and beliefs (about differences between both genders)
2. Identity and self-perception (as male or female and the associated self-evaluation)
3. Attitudes and preferences (related to the affiliation to one gender and the associated activities and features)
4. Observable behavior

On the one hand, theoretical concepts of the process of establishing gender differences must clarify the question what kind of basic mechanisms are responsible for the materialization of differences. On the other hand, they have to examine when those processes are being realized, too, and how alterations within different states of development are related to each other (Trautner, 1997, S.331).
Biological influences as reasons for several gender differences in the fields of performances and interests are still being discussed and examined in empirical studies. Indeed, there is a consensus that the influence of biological factors, e.g. hormones or differences in cerebral lateralization, does not happen directly but is conveyed by interlinks; and that biological factors influence each other (e.g. an increased implementation of certain behaviors can lead to changes of the hormone level or brain structure), and that biologically induced behavioral differences in humans can be overlapped by social influences (ibidem, p.366; see also Geake, 2007; Willingham, 2006).

Since the middle of the last century, the social learning theory as an explanatory concept for gender differences – especially in the areas "interest" and "performance" – has dominated the discussion (cf. Hannover, 2004). Here, the influence of the social environment is regarded as the main cause for differences. On the one hand, the influence comprises differing reactions of parents and other significant persons towards similar behavior patterns of boys and girls: gender-appropriate behavior is reinforced resp. rewarded; whereas gender-inadequate behavior is ignored and therefore deleted, or punished and oppressed. On the other hand, boys and girls observe models used by both genders and imitate them. The reactions of the environment on the model behavior pattern determine whether the observed behavior will be performed later as well. Important agents of socialization relating gender differences in behavior are parents, pedagogues (educators in kindergarten and teachers) and reference persons of the same age (peers). Models of gender-typical behavior are also to be found in the medial environment, e.g. in books and films.

The importance of the social learning theory as an explanatory concept and therefore the influence of parents, teachers and peers is still undisputed but is not a sufficient explanation for gender differences in identity and self-perception (cf. Hannover, 2008). Meanwhile, the social learning theory is supplemented by cognitive approaches that emphasize the own activity of the individual regarding his or her acquisition of a gender role. The work of Kohlberg (1966, quoted in Trautner, 1997) was groundbreaking in this area: he found out that the child's perception and understanding regarding gender typing of the environment and the personal gender origin are the motor for the acquisition of gender-typical characteristics. Hannover enhanced this approach and determined the formation of a gender-related identity to be the central development task and a gender-typed behavior and self-concept of personal skills and features as a process of "identity regulation". Pieces of information (such as the differences between the genders) that originate in the social environment support a process that has an effect on each child: the development of a structure of knowledge about the self. This knowledge structure then "controls" the child's actions.

Social psychological approaches about the origin of gender differences emphasize the role of the social context: this happens on the one hand in the form of attributes in specific situations, e.g. the emphasis of the gender affiliation and on the other hand as the interplay of different variables in social systems and structures. One example regarding the attributes of social contexts that strengthens gender differences would be the phenomenon of "stereotype threat" (Steele, 1997). It demonstrates that girls and women in situations with masculine-connoted tasks, in which their gender origin is emphasized, show worse achievements than in neutral situations. The systemic interplay of attributes of different social structures concerning the maintenance or reduction of the girls' interest in MINT activities is described e.g. by Ziegler and Stoeger (cf. Ziegler et al. 2010) by the sociological term “Aktiotop”. The authors give explanations why the effect of support measures is merely a short-term one because there are counter-influences of variables that originate in the girls’ social space of actions.

Gender-typing by primary school children and technology

Concepts and beliefs

Concepts of gender-typing are cognitive schemes that comprise probability statements on attributes that differentiate between both genders. They are often described with the terms “gender stereotype” or “gender role stereotype”. In this context it is important that the knowledge of these classifications, which are learned in the social and cultural environment, may not be equated with an acceptance of these classifications.

In general, children show a development process that ranges from a complete unconsciousness of gender stereotypes via a very rigid stereotyping through to a more flexible classification of attributes. Stereotypes begin to evolve at early ages from two to three years. These attributions, as Trautner’s studies show (Trautner et al., 1988), reach the maximum rigidity at the beginning of primary school, which means at the age of six, and become more and more flexible during the course of primary school up to the end of puberty.

In his extensive presentation of the development process of stereotyping, Trautner (1997) furthermore points out that research results of children are highly dependent on methods. When using “forced choice” answers in the examination, which means that the children must match a certain attribute with gender, the rigidity of stereotypes increases until the beginning of adolescence. In contrast to this, when using graded answers in the examination, stereotypes become seemingly more flexible at the ages between nine and ten years.

In a questionnaire study, the UPDATE project examined the views of 235 German primary school children of the grades 3 and 4 (plurality of age nine and ten years) on the gender adequacy of specific technical activities (Endepohls-Ulpe, Stahl von Zabern & Ebach, 2010). The children completed a questionnaire with closed questions where they could gradually indicate their level of agreement concerning different technical (and scientific) activities: operating a computer, working with tools (hammer, screwdriver, saw, etc.), doing chemical experiments, playing and building with LEGO-technology, operating machines and electrical devices, repairing a bike, building and constructing (e.g. tree-house, hut), dealing with computer games and learning programs. Inter alia, the children were asked to indicate by means of two graded items whether the corresponding activities were rather boys’ activities or girls’ activities. On average, boys principally indicated that all the mentioned activities were suited for boys and complementary that they did not think that the activities would be interesting to girls. In contrast to this, girls principally did not think that the activities were rather appropriate for boys, though in their opinion the activities also did not tend to be exclusively part of the girls' scope.

At this point "computer work" took a special position. Here the girls most clearly rejected a stereotyped masculine classification and boys regarded it as the only item where they claimed that the activities would not to be exclusively reserved for their own gender.

Seiter (2009a) questioned 178 girls and boys from primary schools in Vienna, grades 2, 3 and 4 (plurality of age eight to ten years), whether boys or girls achieve better performances in the subject "Technical Working" (compulsory subject for boys and girls in primary schools in Austria) and whether technology was estimated as equally difficult for both boys and girls. Boys and girls mainly considered technology to be equally difficult for both genders. However, compared to the answers of girls, a larger number of the boys believed that boys are performing better in technology working, and just in the same way fewer boys than girls believed that here the achievements of both genders were the same.

Thus the German examination, which is aided in parts by the Austrian study, clearly reveals that boys at primary level show a stereotyping of technical activities as "male". Girls at this age do not assign technical activities clearly to one gender.

Identity and self-perception

Children at the age of two to three years are able to assign themselves and other persons reliably to the correct biological gender. At the beginning of primary school almost all children have understood the definiteness of this classification (acquisition of understanding gender-constancy). Up to the age of eight to nine years boys incorporate preferentially masculine attributes to their self-concept and girls rather incorporate feminine attributes (cf. Trautner, 1997). Only beyond this age, self-attributions that are rather to be allocated to the other gender's stereotype can be found more frequently.

The differences in contents mostly refer to the level of personal and social attributes – girls and women here rather describe themselves with expressive attributes and with notions that are related to closeness with other persons. Boys and men rather describe themselves with instrumental attributes which emphasize their individual independence (cf. Hannover, 2008).

Besides, gender differences frequently appear with respect to self-assessment. Boys and men mostly asses their own abilities to be significantly higher and they have higher expectations to achieve than girls and women. Particularly evident are these differences in those fields that are connoted with masculinity, e.g. mathematics and sciences (Rustemeyer, 1999; Rustemeyer & Jubel, 1996; Tiedemann & Faber, 1995; Ziegler & Stöger, 2004).

The examination of German primary school children (Endepohls-Ulpe et. al., 2010), which is described above, also questioned children on the self-assessment of their own skills regarding the technical activities listed in the study. Here the boys felt they were doing well in all of the activities. This was not the case among the girls – with the exception of operating a computer, computer games, learning programs, operating machines and electrical devices. Regarding these activities boys also showed a self-assessment that was significantly more positive compared to the girls. Furthermore, the boys thought they were mastering all those activities better than the girls (but on average not better than other boys), while girls neither thought they were performing better than boys nor other girls.

The survey of Austrian primary school children on the subject technology working (Seiter, 2009a) revealed a similar result on the descriptive level: among the boys and girls who indicated they really used the computer in class there was an equal self-assessment of their skills. Girls rated their drawing and constructing skills to be similarly well or even slightly better than the boys did, but the boys were more confident about their ability to work with tools and machines as well as producing and building.

Furthermore, the results of a master's thesis within the framework of the UPDATE-project, which examined attitudes and motivation of Finnish primary school children (5^{th} grade) regarding the topic "technology" indicated that girls expressed a lower self-confidence about their personal skills in all practical and technical activities. They – as well as the Austrian primary school girls, too – felt that their strong points would rather concern planning activities (Valkama & Wright 2008)

With regard to the self-concept of personal abilities there was on the one hand a tendency among boys towards a more positive self-assessment, which also corresponds to general findings on gender differences. Specifically with respect to practical and technical abilities there is a collective negative self-assessment among girls. An exception, however, is the field of "working with the computer": here the girls consider their personal abilities to be good.

Attitudes and interests

According to Trautner (1997), generalizable age trends concerning the evaluation and the individual attitudes towards cognitive concepts of gender differences in the form of preferring or rejecting certain gender-related features, culminate at the beginning of primary school before they gradually decrease in favor of personal interests later on.

Particularly girls of pre-school age have already clear associations about the feminine role, but compared to the boys they commit themselves less to their own gender role in their activities. Boys strongly prefer activities of their own gender role but this data rather refers to the field of toy preferences since this field is most frequently examined in empirical studies.

With regard to gender-typing of technical interests or to preferences related to technical activities, the findings of the UPDATE project show a picture that is much sharper contoured.
According to the survey among German primary school children (Endepohls-Ulpe et al., 2010), boys stated that they liked all activities mentioned in the survey and thought those activities were exciting. However, among the girls even when they indicated they enjoyed a particular activity, there was a more positive evaluation of this activity by the boys. Girls stated they enjoyed operating a computer and that this activity was exciting. The same applied to chemical experiments (rather a scientific activity), computer games and learning programs. Girls also felt that exactly and only these activities were simple and the others were not. According to their statements, girls felt that the other activities listed in the survey were neither fun nor exciting. The boys in contrast evaluated a larger number of activities listed in the survey to be simple; they felt that only chemical experiments and repairing a bike were difficult, but this opinion was also found to a lesser extent compared to the girls.
A school survey of Seiter (2009a) indicated that boys appreciated the subject “technology working” most (with the exception of sports), while girls rather preferred the subjects music or art education. Interestingly, among the girls technology working was a bit more popular than textile craft, which is rather connected to the female stereotype and which had – equal to the subject German – the lowest ratings among boys.
Thus, primary school children definitely show gender-typed attitudes and preferences regarding technical activities or technology classes, which is particularly evident in practical and technical areas.

Behavior

Gender differences concerning the observed behaviors were mostly examined with regard to children’s kinds of playing. These differences appear between the ages of two to three years. When having the opportunity, boys and girls increasingly play with objects that are associated with their own gender. However, the range of toys in this case is decisive: depending on the kind of toy available, playing characteristics of the other gender are also shown.
The UPDATE project observed manifest behavior patterns in relation to differences between girls and boys only unsystematically and in smaller pilot projects, so that it is not possible to make general statements here. When primary school children have the choice between textile craft and technical working as it is the case in Finland, boys choose technical working according to their gender and girls mostly choose textile working (Rasinen et. al, 2009), even when the girls previously have attended technical working classes (Pellinen, 2008).

Concerning activities in craft lessons, self-reports of Austrian primary school children who are taught technical working up to 4th grade revealed no gender differences (perhaps as a result of lacking options in practical activities) (Seiter, 2009a). Concerning the selection of the subjects “technical working” and “textile working”, which is happening from 5th grade on, boys then select technical working in large numbers and girls primarily textile working (Seiter, 2009b).

With regard to technical and particularly practical technical activities, it must principally be assumed that primary school children show gender-typical differences in behavior when having the freedom of choice.

Summary of the current research in gender-typing of technology at primary school age

Activities in technical areas are obviously stronger and more frequently stereotyped among boys at primary age than among girls. According to the beliefs of boys, all kinds of technical activities belong to the male scope of responsibility and field of competence. Related to technical areas their self-assessment of personal competence is high. Generally they regard themselves to be more competent than girls. According to the boys’ statements they enjoy technical activities and show great interest here – and that is even the case when technology is offered in school. When having the freedom of choice, boys rather choose technology working as their subject and avoid subjects that are more connoted with femininity, such as textile working.

Among girls the situation of gender typing technical activities is not that clear. Technical activities are not exclusively stereotyped as male by older girls in primary school. They assess their personal competences as low, lower than the competences of the majority of boys. This is particularly true for practical-technical activities. Those activities are not appreciated by girls, too. Girls rather seem to enjoy theoretical working, e.g. planning activities in technical classes. Here their self-assessment of personal competence is positive. Principally, technology as a school subject is not necessarily considered to be negative by girls. The choice behavior related to technical activities and subjects in school, however, clearly conforms to gender roles again.

Another exception within this framework is “working with the computer” because neither girls nor boys feel that it is a male preserve. Girls enjoy working with the computer and their self-concept of their personal abilities in this field is good, too (though not quite as high as the boys’ self-assessment). This circumstance is even more remarkable because the data collected by the UPDATE project (Ebach et al. 2010) revealed a distinctly weaker self-concept of personal abilities to operate a computer among women in engineering studies than it had been found among male students of engineering studies and even of non-technical studies. By contrast, female engineering students assess their practical-technical competences as significantly higher than female and male students of non-technical studies. The weaker self-concept of the female engineering students of their abilities to operate a computer compared to the self-concept of the primary school girls could possibly be interpreted as a cohort effect that originates from the fact, that computers have increasingly found their way into children's rooms and educational institutions in the last 10 or 15 years. Here, practical experiences of girls are possibly more extensive and all in all, also more positive because the user interface of computers and games today have been made much more suitable for children.

In contrast to this interpretation, an American study that was carried out already in 1992 (Williams & Ogletree) revealed that female and male pre-school children felt the computer would belong to their own gender. Additionally, there were no gender differences to be found in the computer competences of the three- and four-year-old children. Whitley's meta-analysis (1997, quoted in Ruble t al., 2006) indicated that boys of all ages had a more positive attitude towards computers, but here the gender difference was considerably greater among teenagers than among younger children. Thus, it would be interesting to examine whether there are influences during primary school age and adolescence that lead to a decrease of the girls' assessment concerning their computer competences and how these influences could be characterized.

Factors in the social environment of primary school children that influence gender typing in technical fields

The influence of parents

The significance that is assigned to the parents' differential treatment of boys and girls for the development of gender typing, e.g. regarding personal traits, has considerably decreased during the last centuries. Meta-analyses only revealed few statistically important differences among the many aspects of parental behavior (e.g. Lytton & Romney, 1991, quoted in Hannover, 2008). Manifest differences, however, are to be found in terms of an affirmation of gender-role-consistent activities, e.g. playing with dolls or tools, and with respect to the range of gender-typed toys and playing themes. Klugmann (1999) points out that typical toys and toy figures for boys often possess certain technical attributes or technical equipment and that they are also identified by technical terms.

Additionally, parents seem to be important in the process of gender-typing as role models themselves: mothers who work and fathers who are involved in the housework can be connected with less gender-typed attitudes and behavior patterns among their children.

Within the framework of the UPDATE project remarkable results on the early influences on differences in interests and self-efficacy among girls were revealed: a study was carried out that was to identify barriers and motivating factors regarding the choice of women for job trainings in technical fields (Ebach, Endepohls-Ulpe & Stahl von Zabern, 2009). Within the scope of this questionnaire study, students of different engineering studies at several universities in Rhineland-Palatinate (n = 141) and students of non-technical studies at the University of Koblenz (n = 179) were asked about possible factors influencing their subject choice. These influences covered among others questions about their experiences with technology during their childhood, about dealing with technology in extra-curricular activities, and to what extent their parents supported them in acquiring science and IT topics during their childhood.

On the one hand, the results of this study indicate that already at primary school age there are important gender differences in interests and activities in terms of technical topics, which affect the future processes of vocational choice. On the other hand, the UPDATE findings indicate that parental influences are important for the development of technical interests. Girls, who later selected technical degree courses, deviated from gender stereotypes already during childhood, at least in terms of their intellectually-based interest in technology and science. Those girls also recalled a stronger feeling of competence regarding technology and science during primary school age. Since the respondents (interestingly in particular the students of engineering studies) unanimously remembered only little support in their technical interests on the part of their primary schools, family influences seem to play an important role here. Compared to young men, young women remembered significantly more support from their mothers in terms of acquiring technical abilities (e.g. operating a computer), and assessed this support to be essential. With respect to support from the father in technical and mathematical tasks, young women also showed higher figures than young men. Here, particularly female students in technical degree courses remembered that they had received considerable support from their father. Thus, the encouragement and support of fathers and mothers in technical activities seem to be of importance for raising and maintaining interest in technology and self-experienced technical competence of girls.

The influence of teachers

There is substantial empirical evidence that teachers treat girls and boys differentially. This evidence includes on the one hand the area of basic interaction in the classroom, e.g. asking pupils, giving feedback and disciplining them (e.g. Frasch & Wagner, 1982; Younger, Warrington and Jaquetta, 1999), on the other hand it includes differential treatment depending on the subject. Teachers have certain expectations towards the suitability of pupils for certain subjects that conform to gender stereotypes (Tiedemann, 1995; Rustemayer, 1999; Ziegler, Kuhn & Heller, 1998) and that affect the subject-related self-concept of boys and girls. These expectations have a demonstrable negative influence on girls' achievement and their decisions within the educational system in the subjects mathematics and sciences.

Pedagogues also represent important role models. Thus, the lack of female teachers – and therefore the lack of competent and successful models, particularly in subjects like physics or chemistry – is considered to be the reason for the girls' unwillingness to choose science classes in secondary schools (Hannover, 2008). Furthermore, the attitude and the self-experienced competence of the pedagogue in terms of the subject topics obviously seem to be of importance. A US-survey among pupils of the first two primary school grades including their female teachers showed that girls who were taught by female teachers that were unsure and anxious about mathematics, achieved less progress within one year than girls who were taught by female teachers without anxieties concerning mathematics (Beilock et. al 2009). The fears of female teachers did not have an influence on the boys in their classes.

The data collected by the UPDATE project support the thesis that in terms of technology education in the primary school sector, the pedagogues' attitudes and role-model behavior seem to be responsible for gender differences.

Principally it should be noted that most primary school teachers in each participating UPDATE country are female (cf. Rasinen et al., 2009). It is assumed that female teachers are more reserved and feel less competent when dealing with technical topics, which leads to corresponding consequences in the behavior of their female pupils. A pilot study on the implementation of curricular instructions for technical topics at primary schools in Rhineland-Palatinate (Endepohls-Ulpe et al., 2010) showed that in particular female teachers avoid technical topics in class although these topics are compulsory standards of technology education within the subject "Sachkunde."

However, even after restructuring the degree courses for primary school teachers in German universities, the topic "technology education" is not considered to be part of teacher education, so that female students in particular are hardly able to eliminate their deficits. A survey among BA students at the University of Koblenz (Endepohls-Ulpe & Ebach, 2009), which has not been completely analysed yet, indicated that only 6% of the 49 students with their main focus on primary school education felt they had acquired sufficient knowledge to teach technical topics.

According to the social learning theory the perception of the teachers' appreciation of good achievements in technical activities can definitely be considered as an incentive to further engagement among primary school children. Pupils of the primary school grades 3 and 4 questioned by the UPDATE project (Endepohls-Ulpe et al., 2010) unanimously did not agree with the thesis that children who were good at one of the listed activities would be particularly popular with teachers. Only the boys felt, that being good at technical activities had a slightly positive effect on marks at school – but only for boys.

The influence of peers

Reference persons of the same age, too, can produce gender-typed behavior through their reactions and their function as a model. With her analysis of influences of group processes during childhood Eleanor Maccoby (2000) showed that gender differences particularly occur in the context of pairs or groups, and lesser when just comparing average attitudes and behavior of boys and girls. Already at the age of three years children start preferring playmates of the same sex. Their attractiveness increases during pre-school and at the age of six the majority of children – when having the freedom of choice – stay in same-sex groups. This phenomenon obviously can be observed in a variety of cultures.

According to Maccoby (ibidem) male and female peer groups differ in terms of several characteristics, e.g. activity preferences or interaction styles. Furthermore, there are cognitive and social dissociation processes which emphasize differences between groups or similarities within the group. Therefore, a large number of boys are oriented towards traditional masculinity standards (cf. Budde, 2008). Regarding at least elder pupils, Budde (2005) defines technology competence as an area where male pupils produce "hegemonial", i.e. dominant forms of masculinity. This happens within male groups, but is also used for dissociation from girls as well as establishing superiority over girls.

The survey among German primary school children on the social reactions of same-aged children on competences in technical activities (Endepohls-Ulpe et al., 2010) indicated that neither girls nor boys believed that a girl with high technological competences – no matter what area – would be popular with boys. Boys even rejected this to a higher extent than girls. Both boys and girls equally assessed the popularity of a technically competent girl among her female peers to be rather low. The idea of having a technically competent girl as a friend was principally rejected by the boys to a large extent. The girls were not that negative within their own reference group and even rated the popularity of a girl with competencies in the fields "building and constructing" as well as "playing with computers und handling learning programs" as rather high.

Compared to the girls, the boys could rather imagine that a technically competent boy would be particularly popular with boys. However, both girls and boys denied that such a boy would be popular with girls and here the boys denied it more strongly. Concerning the majority of listed activities, the boys reported they would enjoy having a friend who is competent in these fields. For the girls, technical competence was not a factor that would make a boy more attractive as a potential friend.

The results of this study possibly reflect the general tendency of eight to eleven-year-old children to prefer interaction partners of the same sex and at the same time their social dissociation from the opposite sex. However, it becomes evident that within same-sex reference groups boys think that technical competences would be a social benefit. Girls who appear to have competences in this area, which boys normally claim for themselves, are disliked by boys. Within the girls' group, too, technical competences do not win popularity. However, in terms of activities that are not typical for one gender the girls are a bit more tolerant among themselves than boys, or rather they do not seem to consider all of the technical activities to be typical for boys and estimate these activities to be a factor that might increase social attractiveness.

Summary of the results on social influences

Influencing factors of the social environment lead obviously systematically towards a gender typification concerning technical topics. The reinforcement of gender-typical playing activities and the provision of typical boy or girl toys at home lead to the fact that boys already from their early years on are more often involved in practical activities. The results of the atypical socialization experiences of female engineering students emphasise the importance of encouraging experiences at home, particularly for girls. In Germany especially the parental home as a socialization factor is probably of high importance because technology education within the German education system – despite its implementation within the curriculum – is hardly offered at primary level and is not a relevant component of achievement in school.

Female pedagogues and teachers, who hold the majority of teaching staff in Europe, rather seem to be negative models of technology competence particularly for girls. These conditions do not seem to have such a negative effect on boys, whose gender-role-stereotype includes the attribute of technical competence.

Within the groups of same-aged persons, the boys' socialization influence clearly leads towards technology competence. Technology competence is an area where superiority within one's own gender group and superiority over girls can be demonstrated. Technically competent girls do not fit into this hierarchical order and are disliked. Technical competences are tolerated within girl groups but are not of great importance as "social capital".

Consequences for technology education

The concluding question is what the findings about gender typing of technology and socialization framework conditions for children at an early age mean for a future implementation of technology education.

As it surely has become clear, the situation for girls is substantially more unfavorable than for boys. Particularly with respect to practical technical activities the conditions for girls concerning the assessment of personal competences and interest are worse than for boys. This leads to corresponding consequences in terms of future achievements and choice behavior. Yet, particularly the girls regard technology and technical activities less rigidly to be a male preserve. There are activities, e.g. constructing and computer work, that are of interest for girls and where they feel competent, at least in primary school.

Principally it can be assumed that girls are not completely opposed to technology classes. This is confirmed by the Austrian results on the opinions of the subject “technical working”. Gender-typed decisions of Austrian and Finnish pupils in terms of the subject “technology working” at the end of primary schools confirm the thesis that the offer of technology classes in its traditional form as a boys-oriented subject and as an alternative to textile working does not really encourage girls to choose technology. .

But technology classes that add to the girls’ strengths and interests would absolutely have the chance of success. The contents taught in technology classes principally should be presented in a way that enables girls to perceive the acquired skills to be compatible with a female identity.

Thus, topics that are rather gender-neutral or even have female connotations should be considered. Dakers and Dow (2005) provide examples for lesson units, e.g. “producing perfume” or “renewable energies”. Topics such as the protection of the environment, space construction or medicine technology seem to be suitable.

Primary school age is a favorable period to present the topic technology to girls because the stereotypes of the children are less rigid than at the end of kindergarten or the beginning of puberty, a period of time when the personal gender identity is very much in the limelight again (cf. Hannover 2004).

Future offers must counteract the lack of self-experienced competence through practical-technical activities, where girls can experience success and acknowledgement. The subject art, which represents a rather female domain, here possibly offers points of contact. Thus, topics such as the production and design of food or cookie packages could be offered, as it is done in the English subject “Design & Technology” (Lunt, 2009). However, on principle, pedagogical support strategies are necessary for pre-school age because girls develop the self-perceived deficits and aversions against practical-technical activities significantly before primary school ages. This happens e.g. through the offered and self-imposed gender-typed toys and playing activities.

Socializing framework conditions for children reveal that environmental influences systematically support the girls' avoidance of technical topics. A complete or extensive lack of technology education during primary school in Germany means a missed opportunity to generate and maintain interest in these fields and to provide competences.

Furthermore, female teachers who perceive themselves as less competent in technology represent quite unfavorable models for girls. Teaching staff of primary levels not only should be provided with a better training of how to teach technology to offer technical topics, they also should receive more support regarding their personal technical competence.

The framework described above, which is produced by gender-typing at primary school age and by the involved socializing instances, suggests that at least for the boys at primary age there exist optimum conditions to raise and maintain their technical interest (if technology classes take place at all). However, the lack of skilled technical personnel, e.g. engineers, which is lamented by the German and European economy, speaks against it. Certainly extra-school factors such as the image of certain jobs, or traditions of imparting contents at universities and applied universities do play a role in the development of this problem.

But also a change in technology conception and didactics is required. At this point, an extensive discussion on general goals and contents of modern technology classes cannot take place. Within the framework of the UPDATE project, different ways were illustrated how the attractiveness of technology classes – both for boys and girls – can be increased (cf. Dakers & Dow, 2009). In particular a creative and open-minded approach to solutions seems to get a hold of children. For girls, social aspects seem to be important regarding the field of product design. According to Dakers and Dow (2009), social and ethic effects of technology play an important role on a higher level of conceptual knowledge about technology. Thus, sophisticated technology classes that are not designed as handicraft lessons for boys based on the pure production of a certain object, will be attractive and motivating for girls, too.

References

Becker, F.S. (2009).
Why not opt for a career in Science and Technology? An analysis of potentially valid reasons. Paper presented at the *SEFI 37th Annual Conference, Rotterdam*, July 1-3, 2009.

Beermann, L., Heller, K.A. & Menacher, P. (1990).
Mathe: nichts für Mädchen? Bern: Huber.

Beilock, S. L., Gunderson, E. A., Ramirez, G. & and Levine, S. C. (2009).
Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences.* www.pnas.org/cgi/doi/10.1073/pnas.0910967107. Access Sept. 2010.

Bonin, H., Schneider, M., Quinke, H., Arens, T. (2007).
Zukunft von Bildung und Arbeit. Perspektiven von Arbeitskräftebedarf- und -angebot bis 2020, I Z A Research Report No. 9.
http://www.iza.org/en/webcontent/publications/reports/report_pdfs/iza_report_09.pdf.
(AccessSept.06,2008).

Budde, J. (2005).
Männlichkeit und gymnasialer Alltag. Doing Gender im heutigen Bildungssystem. Bielefeld: Transscript.

Budde, J. (2008).
Bildungs(miss)erfolge von Jungen und Berufswahlverhalten bei Jungen/männlichen Jugendlichen. Bildungsforschung Band 23. BMBF: Bonn, Berlin.

Dakers, J. & Dow, W. (Eds.),
Understanding & Providing a Developmental Approach to Technology Education - A Handbook for Teachers. University of Glasgow: Faculty of Education

Ebach, J., Endepohls-Ulpe, M. & Stahl von Zabern, J. (2009).
Motivating Factors and Barriers to Study Engineering - Gender Differences and Possible Consequences. In VDI – the Association of German Engineers (Ed.), Gender and Diversity in Engineering and Science (pp. 215-230). Düsseldorf.

Ebach, J., Endepohls-Ulpe, M., Ruffer, C. & Stahl-von Zabern, J. (2010, in press).
Pursuing a Career in a Technological Field: Motivating Factors and Barriers for German Students, In D. Balahur & P. Fadjukoff (Eds.) *Women and technological education: A European comparative perspective - The 10 commends for the policy makers.* "Alexandru Ioan Cuza" University Press.

Eckes, T. & Trautner, H. (Hrsg) (2000).

The developmental social psychology of gender. Mahwah, N.J.

Endepohls-Ulpe, M. & Ebach, J. (2009).

Results of empirical studies with German students and teachers – concluding suggestions for an enhanced and gender sensitive-curriculum of technology education. *Final conference of the European project UPDATE, Madrid, Spain*, Nov 23 – 24 2009.

Endepohls-Ulpe, M. (2008).

Hochbegabte Mädchen in Mathematik, Naturwissenschaft und Technik – Chancen und Risiken. In E. Sander & B. Kessler (Hrsg.), *Ada-Lovelace Schriftenreihe*. Heft 13. Remagen: Fachhochschule Koblenz

Endepohls-Ulpe, M., Stahl-Von Zabern, J. & Ebach, J. (2010).

Einflussfaktoren auf das Gelingen von Technikerziehung für Mädchen und Jungen im Primarbereich - Ergebnisse aus dem Projekt UPDATE. In C. Quaiser-Pohl & M. Endepohls-Ulpe, *Bildungsprozesse im MINT-Bereich* (S. 29-47). Münster: Waxmann.

Frasch, H. & Wagner, A. C. (1982).

"Auf Jungen achtet man einfach mehr..." . In I. Brehmer (Hrsg.), *Sexismus in der Schule* (260-278). Weinheim: Beltz.

Geake J. (2008).

Neuromythologies in education. *Educational Research*, 50, 123-133.

Hannover, B. (2004).

Gender revisited: Konsequenzen aus PISA für die Geschlechterforschung. *Zeitschrift für Erziehungswissenschaft*, 7, Beiheft 3, 81-99.

Hannover, B. (2008).

Vom biologischen zum psychologischen Geschlecht: Die Entwicklung von Geschlechtsunterschieden. In A. Renkl (Hrsg.), *Lehrbuch Pädagogische Psychologie* (S. 339-388). Bern: Huber.

Huston, A.C. (1983).

Sex-typing. In E.M. Hetherington (Ed.), *Handbook of child psychology*. Vol. IV. (P. 387-467). New York: Wiley

Klugman, K. (1999).
A bad hair day for G.I.Joe. In B. Lyon Clark & M. R. Higonnet (Eds.). *Girls, Boys, Books, Toys. Gender in Children's Literature and Culture* (pp.169-182). Baltimore: Johns Hopkins University Press.

Lunt, J. (2009).
Primary School Children's Perceptions of Design and Technology. In J. Dakers & W. Dow (Eds.), *Understanding & Providing a Developmental Approach to Technology Education - A Handbook for Teachers* (pp.85-102). University of Glasgow: Faculty of Education.

Maccoby, E.E. (2000).
Psychologie der Geschlechter. Sexuelle Identität in den verschiedenen Lebensphasen. Stuttgart: Klett-Cotta.

Pellinen, T. (2008).
Craft Teaching Emphasizing Technology Education and Its Effect on Girl' Perceptions of Technology. Master Thesis at the Department of Teacher Education, University of Jyväskylä.

Quaiser-Pohl C. & Jordan, K. (2004).
Warum Frauen glauben, sie könnten nicht einparken- und Männer ihnen Recht geben. München: Beck.

Quaiser-Pohl, C. & Endepohls-Ulpe. M. (2010) (Hrsg.).
Bildungsprozesse im MINT-Bereich. Münster: Waxmann.

Rasinen, A., Virtanen, S. Endepohls-Ulpe. M., Ikonen, P., Ebach, J. & Stahl-von Zabern, J. (2009).
Technology education for children in primary schools in Finland and Germany: different school systems, similar problems and how to overcome them. *International Journal of Technology and Design Education* 19 (4), 367-379.

Ruble, D. N., Martin, C. L., & Berenbaum, S. A. (2006).
Gender development. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of Child Psychology* (6th ed., Vol. 3, pp. 858-932). New York: Wiley.

Rustemeyer, R. & Jubel, A. (1996).
Geschlechtsspezifische Unterschiede im Unterrichtsfach Mathematik hinsichtlich der Fähigkeitseinschätzung, Leistungserwartung, Attributionen sowie im Lernaufwand und im Interesse. *Zeitschrift für Pädagogische Psychologie*, 10, 13-25.

Rustemeyer, R. (1999).

Geschlechtstypische Erwartungen zukünftiger Lehrkräfte bezüglich des Unterrichtsfaches Mathematik und korrespondierende (Selbst-) Einschätzungen von Schülerinnen und Schülern. *Psychologie in Erziehung und Unterricht*, 46, 187-200.

Seiter, J. (2009a).

Die Einstellung österreichischer Schülerinnen und Schüler zur technischen Bildung und technischen Berufen. Eine Befragung an Wiener Schulen im Rahmen des Projektes UPDATE. Grundschule / Volksschule, Schule der 6 – 10-jährigen. Universität Wien.

Seiter, J. (2009b).

“Crafts and Technology” and “Technical Education” in Austria. *International Journal of Technology and Design Education*, 19, 419-429.

Steele, C.M. (1997).

A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, 52, 613-629.

Tiedemann, J. (1995).

Geschlechtstypische Erwartungen von Lehrkräften im Mathematikunterricht in der Grundschule. *Zeitschrift für Pädagogische Psychologie*, 9, 153-161.

Tiedemann, J.. & Faber, G. (1995).

Mädchen im Mathematikunterricht: Selbstkonzept und Kausalattribution im Grundschulalter. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 27, 61-71.

Trautner, H.M. (1997).

Lehrbuch der Entwicklungspsychologie. Göttingen: Hogrefe.

Trautner, H.M., Helbing, N., Sahm, W.B. & Lohaus, A. (1988).

Unkenntnis – Rigidität – Flexibilität. Ein Entwicklungsmodell der Geschlechtsrolle-Stereotypisierung. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 19, 105-120.

Valkama, E. & Wright, S. (2008).

Girls and Technology. Master Thesis at the Department of Teacher Education, University of Jyväskylä.

Williams, W. & Ogletree, S.M. (1992).

Preschool children’s computer interest and competence: effects of sex and gender role. *Early Childhood Research Quarterly*, 7, 135-143.

Willingham, D.T. (2006).
"Brain based" learning: More fiction than fact. AFT – Publications – American Educator. http://www.aft.org/pubs-reports/american_educator/issues/indes.htm. Fall 2006.

Younger, M. & Warrington, M. (1999).
Closing the gender gap? Issues of gender equity in English secondary schools. *Discourse: studies in the cultural politics of education*. 28, 219-242.

Ziegler, A. & Stoeger, H. (2004).
Evaluation of an attributional retraining (modelling technique) to reduce gender differences in chemistry instruction. *High Ability Studies*, *15* (1), 63-83.

Ziegler, A. , Kuhn, C. & Heller, K. A. (1998).
Implizite Theorien von gymnasialen Mathematik- und Physiklehrkräften zu geschlechtsspezifischer Begabung und Motivation. *Psychologische Beiräge*, *40*, 271-287.

Ziegler, A., Schirner, S., Schimke, D. & Stöger, H. (2010).
Systemische Mädchenförderung in MINT: das Beispiel CyberMentor. In C. Quaiser-Pohl & M. Endepohls-Ulpe, *Bildungsprozesse im MINT-Bereich* (S. 109-126). Münster: Waxmann.

Sonja Virtanen, Pasi Ikonen and Aki Rasinen

Elementary School/ General Education:
Girls' motivation towards technology education

Introduction

Technology is traditionally seen as a male dominated area. In Finnish primary schools technology is mainly taught in craft lessons and particularly in technical craft lessons. Those girls who choose to study textile craft have to exclude their technology studies. In the year 2005 only one out of a hundred female students in the Department of Teacher Education at the University of Tampere had studied technical craft in school for more than a few weeks (Luomalahti 2005, 214). This also reflects the situation today. In most schools, pupils are still forced to choose between technical craft and textile craft at grade 4 (age 10), even though the 2004 National Framework Curriculum states that craft is one subject. In the first part of this article an analysis and results of a theory driven content analysis of Finland's National Framework Curriculum 2004 is described from the point of view of technology education.
Secondly girls' motivation towards technology education was studied by carrying out a questionnaire study for 301 fifth and sixth graders. The results and findings are presented and discussed below.

The Analysis of the Finnish National Framework Curriculum

Finland has a basic comprehensive education system for all pupils in grades 1-9 (age 7-15). Compulsory education consists of elementary level grades 1-6, and lower secondary level grades 7-9. Schools and municipals write their own curricula based on the National Framework Curriculum (2004). The National Framework Curriculum describes the main objectives and the core content of every school subject and cross-curricular themes. There are also some descriptions of methods and ways of learning. Cross-curricular themes should have the central emphasis on educational and teaching craft. Some subjects are taught only in the grades 1-4, and/or in the grades 5-9, and some only in the grades 7-9.
A theory driven content analysis concentrating on technology education, specifically with regard to the objectives and contents of the National Framework Curriculum 2004, was carried out. Besides the different subjects and cross-curricular themes, the analysis in general referres to education at grades 1-6 (age 7 to 12). In particular, the aim was to find out in which subjects technological innovation processes (see figure 1, level 3) can be found. Levels 1 and 2 describe the basic levels of the pupils' technological competence, whilst level

3 describes the highest level of learning: understanding, application and invention. Level 3, the technological innovation process, comprises many conceptual and functional levels, such as knowledge of materials and tools, know-how, understanding of the concepts of technology and their application. It is important that the knowledge one has is being applied or put into practice in an innovative, "creative new" way. The innovation process is associated with brainstorming, problem-solving, innovativeness, inventiveness, designing, modelling, evaluation, experimental approaches, creativity and aesthetic and ethical aspects. The aim of technological activity is to integrate awareness raising, learning and design processes in order to enable the application of these steps and create innovative solutions.

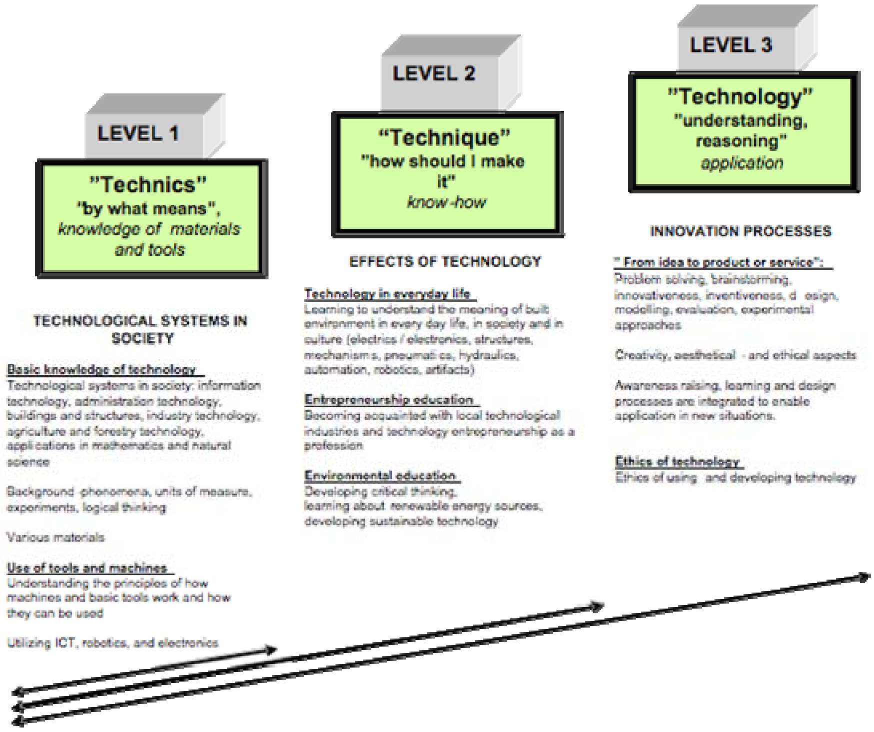


Figure 1 *Framework for curriculum analysis. Pupils' mental processes of understanding and the level of technological competence (modified version Virtanen 2008; Rasinen, Virtanen, & Miyakawa 2009, 77).*

The analysis of the National Framework Curriculum provided evidence that the subjects in which innovation processes are realised well are the following: *craft* (grades 1–4 and grades 5-9, in 5-9 particularly in *technical craft*) and *visual arts*.

In craft (grades 1-4) some of the objectives are that pupils learn to master the entire craft process: brainstorming, designing, modelling, building and evaluating. Instruction is implemented through projects and themes, which correspond to the pupils' stage of development. This instruction involves experimentation, investigation and invention. The instructional tasks are intended to promote creativity, problem-solving skills, an understanding of everyday technological phenomena, and aesthetic, technical and psychomotoric skills (National Framework Curriculum for Basic Education 2004, 240). In *visual arts* pupils are encouraged to stimulate their imagination by making observations and inventions. The objectives of the instruction are to foster the imagination and to promote the pupils' skills in creative problem-solving and investigative learning (National Framework Curriculum for Basic Education 2004, 241-242.). Although the activity in visual arts cannot always include technological content, meaningful and integrative projects between technology educational themes and visual arts would increase holistic teaching. The cross-curricular theme *Human Being and Technology* guides the pupils to understand the individual's relationship to technology and to become aware of the importance of technology in our everyday life. Education has to comprise the fundamental knowledge of technology, its development and its impact. Through encountering these topics, pupils learn to understand technology and thus can acquire creative problem-solving skills.

Gender-specific interests in technology education

Traditionally technology has been a field dominated by males and it is seen as a topic closely connected to the male gender stereotype. At the beginning of primary school, children's gender stereotypes adhere to the cultural standards concerning toys, activities and vocational roles. The toys of boys' are often electronic and the toys of girls are based on developing social skills (Weber & Custer2005, 55-56).

A questionnaire study was conducted to investigate pupils' motivation towards various technological activities. There were 301 fifth and sixth graders who answered the questionnaire, together 150 girls and 150 boys, one not known (N=301). The initial items in the beginning of the structured questionnaire included questions concerning the background information: age, gender and what pupils have studied (technical craft or textile craft or both) at school, what kind of activities pupils have done at school and what kind of material they have used. After marking the background information, pupils marked their level of agreement or disagreement by using the Likert scale which includes the graduations 1-4 (1= I fully agree, 2= I partly agree, 3= I partly disagree, 4= I fully disagree). They made statements about different technological activities dealing with various types of motives. The questions were divided in categories based on Kosonen's 1996 theory of motivation. These categories are: 1) Motives based on emotional experience, 2) Motives based on contents of technology, 3) Motives based on accomplishment and achievement, 4) Motives based on social interaction, 5) Reluctance, 6) Working processes. The data was collected in spring 2009 and the pupils were chosen from schools in bigger towns and some from smaller communal schools in different parts of Finland.

Results based on the category frequencies

With respect to the question which content area of craft studies pupils have studied at school, there were the following results: 143 pupils (29 girls and 114 boys) have studied technical craft, 98 (92 girls and 6 boys) textile craft, and 55 (28 and 27 boys) have studied both. 5 didn't answer to this question at all.

Motives based on emotional experience

When pupils were asked about craft artifacts or about using tools and working in craft lessons, the answers generally were very positive. Over 86 % of all pupils fully or partly agreed with the statements: "*I like the crafts that we do at school"* and *"I find it important that my artifact is well done and looks nice"*. The majority of pupils found it nice that they can use tools well. However, 64% of boys, but 46% of girls totally agreed with the statement *"I find it nice if I can use tools well"*. In addition, over 73% (77% of girls and 73% of boys) of pupils fully or partly agreed with the statement "*When working in the craft lesson, the work carries me away".*

Motives based on contents of technology

Over 86% of pupils fully or partly agreed with the statement *"I like the craft that we are doing at school"*. Also when pupils were asked about what kind of projects they would like to do, 79% of girls and 84% of boys fully or partly agreed with the statement *"I would like to do an useful artifact for my home"*. When pupils were confronted with the statement *"The best for me is if I can create my own idea and realise it"*, the majority (78% of girls and 85% of boys) fully or partly agreed with it. Most of the pupils, but with a little difference in answers between girls (74%) and boys (85%) fully or partly agreed with the statement *"I like building and constructing things".* The majority (over 70%) of pupils fully or partly disagreed with the statement *"I would like to study how commercials affect people".*

The statements that had some or remarkable difference between the answers of girls' and boys'. With the statement *"It's fun to learn how to use different tools"* 42% of boys and 33% of girls fully agreed, but more girls compared to boys partly disagreed with the statement. The statements dealing with environment and nature strongly segregated girls and boys: 63% of girls, but only 42% of boys fully or partly agreed with the statement *"I'm interested in inventing solutions for keeping the environment clean"* and 75% of girls and 50% of boys agreed with *"I would like to learn how to preserve the nature".* Only few girls (8%) and more boys (20%) fully disagreed with these statements. When pupils were asked about the projects that are done in craft lessons, 74% of the girls and only 50% of the boys fully or partly disagreed with the statement *"I don't care what kind of artifacts we are doing in craft lessons".* And when asked *"I like to do decorative artifacts",* 74% of the girls and 49% of the boys fully or partly agreed with the statement. Only 17% of the girls, but 55% of the boys fully agreed with the statement *"I like to build electronic devices".* One explanation for this difference might be that girls who have studied textile craft (the majority in this data), perhaps have never constructed electronic devices. 56% of the girls and 41% of the boys fully or partly agreed with the statement *"I want to learn the risks of using internet",* but more boys compared to girls disagreed with this.

Motives based on accomplishment and achievement

The statements that are included in this group of motives had a difference between the answers of girls and boys. With the statement *"I'm afraid of doing something wrong"* 64% of girls, but only 44% of boys fully or partly agreed. When considering the statement *"I think that we are doing too easy projects in craft lessons ",* only 64% of the boys and 77% of the girls fully or partly disagreed with the statement.

Motives based on social interaction

The statements that are included in this group of motives indicated also a difference between the answers of girls' and boys'. Girls found it more important to get support from the teacher, because the majority (82%) of girls and only 61% of boys fully or partly agreed with the statement *"I think it's important that the teacher supports and encourages me".* With the statement *"My family encourages me to do crafts"* 25% of the girls and 12% of the boys fully agreed with the statement. More boys compared to girls answered that they partly disagree with the statement.

Reluctance

The pupils' answers to the statements in this section indicated no difference between girls' and boys'. The majority (over 80% of girls and 72% of boys) of pupils fully or partly disagreed with the statements *"I feel often bad when doing craft"* and *"The craft teacher is too demanding"***.** This is also true with regard to the statement *"I think doing craft is boring*", because 73% of pupils fully or partly disagreed with it.

Working processes

Some of the statements that are included in this group had a remarkable difference between the answers of both genders. More boys (compared to girls) seemed to like solving problems independently because 20% of boys but only 5 % of girls fully agreed with the statement *"I want to solve problems completely on my own"***.** On the other hand 22% of girls and 8% of boys fully disagreed with the statement. Also more than half (58%) of boys fully agreed with the statement *"I find it interesting to test and try different kind of things"*, when only 38% of girls answered that way.

The majority (68% of girls and 61% of boys) fully agreed with the statement *"I think it's good that the teacher tells exactly what to do next"***.** When pupils were asked about working in a group or alone, there were no remarkable differences between both genders. Over 81% of all pupils fully or partly agreed with the statement *"When I face a problem I want to try to solve it with the help of my friend or teacher"* and over 85% of the pupils agreed with *"I like working in groups*". The result was almost the same as in the statement *"I think group working does not fit into craft lesson"*, because on average, 70% of all pupils fully or partly disagreed with the statement. There was a little difference between the answers of girls' and boys', when pupils were asked if they would rather work alone or with a friend. Almost half of the girls (44%) and less boys (36%) fully disagreed with the statement *"I rather work alone than with a friend*". Pupils were also asked what they think about of doing identical artifacts. Over half (63%) of all pupils fully or partly disagreed with the statement *"I like it when everyone makes exactly the same kind of artifact".* However, it seemed that a couple more boys fully agreed with this statement.

The T-Test

T-Test (SPSS for Windows) was used to compare the means of two groups', girls' and boys' answers and to find significance of the differences between them. Before running the T-test the data was cleaned; the empty answers to the statements were compensated with the mean value of that statement. The final data included 281 answers (N=281). The statements that had statistical significant difference between the answers of girls' and boys' can be found from the table 1. The null hypothesis (H_0) was rejected when P<.01 **.

Statement	boys' mean	girls' mean	mean difference	sig.
I like to build electronic devices	1,67	2,52	0,85	***
I like to do decorative artifacts	2,48	1,88	0,60	***
I would like to learn how to preserve the nature	2,55	1,97	0,58	***
I want to solve problems completely myself	2,31	2,78	0,47	***
I'm interested in to invent solutions for keeping environment clean	2,72	2,27	0,45	***
I'm afraid of doing something wrong	2,69	2,25	0,44	***
I think it's important that teacher supports and encourages me	2,31	1,88	0,43	***
My family encourages me to do crafts	2,59	2,21	0,38	***
I find it interesting to test and try different kind of things	1,55	1,91	0,36	***
I don't care what kind of artifacts we are doing in craft lessons	2,50	2,85	0,35	**
I like building and constructing things	1,63	1,95	0,32	**
I think that we are doing too easy projects in the craft lessons	2,63	2,95	0,32	***
I find it nice if I can use tools well	1,43	1,67	0,24	***

*

Table 1 *t-Test results*

p< .05

** *P*< .01

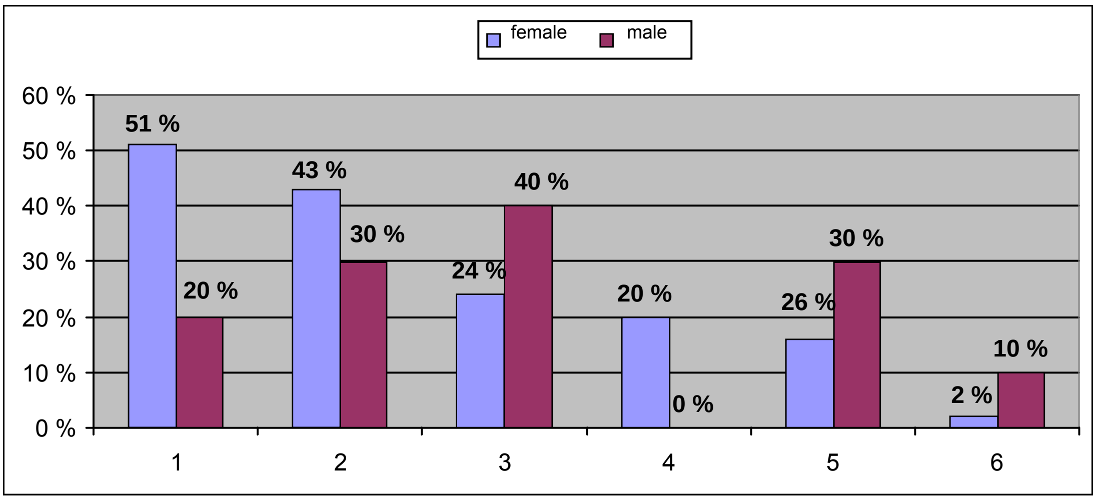
****p*< .001

The greatest statistically significant differences between the motives were linked to the group of "Motives of the contents of technology education". Compared to girls, boys liked more to build electronic devices. One explanation for this difference might be that those projects are only done in technical craft lessons and most of the girls in this data (and in general in Finland) have studied textile craft in school. Therefore girls don't know much or anything about building electronic devices. Secondly, the biggest difference was that girls cared more than boys that their artifact would be decorative. Also girls were more interested in how they could preserve the nature and find solutions for keeping the environment clean. Although we can't say how much these contents are related to technology education when girls answered them, but we can say that based on these results preserving the nature and environmental themes could be contents that motivate girls in technology education. Boys liked more (in comparison to girls) to build and construct things, but in general boys didn't care that much what is done during the craft lessons.

There were also differences in motives of girls' and boys' linked to the group of "Motives based on accomplishment and achievement". Boys thought more than girls that the projects that are done in craft lessons are too easy, and girls intended they were more afraid of doing something wrong. In comparison to girls boys found it nice that they can use tools well. Boys seemed to master better working in craft lessons and were more self confident about themselves than girls. When the pupils were asked about the craft process or working in craft lessons, boys generally wanted to solve problems independently on their own and found it interesting to test and try different kind of things. Social interaction seemed to be important for girls, because girls found it more important to get support and encouragement from the teacher.

Results of other findings during the UPDATE-project

The following study started in 2009 and is still continuing at the University of Jyväskylä Department of teacher education. The project is called “The Trick track-project”. It is part of a basic course in the primary school teacher education programme and is compulsory for all the students. The emphasis is put on pedagogy, but in addition basic technical working skills are studied. Based on our earlier experiences we were worried about the possibility that during this kind of hands on -project students concentrate too much on developing only their skills instead on pedagogical and philosophical ideas behind the activities. Because these students will be working as primary schools teachers, we found it important to study how students liked this project and if there are gender-related differences. Students are guided to understand why problem-solving and application are important skills for pupils. The project is organised in collaborative groups who have to design and build up a roller-coaster for a ball. The study was implemented by asking second year basic course students to fill out a questionnaire after the Trick track-project session (4 hours). In total, there were 59 students, 10 males and 49 females.



Graph 1 *Pedagogical aspects of Trick track*

1 = pedagogic of problem-solving

2 = cooperation, working in a group (social aspect of learning)

3 = creativity, sussing out, playfulness

4 = use of various materials, tools and techniques
5 = new idea / aspect
(6 = no answer)

Half (51 %) of the female students and 20% of males mentioned that their pedagogical understanding of the problem-solving process was developed during the project. The secondly mentioned aspect among females and males was cooperation, working in a group (social aspect of learning). The difference between answers of females and males was in creativity, sussing and playfulness. Only 12/49 (24 %) of females, but 4/10 (40 %) of males mentioned that it was the best pedagogical aspect in the project.

Some statements of the students' notes:
F: *"At least my problem-solving skills have developed."*
F: *"During the work I have particularly learned problem-solving skills and how to handle out frustration."*
F: *"The Trick track-project is a good tool to use in school lessons. Pupils will learn playful problem-solving strategies.*
M: *"Trick track was a great idea to develop group working skills."*
M: *"During the Trick track project, there was a good atmosphere for creativity."*

The sample in this study was relatively small (N=59), but the reliability of results will probably increase during next year when app. one hundred new student will answer the questionnaire. The Trick track-project is an example for demonstrating how pedagogical theories (problem-solving, collaborative learning) can be studied in hands-on projects. These first results indicate that it is reaching its' objectives. Students with varying backgrounds can participate in the project, have the opportunity to gain positive experiences and to reach the objectives of the course. It is also important to notice that female students, despite of their limited experience with materials used in project, gave very positive feedback.

Conclusion

A positive aspect of technology education in Finland is that it can be found in the National Framework Curriculum 2004. It is mainly realised in craft, although the 2004 National Framework Curriculum also introduced the cross-curricular theme "Human Being and Technology" (Rasinen et. all 2009, 373.)
In Finland, craft studies as a subject traditionally have been divided into technical work (boys' craft) and textile work (girls' craft). Changes in national curricula (1970, 1985, 1994, 2004),

emphasised that there should no longer be a division between girls and boys, and both genders should study the same content. Anyhow the documents allowed the schools to emphasize one of the two craft domains and therefore nothing actually changed in practice. (Rasinen, Ikonen & Rissanen 2006, 450-452.) In the year 2005 only one out of a hundred female students in the Department of Teacher Education at the University of Tampere had studied technical craft in school for more than a few weeks (Luomalahti 2005, 214). This also reflects the situation today. In most schools, pupils are still forced to choose between technical craft and textile craft. This division also could be seen from the data (N=301) of the questionnaire study in this article. As a result of this division girls have been excluded from various technological studies. Because of the long tradition of a gender-based division, the contents of textile craft have consisted in a certain way that they maintain traditional gender stereotypes.

According to the curriculum analysis, pupils are encouraged only during technical craft (and arts) to learn important skills like innovativeness, inventiveness, creativity and problem-solving. Technical craft can be seen as supportive technology education by encouraging pupils in the creative use of various materials and techniques for different purposes. This should be combined with studying technological structures, concepts, systems, applications and attempts to find creative solutions to the problems they encounter. If pupils have to choose one subject area (in other words omit technical craft) for the grades 5-9, it will not be possible for them to continue to study technology education as such.

Based on the questionnaire, girls were more interested in environmental aspects. So these should be emphasised in technological studies in order to raise the girls' interest. Also teachers and parents should pay attention to the support and encouragement of girls in technological studies. Girls seem to appreciate the aesthetics dimensions when doing artifacts on their own. The stereotype of technical craft artifacts might be the opposite. The way of working and the products could be considered as rough and masculine and probably as not being aesthetic.

References

Borg, W.R. & Gall, M.D. 1989.
Educational Research. New York: Longman.

Kosonen, E. 1996.
Soittamisen motivaation varhaisnuorilla. Jyväskylän yliopisto. Musiikkikasvatuksen lisensiaattityö.

Luomalahti, M. 2005.
Naisopiskelijoiden teknologiasuuntautuminen luokanopettajakoulutuksessa. Tampereen yliopisto. Acta UniversitatisTamperensis 1065.

Metsämuuronen, J. 2008.
Monimuuttujamenetelmien perusteet. Helsinki: International Methelp.

National Framework Curriculum for Basic Education 2004.

Rasinen, A., Virtanen, S., Endepohls-Ulpe, M., Ikonen, P., Ebach, J. & Stahl-von Zabern, J. 2009.
Technology education for children in primary schools in Finland and Germany: different school systems, similar problems and how to overcome them. International Journal of Technology and Design Education 19, 368-379.

Rasinen, A., Ikonen, P. & Rissanen, T. (2006).
Are girls equal in technology education? In Marc J. de Vries& I. Mottier (eds.) International Handbook of Technology Education.Revieving the Past Twenty Years. Rotterdam: Sense Publishers. 449-461.

Weber, K. & Custer, R. 2005.
Gender-based Preferences toward Technology Education Content, Activities, and Instructional Methods. Journal of TechnologyEducation 16 (2), 55-71.

Carmen Ruffer and Wenka Wentzel

General Education:
Girls'Day – Vocational Orientation in Technology, ICT, Natural Sciences and Crafts

Every 4th Thursday of April technical enterprises, universities and research centres are invited to organise an open day for girls –' Girls'Day - Future Prospects for Girls'. During this national day of action a wide range of professions and activities is presented to girls of ten years and upward. Between 2001, when the campaign started, and 2009 the nationwide project mobilised more than 900,000 girls for over 50,000 events in technology, ICT, natural sciences and crafts (Nationwide Coordination Bureau, www.girls-day.de, 2009) Scientific evaluation shows certain effects of this event on girls, organisations and schools who participate in Girls'Day.

"Shaping technology – Making equal opportunity a reality" is the guiding principle of the non-governmental organisation Competence Centre Technology, Diversity and Equal Chances in Bielefeld, Germany. The main objective of the Competence Centre is to actively shape Germany's path towards becoming an information- and knowledge-based society. To this end, it develops and carries out a wide range of initiatives and projects that exploit the potential of women as well as men to make equal opportunity a reality in all spheres of society and work. The strategy of equal opportunity presupposes recognition of people's diversity, their varied biographies, lifestyles, and capabilities and promotes the development of the potential and opportunities this diversity entails. It uses diversity as a success factor in achieving gender and generational equality in social development.

Against the background of manifesting diversity in the vocational sector, the Competence Centre has set up the campaign Girls'Day, a day of vocational orientation in technology, ICT, natural sciences and crafts in order to actively support girls in discovering their skills in the field of technology, science and handicraft. The nationwide aligned campaign has a great impact on the public and presents a wide range of professions and activities to girls of ten years and upward.

Girls'Day has established itself as a nationwide initiative on female vocational orientation, therefore at this point this analytical review shall provide a summary of the project and its goals, give a short description of the project's structure as well as a presentation of the evaluation results 2008. A significant component of this report is the project's evaluation of

2008 because it provides the reader a comprising impression of the project's effectiveness as well as an access to the experiences of all involved parties.

1. About the Project

The project Girls'Day – 'Future Prospects for Girls' is funded by grants from the German Federal Ministry of Education and Research, the German Federal Ministry for Family Affairs, Senior Citizens, Women and Youth and the European Social Fund. The project is supported by the German Federal Ministry of Education and Research, the German Federal Ministry for Family Affairs, Senior Citizens, Women and Youth, the Confederation of German Employer's Associations (BDA), the German Confederation of Trade Unions(DGB), the Federal Employment Agency (BA), the German Chambers of Industry and Commerce (DIHK), the Federation of German Industries (BDI), the German Confederation of skilled Crafts (ZDH) and the Initiative D21. In Cooperation with the nationwide coordination office they form a supervising board for Girls'Day – Future Prospects for Girls.

The core concept of the project is the encouragement of girls at early stage of life, the involvement of the girls' environment and the activation of the girls individual initiative. By actively taking part in Girls'Day, girls shall be particularly motivated and encouraged to seize their career options. Subsequently, they choose to study or work even in professional fields that are presently not typically female. Being a nationwide event that takes place at a uniform date, Girls'Day shall also combine regionally limited initiatives to achieve far-reaching effects unprecedented so far. The number of girls choosing "typically female" careers or subjects of study is disproportionately high (Federal Statistical Office, 2008). In doing so, they do not fully exhaust their career opportunities. This is in opposition to trade's and industry's complaints about an increasing lack of qualified staff in the technical field. Girls'Day opens up extensive future prospects to a generation of qualified young women by establishing contacts and drawing attention of the industry and the public to girls' strengths.

More than 70 % of the girls in Germany who start traineeships choose one out of only 20 different jobs. In comparison to that, about 50% of boys choose one out of 20 different job trainings (Federal Statistical Office, 2008). The vocational trainings that are most frequently chosen by girls are: sales assistant, office clerk, hairstylist, doctor's and dentist's assistant. In many cases these professions offer lower payment and less prospects than jobs in the industrial sectors (Federal Statistical Office, 2008). Within the scope of science and technology, women are also under-represented. Less women than men study information technology or engineering, less women than men are engaged in research. In winter semester 2007/2008 222,561 male students registered for mathematics and nature sciences, but only 129,017 female students opted for these academics. 257,418 male students registered for engineering sciences while only 65,133 women decided to study engineering (Federal Statistical Office, 2008). In contrast to this, girls are very successful at school and achieve on average higher graduations as boys. Companies complain about a lack of qualified personnel in the near future. On this background and for the sake of equal opportunities for men and women they are well advised to offer careers to skilled girls and young women.

The results of the concomitant research indicate that girls at an early stage of life already formulate an interest in technology and craft, if they have an opportunity to gain positive hands-on experiences (Nationwide Coordination Office, 2008).

In nearly all German states, the Ministries of Education have recommended headmasters to offer the participation in the Girls'Day as a school event. Given regard to the day as a useful, practically oriented supplementation to vocational orientation at school, members of the Standing Conference of Ministers of Education and Cultural Affairs have been involved in the preparation of the campaign since 2002.

Regional groups work in close cooperation between trade unions, chambers, employers' associations, employment offices, women's representatives and other multipliers. They work together in networks to organise Girls'Day in their region, e.g. match girls and company events. The working groups benefit from dissemination of experiences and advisory service of the nationwide coordination bureau. This ensures that the campaign becomes a constantly available opportunity for girls and young women, while they are in search of career possibilities. Multipliers receive support from a nationwide dialogue. Regionally limited initiatives are combined to achieve far-reaching effects.

	Events	Girls	Working Groups
2001	39	1.800	-
2002	1.267	42.500	83
2003	3.905	101.011	173
2004	5.303	114.063	210
2005	6.974	127.115	267
2006	7.085	121.681	309
2007	8.113	137.489	345
2008	8.626	132.537	350
2009	9.015	126.696	355
total	50.327	904.902	

Table 1: *Participation in Germany since 2001 (Nationwide Coordination Bureau, 2009)*

Between 2001, when the campaign started, and 2009 the nationwide project mobilised more than 900,000 girls for over 50,000 events in technology, ICT, natural sciences and crafts (Nationwide Coordination Office, 2008). The results of the campaign's concomitant research indicate that the vocational choices of girls seem to be influenced in a very positive way (Nationwide Coordination Bureau, 2008). For companies, the participation in Girls'Day seems to display itself as an innovative and reformative impulse for their recruitment and personnel policy. With the project, a giant stride towards diversity and equal chances for women in job and social life shall be made.

The project also managed to give an impulse for Europe. Based on the German model, a Girls'Day is now organised in Austria, Luxembourg, parts of Belgium, the Netherlands, Switzerland, Spain and Kosovo. Cross-border activities are realised with Austria, Finland, France, Luxembourg, Czech Republic, Poland, Switzerland and Kosovo (Nationwide Coordination Office, 2009)

2. Girls'Day Website and Media

Part of the extensive public relations is the project's homepage that is well known in Germany. (25,040,755 page views by April 23rd 2009, Nationwide Coordination Bureau, 2009). It follows a target group oriented concept and is relaunched every year to start the new Girls'Day campaign. The target groups are girls of ten years and up, teachers, employers and employees, parents, the media, and other organisations. The main features of the website are vocational orientation for girls and service for the Girls'Day participants and multipliers. The campaign's internet site provides an interactive map of Girls'Day activities with information about events organised from companies and organisations on this occasion. Regional contacts and information for and about organisers or working groups are also displayed on a map. Supporting information, e.g. a monthly newsletter for parents, teachers and all other people interested in the campaign can be subscribed. Also, you can order printed information material such as flyers, practical guidelines, posters and stickers. Information material, an all-embracing interactive website and a useful advisory service provide information and support for all target groups. Regional working groups handle local organisation efforts. More than 350 working groups from trade unions, chambers, employer associations, employment offices, and women's representatives have been set up so far. They are actively involved in the implementation of Girls'Day concept at national and regional level.

Girls get useful information on how to attend Girls'Day. The website's exclusive features for girls offer several opportunities: The Girls'Day participants can exchange experiences in an all-girls internet forum, they can take part in Girls'Day contests and other activities like the Girls'Day - Song contest in 2005. Since 2006, they have the possibility to try the computer game "Girls'Planet" that shows women in male dominated jobs like engineer or detective superintendent and gives substantial job information.

Girls'Day raises a wide public awareness: approx. 31,000 articles in print media, 1,250 reports on TV, 900 reports on radio, 14,000 internet articles since 2001. The media's response has increased impressively during the project and is drawing public attention to the strengths and opportunities of girls. Many expressive pictures and interesting reports of Girls'Day activities promote a positive image of girls in technology, ICT, natural sciences and crafts.

3. Evaluation Results 2008

The campaign includes a scientific evaluation. This is to be in a position to use the experience made during this campaign, the participating girls, teachers and the mentors organising the events were polled. In 2008, a total of more than 12.300 questionnaires from 9,570 girls and 2,750 mentors in companies and other organizations were evaluated.

3.1 Survey Results of participating companies and institutions

Companies, research institutes, universities and other institutions open their doors once a year to give girls from ten years up a first insight into the world of work. By preparing a multiplex variety of events on Girls'Day, companies and institutions enable young women to learn about vocational possibilities as well as to communicate with Human Resources Managers and personnel responsible for traineeships. The participating institutions provide access and open their laboratories, workshops and offices in order to exemplify that science, technology and craft are interesting and exciting vocational fields. Employees often are personally available for discussions and individual queries.

„Girls'Day-Future Day for Girls“ is dependant on companies that offer adequate activities that raise the interest of girls; companies that have recognized that continuous Girls'Day-participation has a significant positive effect on gender-sensitive recruitment policy.

An ideal example provides Deutsche Telekom. The company was involved for the ninth time in the nationwide Girls' Day and this year became an official partner. Their press release reads as follows: "As Germany's largest training provider with around 12,000 trainees, Deutsche Telekom uses the Girls'Day as an opportunity to approach the girls as potential future employees. At one of the most popular events of the entire campaign day, the company presents, for example, the work of an IT systems business administrator, an IT systems electronic technician, or an IT specialist, as well as the Bachelor of Business Administration and Bachelor of Engineering degree courses with integrated practical phases, to around 1,200 school girls in Neuss. Innovations determine the economic future of our country. The ICT sector is one of the most important innovation drivers. That's why we believe it is imperative to spark enthusiasm among young people, especially young women, for careers in technology."

At the Girls'Day workshops, trainers gave an impression of the wide range of career opportunities at Deutsche Telekom to the potential of new female recruits. All of the company's strategic business areas will be involved in Girls' Day.

Because companies are such an substantial factor of the campaign's structure, it is of importance what organisators think about vocational orientation of girls. Most of them rated cooperation between schools and companies and activities like Girls'Day as important. But also a family-oriented personnel policy and other aspects were quoted.

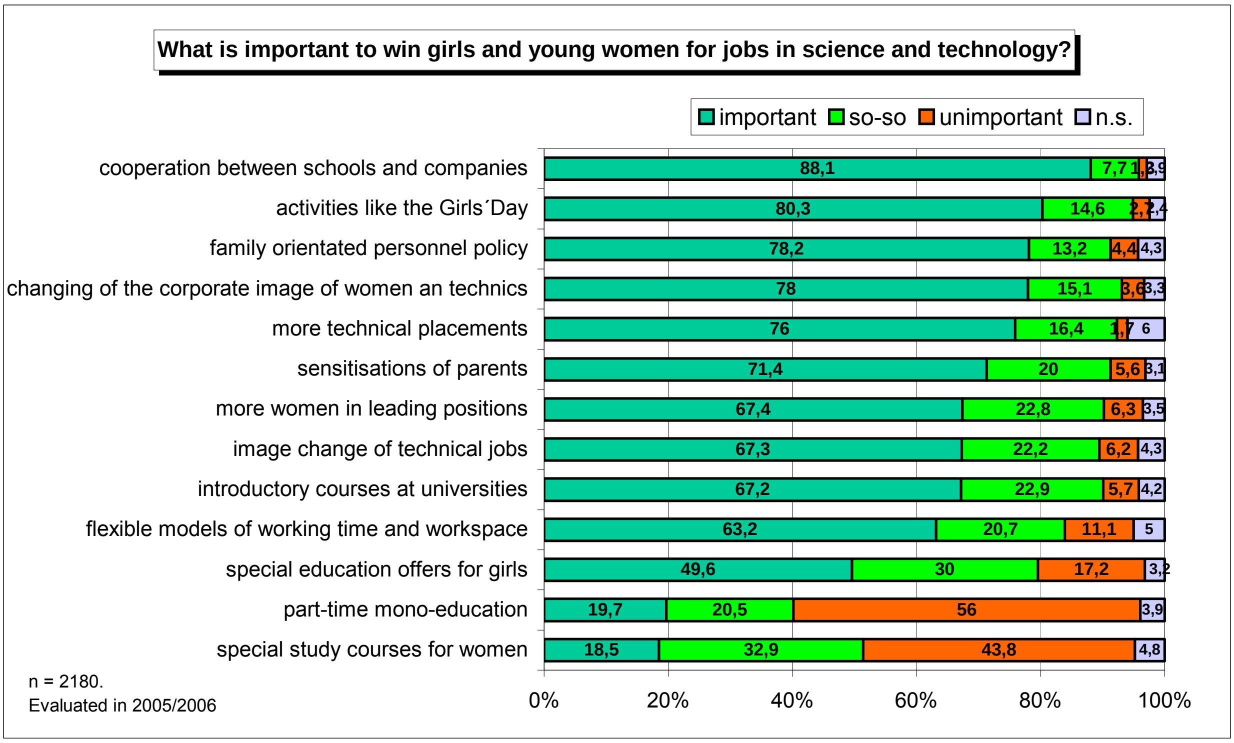


Diagram 2 *Companies and organisations - What is important to win girls and young women for jobs in science and technology? (Nationwide Coordination Office, 2008)*

Most of the companies and other organisations invite generally all interested girls for an open day. The number of open day-activities has increased since the campaign's start in 2001 (Nationwide Coordination Office, 2008). One quarter of the mentors organize Girls'Day for daughters and friends of the employees, e.g. parents, relatives or friends take girls with them to work and act as mentors for the day. Almost 12 percent invite selected schools.

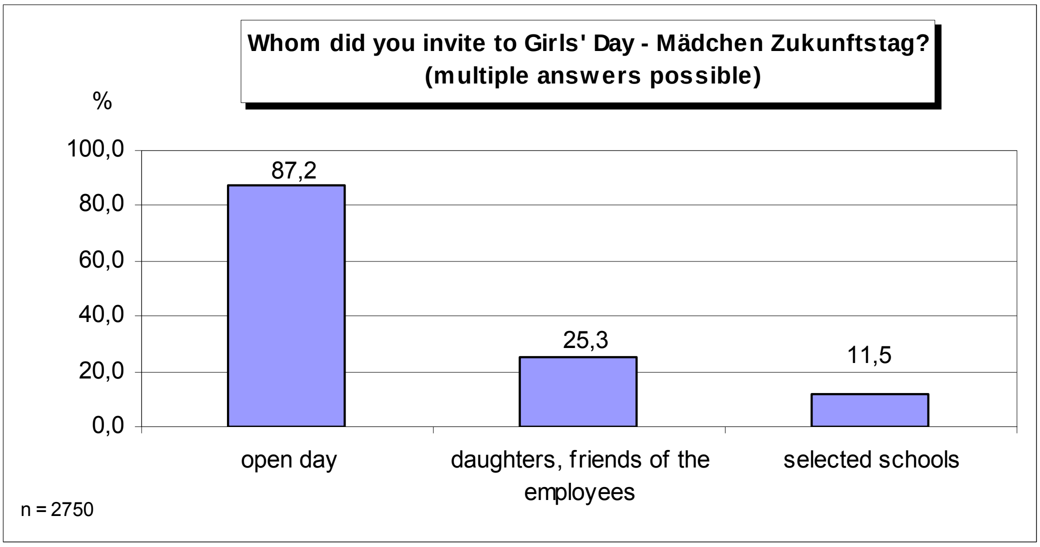


Diagram 3 *Companies and organisations - Whom did you invite? (Nationwide Coordination Office, 2008)*

The reasons for companies and organisations to participate in the campaign are to present their business and open up personnel resources for the future. For more than three quarters of companies and organizations, Girls'Day fits their corporate identity.

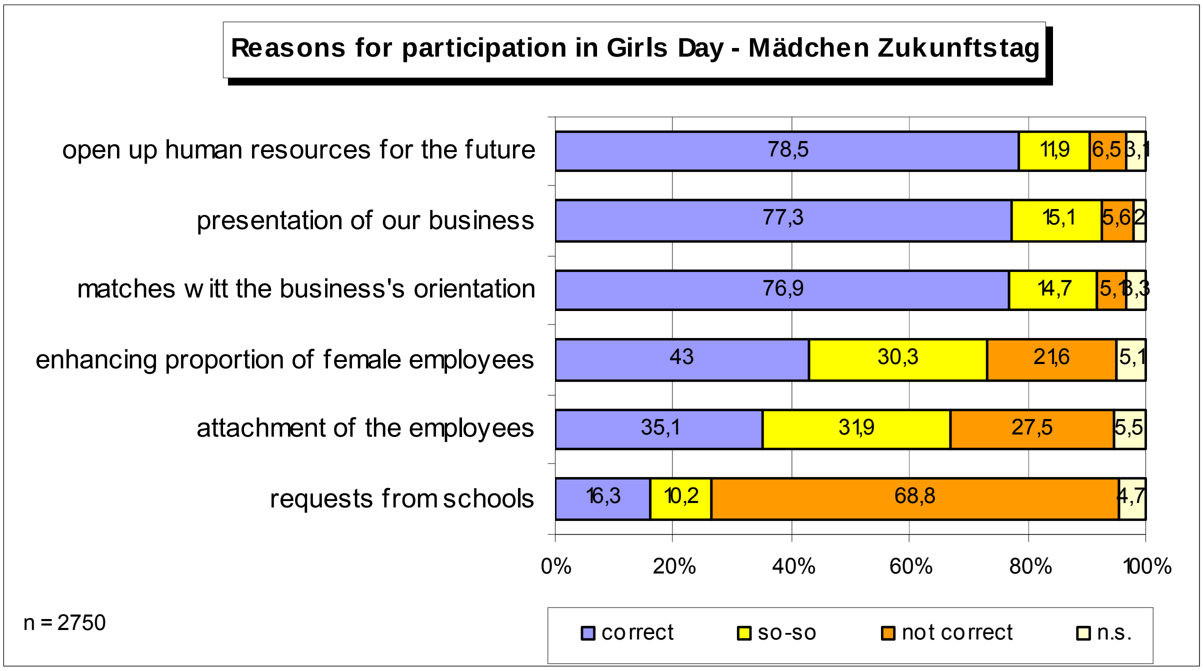


Diagram 4 *Companies and organisations - Reasons for participation (Nationwide Coordination Office, 2008)*

The companies and organisations were asked about their contentment with Girls'Day. More than 80 percent are satisfied or very satisfied.

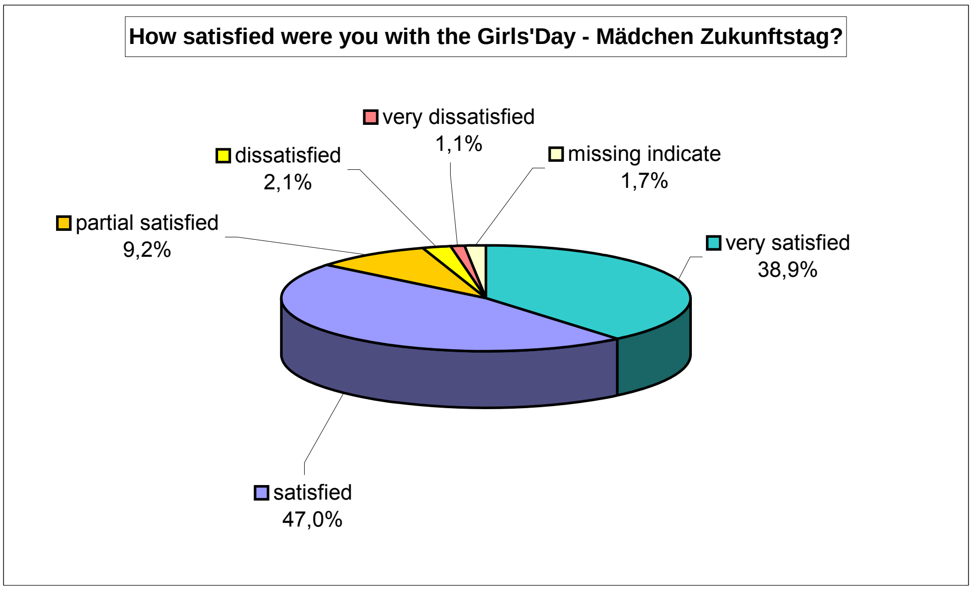


Diagram 5 *Companies and organisations - How satisfied were you? (Nationwide Coordination Office, 2008)*

The companies and organisations get a very positive feedback about Girls'Day. More than 85 percent say that girls showed interest and engagement. More than 74 percent got positive feedback of the employees. In many cases - almost 50 percent – media reported about the activity.

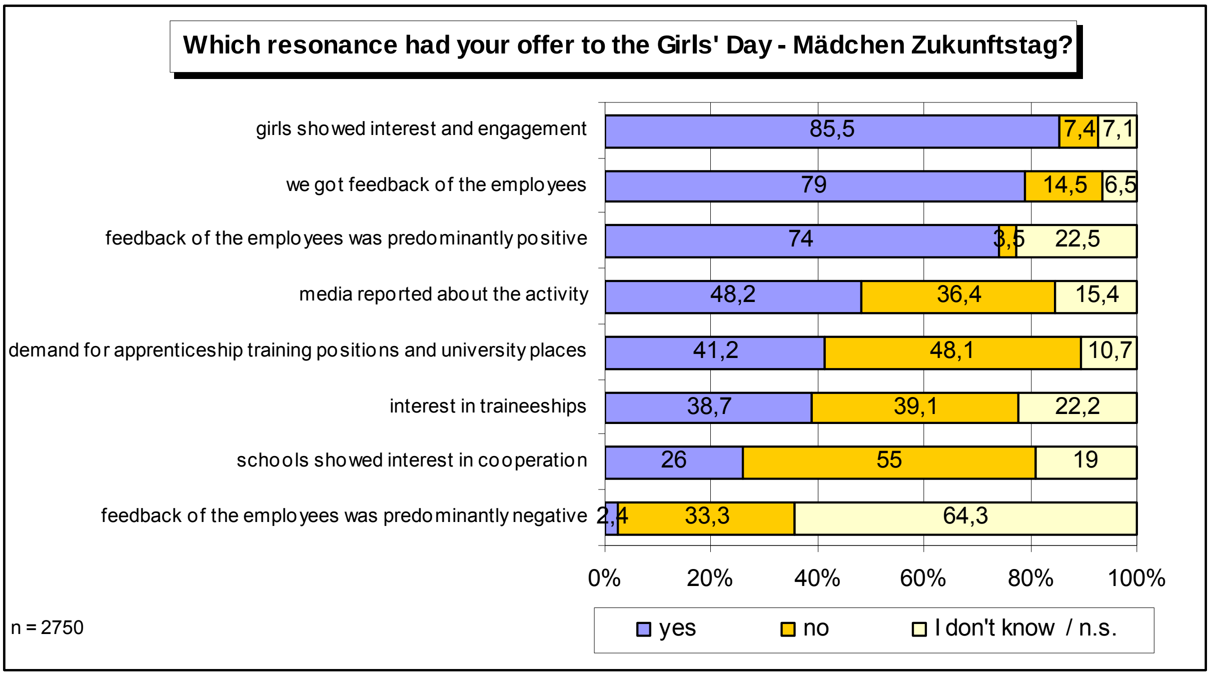


Diagram 6 *Companies and organisations - Which resonance had your offer? (Nationwide Coordination Office, 2008)*

Companies and other institutions do not only engage themselves in bringing girls into technology –related professions on Girls'Day itself. Since 2001, the campaign has become the crucial key event in Germany that is a significant stimulus to the development of support measures for girls. Evaluation results illustrate that companies that have participated several times in the campaign, offer a wider range of gender-sensitive support for girls. Over 50% of the companies that participated at least five times in Girls'Day cooperate with schools. In contrast to that not even one third of the companies participating for the first time in 2008 had such cooperation. (Wentzel, 2008a) The partaking companies and institutions provide a wide-ranging program in order to address girls including cooperation with schools, technology-oriented traineeships and additional public relations. The first participation of companies oftentimes is even the first contact with girls and thus is a novelty to instructors and employees; 86% note that girls were interested and engaged during their activities on Girls'Day (Wentzel, 2008a). That reflects the girls' interest in technology and technology-related fields as well as their wish to explore and follow their skills. Over 90% of the partaking girls note they were satisfied with their Girls'Day activity (Wentzel, 2008b); that shows the campaign's design seems to be aligned adequately to the needs of girls.

The results demonstrate that there is a verifiable exigency to proceed with expanding Girls'Day activities. By establishing offers for girls, companies also make contact with agents involved in the sector of academic and vocational education; hence they establish a valuable basis for sustainable cooperation. That shows that the development of a gender-sensitive recruitment is necessary to achieve a link to the girls' enthusiasm. Therefore companies concentrate more intensely on arranging internships for girls and on gender-sensitive public relations.

Another significant advantage of the campaign is that companies meet potential future apprentices. Over 17% of the companies and institutions receive applications of former Girls'Day participants (Wentzel, 2008a). The campaign is the basis for companies to develop measures that attract girls to technology and design their Girls'Day activities appropriate to them. By representing a diverse and just business culture, companies make a fundamental contribution to a gender-balanced labour-market.

Another good example at federal level is the Bundeskanzleramt (the Federal Chancellery). Girls'Day started on Girls'Day 2003 with special events in the office of the federal chancellor – in the beginning with Gerhard Schröder, since 2005 with Dr. Angela Merkel. The German chancellor welcomes a group of girls every year. In her speech she encourages young women to choose future jobs in science and technology. Several ICT companies, members of the initiative D21 gave practical insight into their work and informed about vocational training.

3.2 Survey Results of schools and teachers

Schools and teachers also are a significant factor of the evaluation. Teachers were asked about their contentment with Girls'Day. Nearly 90 percent are very satisfied, satisfied or at least partly satisfied.

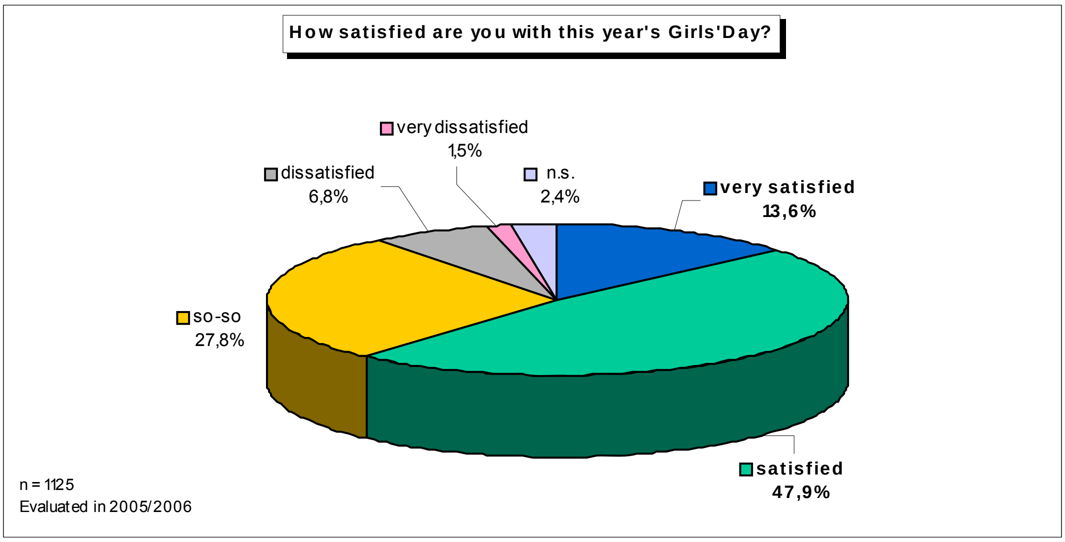


Diagram 7 *Schools – How satisfied were you? (Nationwide Coordination Office 2008)*

What do teachers consider important for vocational orientation of girls in science and technology? Most of them rated cooperation between schools and companies and a different common image of women and technology as important. But also parents' sensitization and more technology-oriented practical trainings were mentioned.

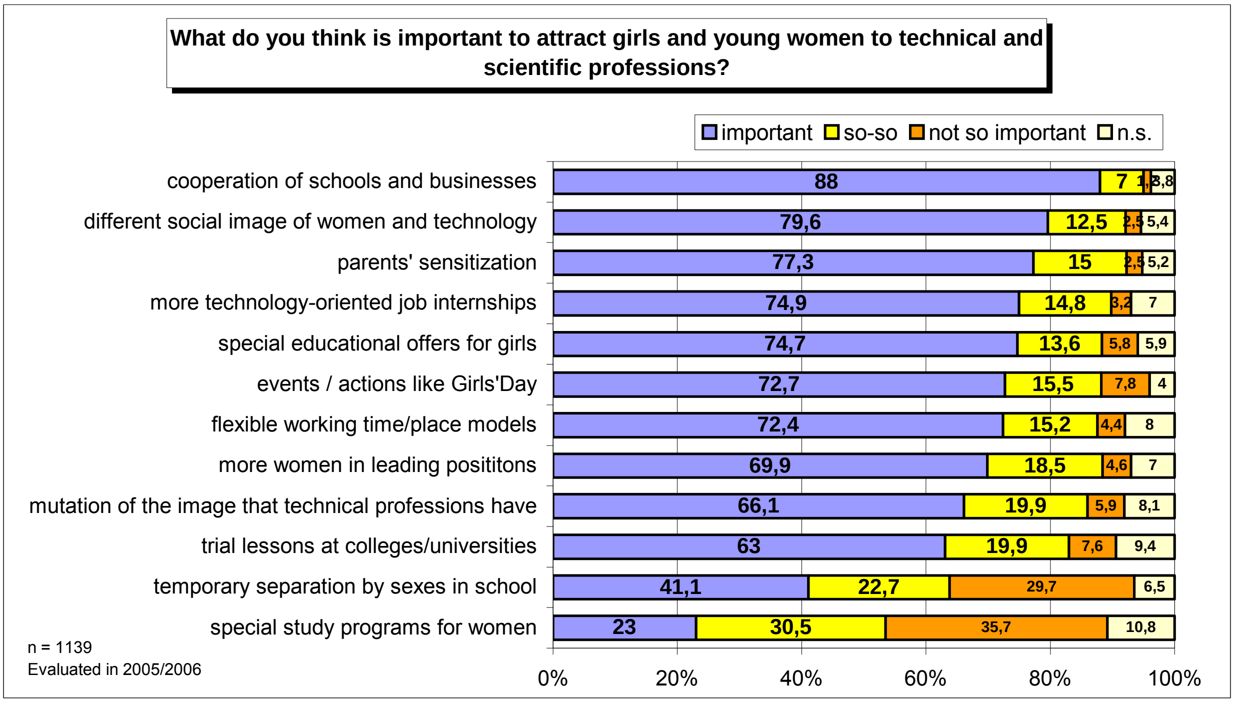


Diagram 8 *Schools - What do you think is important to attract girls and young women to technical and scientific professions? (Nationwide Coordination Office, 2008)*

Asked, what the main factors that influence girls' orientation towards science and technology are, the teachers reported two main aspects. From their point of view, girls do not trust their own capabilities enough and girls do not know enough about these jobs. Girls'Day is to close this gap in information.

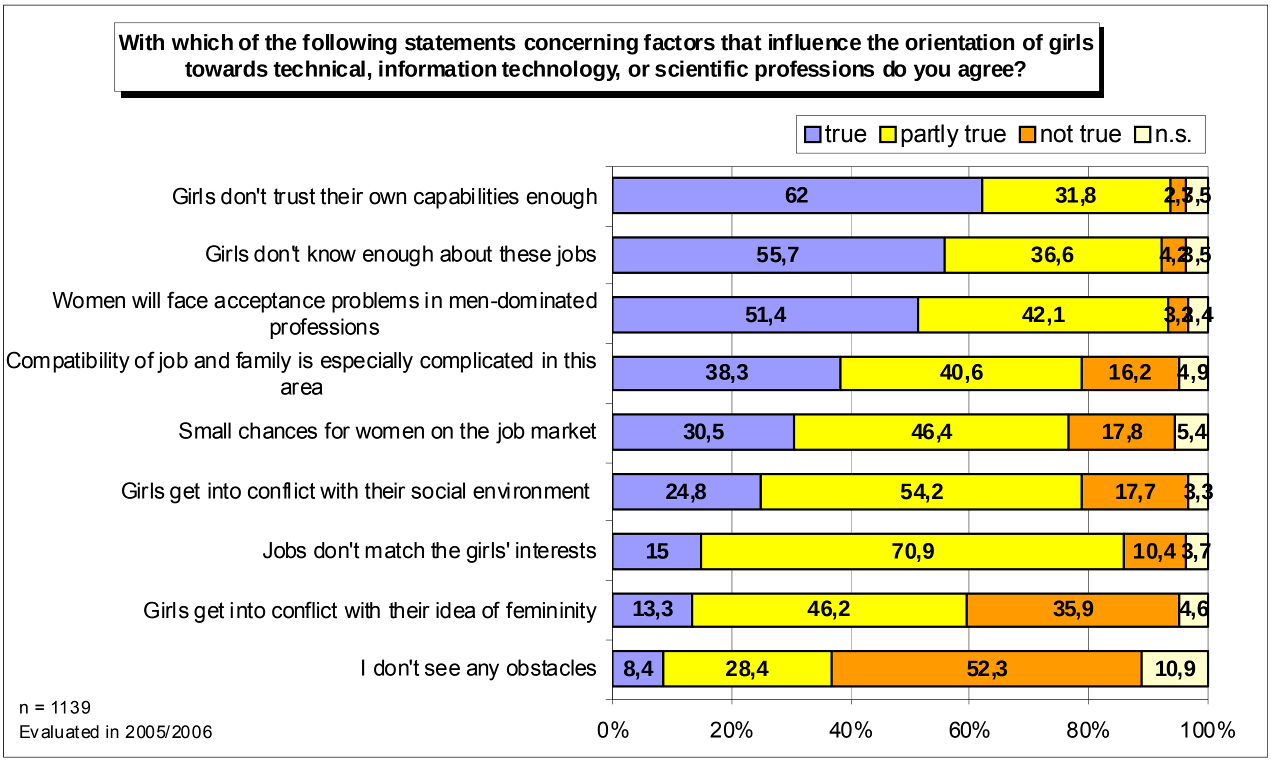


Diagram *9 Schools – With which of the following statements do you agree? (Nationwide Coordination Office, 2008)*

3.3 Survey Results of the Girls

Most of the girls who take part in Girls'Day are between 13 and 15 years old. 13,1 percent are older than 15 years and nearly 20 percent are between 10 and 12 years old. The number of younger girls increased during the campaign. This is very appreciated as age is an important factor in vocational orientation for girls in science and technology.

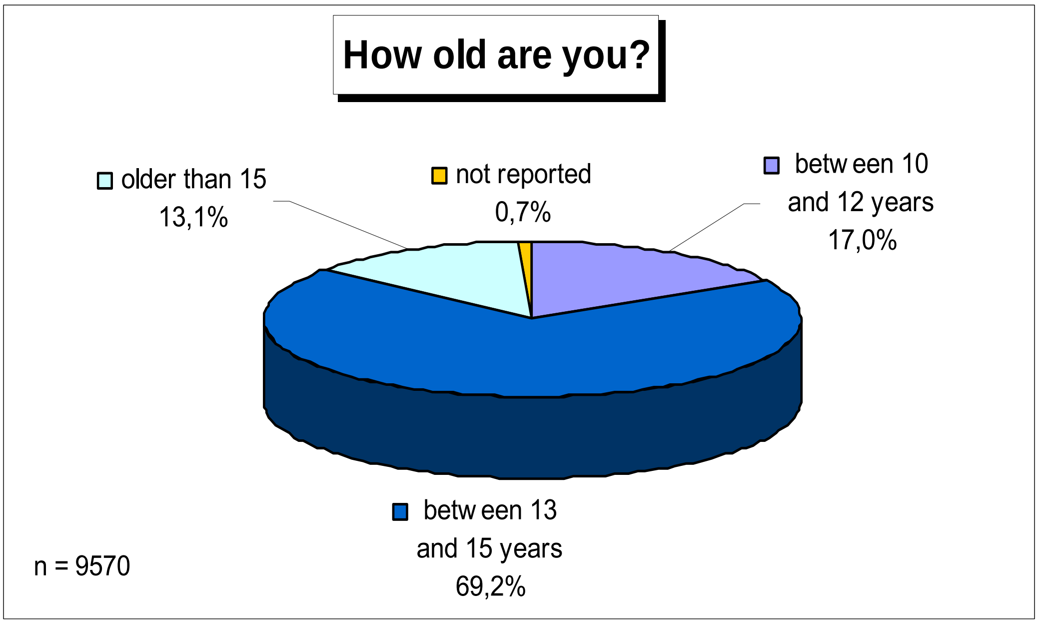


Diagram 10 *Girls – How old are you? (Nationwide Coordination Office, 2008)*

In many cases - more than 30 percent - girls take the initiative to find a Girls'Day event in which they are interested and can take part. Others got help by a friend. A quarter of the matching is arranged by teachers, parents or relatives. This number is decreasing since the campaign started. Girls take their chances increasingly by themselves.

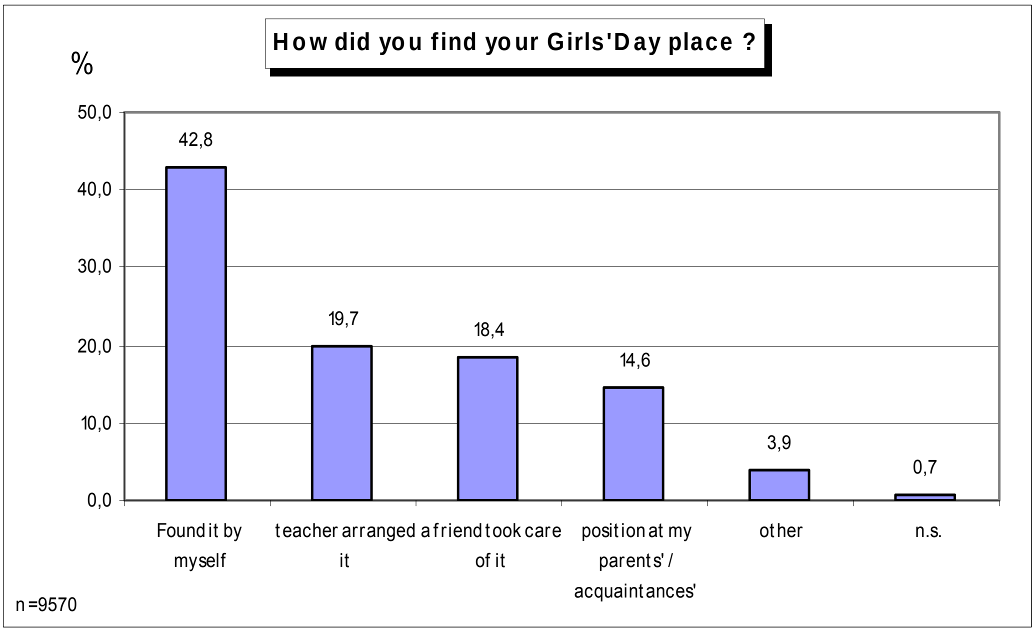


Diagram 11 *Girls – How did you find your Girls'Day place? (Nationwide Coordination Office, 2008)*

The girls' contentment with Girls'Day is very high. More than 90 percent are satisfied or very satisfied.

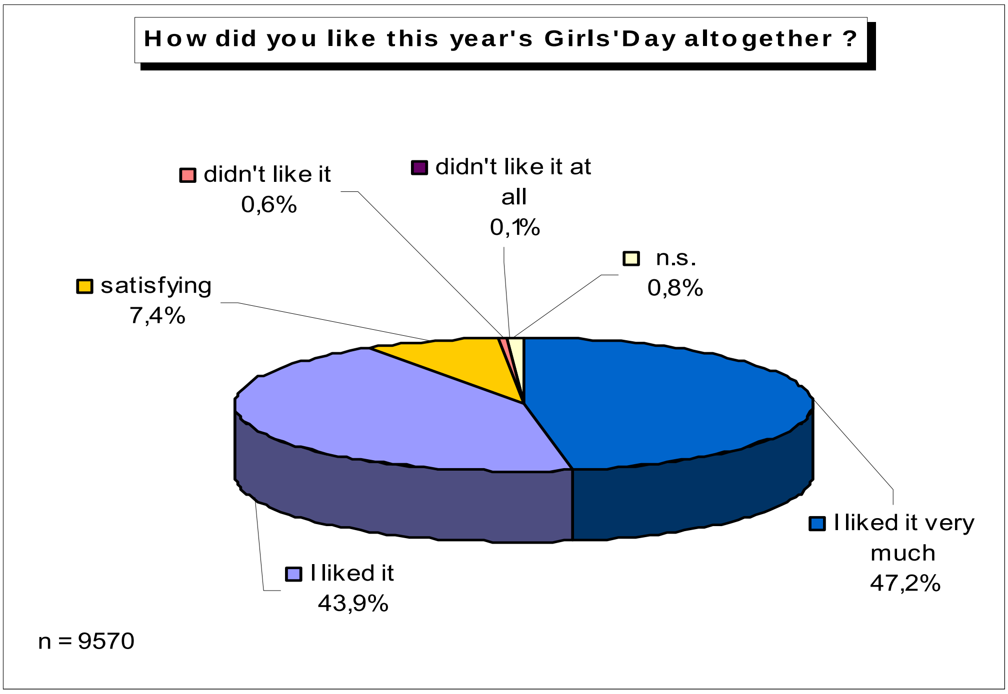


Diagram 12 *Girls – How did you like Girls'Day? (Nationwide Coordination Office, 2008)*

Does Girls'Day encourage young women to tackle jobs previously thought of as male strongholds? What impact does it have on vocational choices and future plans? More than 45 percent of the participants say that they got to know professions they are interested in. Almost 30 percent can imagine to work exactly in the field visited at Girls'Day. Another third still does not know which occupation to choose.

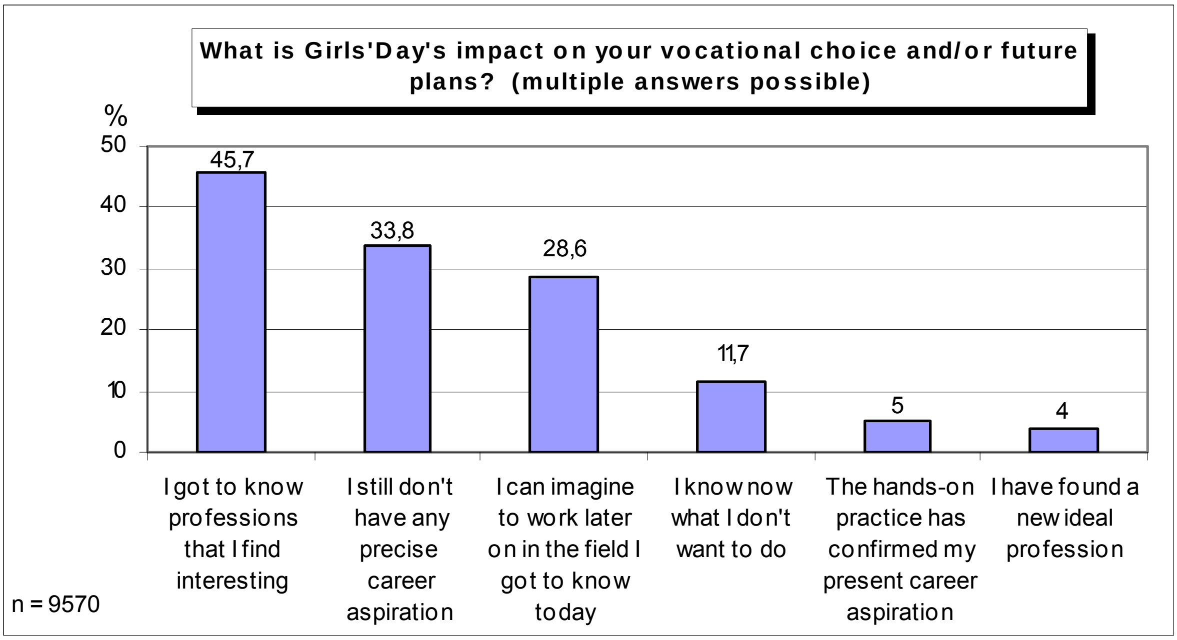


Diagram 13 *Girls – What is Girls'Day's impact on your vocational choice and/or future plans? (Nationwide Coordination Office, 2008)*

More than 36 percent of the girls would like to study or start practical or vocational training at the company, university, research centre, or other organisations they visited at Girls'Day.

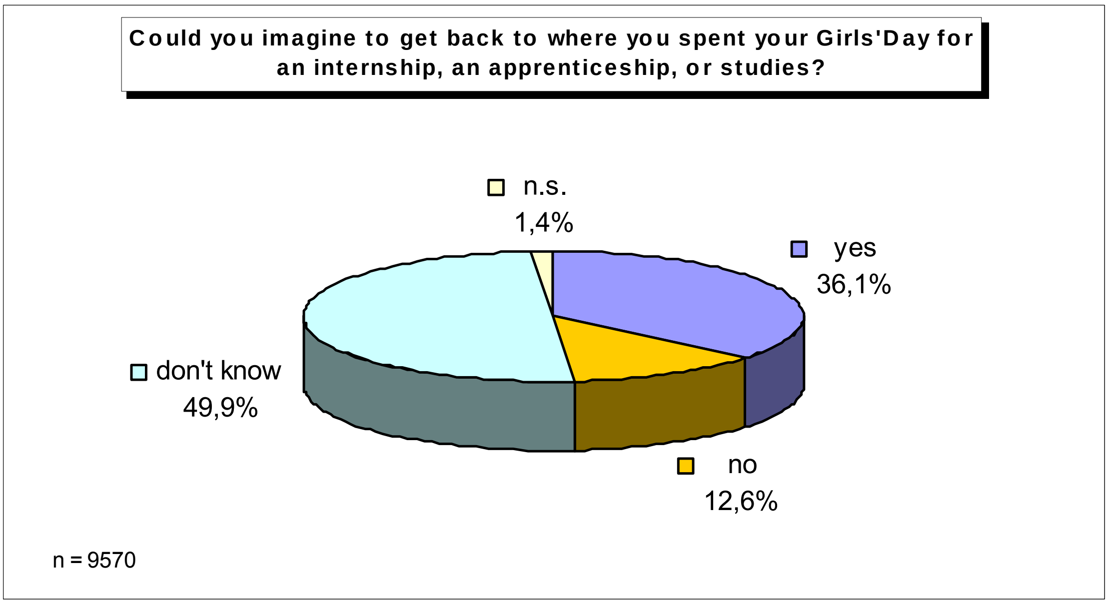


Diagram 14 *Girls – Could you imagine to get back to where you spent your Girls'Day for an internship, an apprenticeship, or studies? (Nationwide Coordination Office, 2008)*

Actually more than a quarter of the companies and organisations report that girls have applied for practical or vocational traineeships because of Girls'Day.

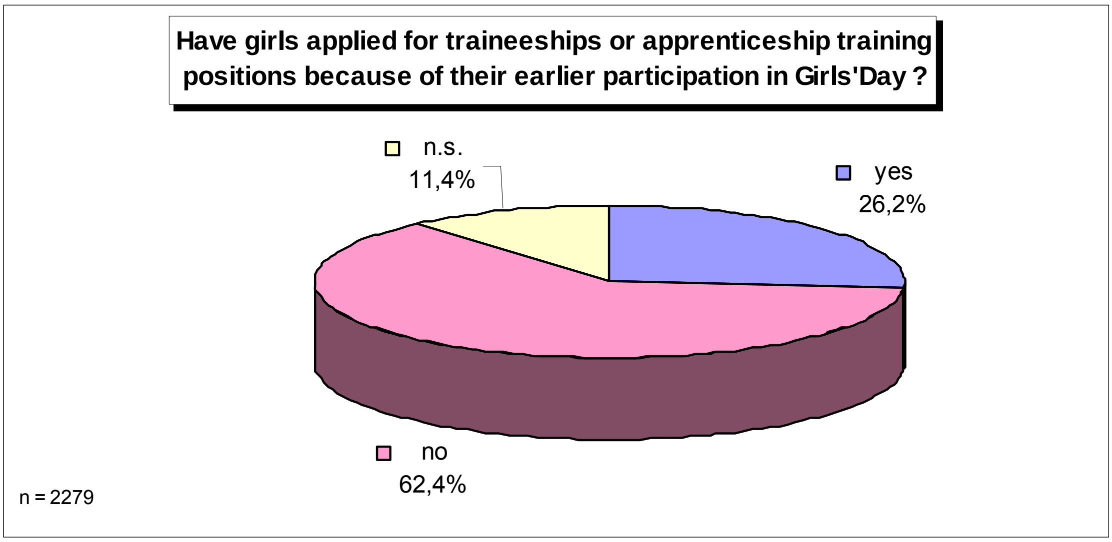


Diagram 15 *Have girls applied for traineeships or apprenticeship training positions because of their earlier participation in Girls'Day? (Nationwide Coordination Office, 2008)*

When asked in which fields they could imagine to work, most of the girls choose arts and design. But the fifth-most common answer is the field of information and communication technologies, in which more than 30 percent would like to work. Multimedia (32 %), science and research (30 %), technology (26 %), crafts (22 %) are also frequently mentioned. More than 20 percent decide in favour of engineering. It is quite amazing how girls express their wide interests when being asked at Girls'Day.

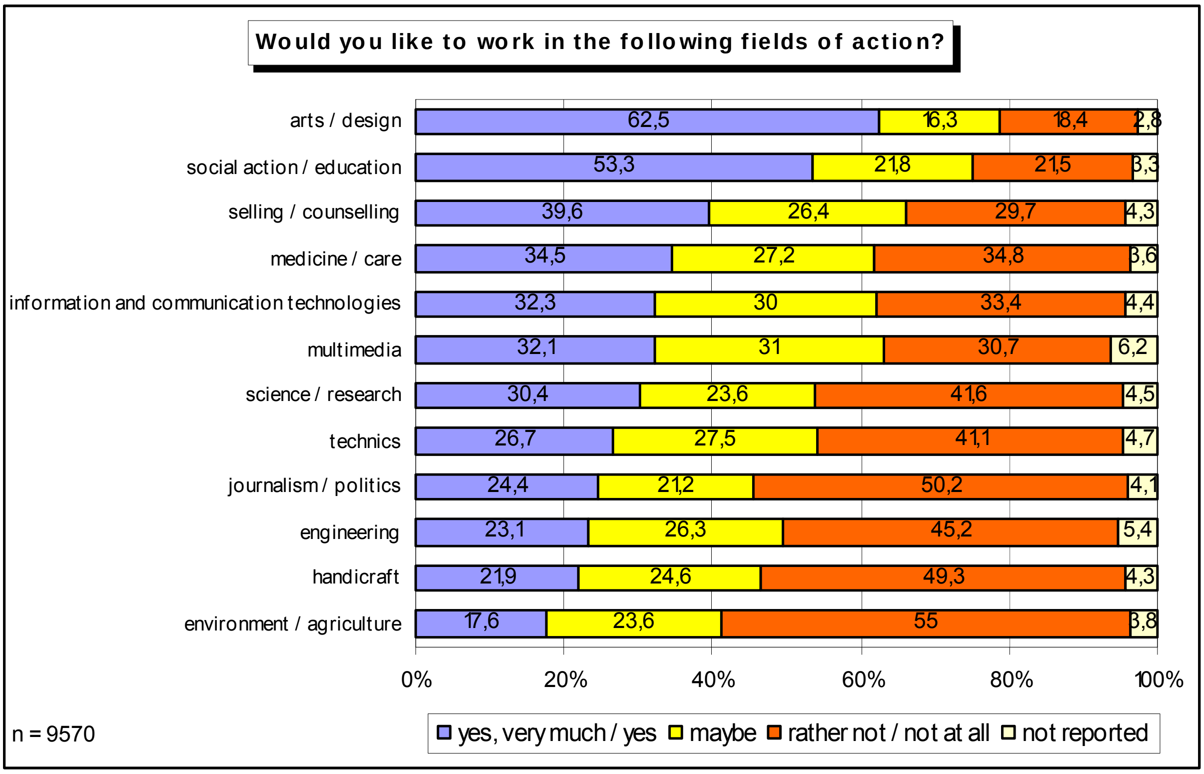


Diagram 16 *Girls – Would you like to work in the following fields of action? (Nationwide Coordination Office, 2008)*

Girls'Day also influences the image of professions in science and technology in a positive way. The girls where asked to which statements about jobs in science and technology they would agree. After Girls'Day nearly 52 percent consider teamwork as very important in these jobs. Almost 45 percent of the girls agree that these jobs offer good career perspectives, only 8 percent regard these jobs as boring.

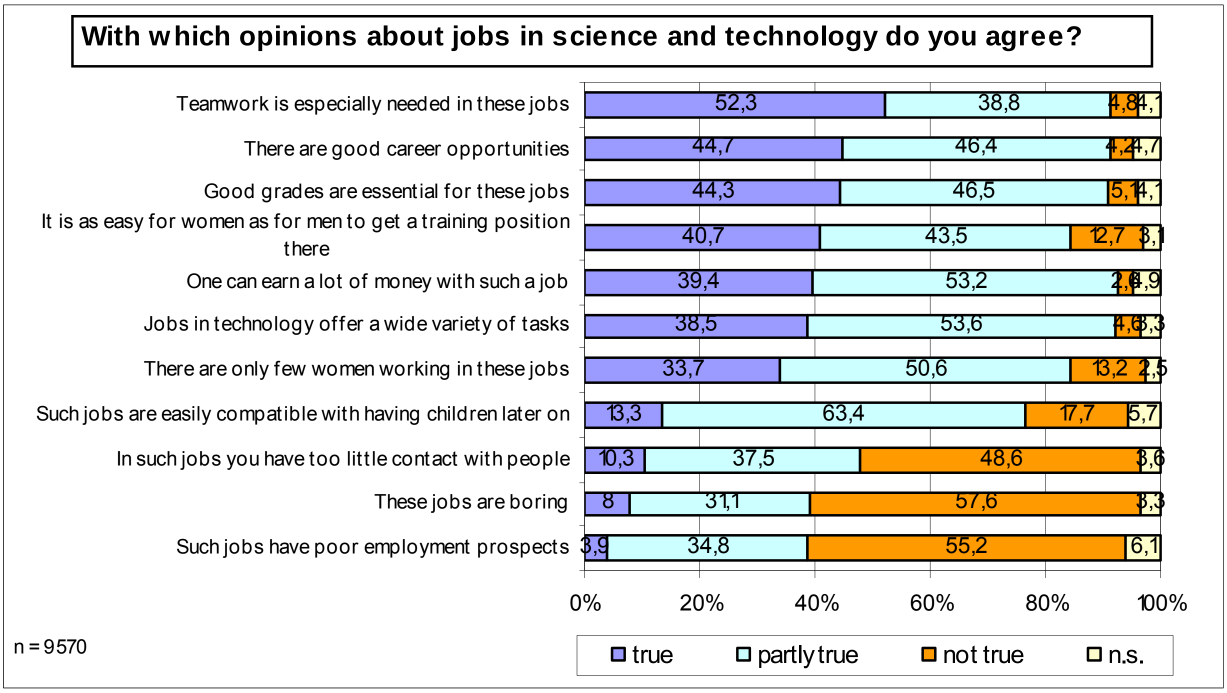


Diagram 17 *Girls – With which opinions about jobs in science and technology do you agree? (Nationwide Coordination Office, 2008)*

4. Conclusion

In order to be in a position to use the experience made during this campaign, the participating girls, teachers and the mentors were polled. In 2008, a total of more than 12.300 questionnaires from 9,570 girls and 2,750 mentors in companies and other organizations were evaluated.

During the last years the concomitant research of Girls'Day has been exceedingly valuable because it demonstrates the campaign's success and benefit. Also mentioned in this context should be the results of the study "Ich will das und das ist mein Weg!" (Wentzel, 2008b) which examines interviews with former Girls'Day participants who are absolving job trainings or degree courses in the field of craft, technology or science. These statements are of value when it comes to the benefit of Girls'Day. They provide evidence that girls *do* opt for technology and science job trainings and degree courses when during the preliminary stages specific conditions are complied. The occupational development of girls is extraordinarily complex and sensitive to environmental factors such as school, teachers, parents, friends and the public in general. The more difficult it is to create initiatives that do not only apply to these challenges, but that also generate a sustainable effect on female job orientation by involving and unifying all those environmental factors.

Primarily responsible for guaranteeing encouragement and promotion of girls are parents, teachers and schools. Girls report that although they achieved good grades in mathematics in school, they were extremely insecured whether they were able to master technical degree courses (Wentzel, 2008b). This respond to the results of many studies: Girls are less self-confident than boys, regarding their achievements in mathematics and nature sciences, even when their actual capabilities are equal (Baumert, 1997; Stürzer, 2003). At this point teachers not only need to be aware that female anxieties can occur, they also have to be prepared when girls face issues of inferiority and insecurity and thus need to develop encouraging strategies that responds to these instabilities.

Another significant factor is the family environment. Girls who succeed in mastering degree courses in the field of science or technology often have parents who appreciate their daughter's skills and respond to her interest with positive feelings (Wentzel, 2008b). It is helpful when parents themselves have a technical background: Girls, whose parents don't have a technical or academic degree, rarely consider to work in this field either (Thum-Kraft, 1991; Wentzel 2008b). Girls'Day also links to the fact that young women orient themselves to get involved in gainful occupation. The campaign and its activities aim at pointing out to all MINT- academics and technical job trainings and degree courses that usually are manned by men. By giving girls the opportunity to test their skills within these fields, girls oftentimes produce interest in new career concepts.

Girls'Day indeed aims at involving sections such as schools, companies and parents, but the sphere of competence shall not influence or restrict the girls individual initiative. This is meant to be a sphere that solely belongs to the girls themselves. Girls report that they rate their Girls'Day activity as "throughout rewarding", as long as they selected it on their own initiative (Wentzel, 2008b).

Another effect of the campaign is that the girls' concepts which they have concerning technical jobs and degree courses, become more positive: they describe technology and science as "fascinating… and creative" (Wentzel, 2008b).

The function of "Girls'Day-Future Prospects for Girls" can be defined as a multi-functional initiative that applies to several aspects. It presents a wide range of opportunities to girls, aligned as encouraging offers, in an appropriate and gender-sensitive way. In doing so, the girls' interest in science, technology and craft can be raised, and in the majority of cases they are enabled to gain new and mostly stimulating experiences. Moreover, Girls'Day activities can help girls to identify their technical skills and find out about strengths they haven't been conscious about before. All in all, new positive experiences oftentimes can function as initial factors to enter technical job fields, prejudices can be dismantled, skills can be strengthened. The evaluation and study results indicate that girls are quite interested in occupations in technology, ICT, natural sciences and crafts, if they are introduced to them appropriately as it happens at Girls'Day. The most valuable result of a Girls'Day participation is that many girls can imagine to undergo a practical training or even start a vocational training as the evaluation illustrates.

Furthermore it can be concluded that Girls'Day meets with a very positive response in Germany by all target groups. Girls'Day – Future Prospects for Girls can have a far-reaching effect on all parties involved in the project. Organisers, institutions and enterprises have the opportunity to gain top personnel resources for the future. The Competence Centre contributes to this development by setting up extensive public relations that guarantee an on-going participation of all parties. In doing so, the service bureau involves companies and initiators in broad public relations, so that companies oftentimes can profit from nationwide public relations for free.

Boys will be on the winning side, too, when they get the possibility to discuss at school about "choice of employment" and about gender bias in professional life.

In 2005, the competence Centre Technology, Diversity and Equal Chances additionally launched the networking project **New Paths for Boys – Expanding Future Opportunities in Work and Family Life** as a nationwide pilot scheme. The project encourages local initiatives to provide special activities, programmes and services for male students, meeting the needs of boys who are experiencing the transition from school to the professional world. Multipliers receive support and benefit from a nationwide network. Models of practice for boy-specific social work aim at holistic support, i.e. at broadening the range of careers from which boys choose in the direction of health care, education and social assistance sector, at rethinking male role models in a more flexible way and at strengthening their social competence.

References

Baumert, J. et al., **1997.**
TIMSS – Mathematisch-Naturwissenschaftlicher Unterricht im internationalen Vergleich - Deskriptive Befunde, Opladen: Leske + Budrich.

Bundesministerium für Bildung und Forschung, 2005.
Erweiterung des Berufswahlspektrums von Mädchen - Girls'Day - Mädchen-Zukunftstag, Berufsbildungsbericht Bundesministerium für Bildung und Forschung, Berlin, 224-225.

Chwalek, D., **2004.**
Heute anders und doch gleich? - Ungelöste Widersprüche in Berufs- und Lebensplanung von Mädchen Doro-Thea Chwalek, Dokumentation der Fachtagung Mädchenwelten heute, Vernetzungsstelle des Nds. Förderprogramms Lebensweltbezogene Mädchenarbeit, Hannover, 69.

Competence Centre Technology, Diversity, Equal Chances.
Girls'Day Publications - http://www.girlsday.de/Girls_Day_Info/Girls_Day_und_mehr/Veroeffentlichungen/Begleitforschung_zum_Girls_Day (July 24th, 2009)

Köhler, U., **2005.**
Girls'Day - Mädchen-Zukunftstag, idee_it: Zwei Projekte des Kompetenzzentrums Frauen in Informationsgesellschaft und Technologie, Naturwissenschaft und Technik - (k)eine Männersache, Aktuelle Studien zur Förderung des weiblichen Nachwuchses in Naturwissenschaft und Technik. 145.

Mellies, S., **2004.**
Der Girls'Day - Mädchen-Zukunftstag - Unternehmen und Organisationen erschließen sich Personalressourcen für die Zukunft. D21 Kongressband 2004: Ideen in Bewegung, Berlin.

Ruffer, C., 2006.
Girls'Day-Future Prospects for Girls, Seoul Women's Foundation, Ed., International Symposium on Development Integrated Empowerment Programs for Female Teenagers, Seoul, Resource Center for Young Women, Seoul, 101-136.

Ruffer, C., **2006.**
Girls'Day - Mädchen-Zukunftstag**,** Computer und Unterricht, 61, 58.

Statistisches Bundesamt, 2009.

Berechnungen Frauen geben Technik neue Impulse e. V., Wiesbaden, June29th 2009, URL: http://www.destatis.de

Statistisches Bundesamt, 2006.

Verdienstabstand zwischen Männern und Frauen März 2006, Wiesbaden, June30th 2009, URL: http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Statistiken/VerdiensteArbeitskosten/ThemenkastenVerdienstabstand,property=file.pdf.

Statistisches Bundesamt 2008.

Fachserie 11, R 4.1, Wiesbaden.

Stürzer, M., 2003.

Geschlechterspezifische Schulleistungen in: STÜRZER, M./ ROISCH, H./ CORNELIßEN, W./ HUNZE,A. 2003: Geschlechterverhältnisse in der Schule, Opladen: Leske + Budrich

Thum-Kraft, M.,1991.

Studienverlauf von Technik-Studentinnen, in: BMUK (Hrsg): Mädchen und Technik, Wien, S. 97-99

Wentzel, W., 2005.

Der Girls'Day - Mädchen-Zukunftstag. Neue Berufsfelder für neue Mädchen, eev-aktuell, 1, 21-23.

Wentzel, W., 2005,

Der Girls'Day - Mädchen-Zukunftstag als Maßnahme zur Erweiterung des geschlechtsspezifischen Berufswahlspektrums, Schule im Gender Mainstream. Denkanstöße - Erfahrungen - Perspektiven. Ministerium für Schule, Jugend und Kinder des Landes Nordrhein-Westfalen und Landesinstitut für Schule Soest, Bielefeld.

Wentzel, W., 2005.

Die Berufsorientierung von Mädchen, 100 Jahre Frauen an deutschen technischen Hochschulen, CD-ROM, Dokumentation des Symposiums an der Universität Karlsruhe.

Wentzel, W., 2005.

Fünf Jahre Girls'Day - Mädchen-Zukunftstag - eine Zwischenbilanz, Zeitschrift für Frauenforschung und Geschlechterstudien, 1, 114-130.

Wentzel, W., **2006.**
Der Girls'Day - Mädchen-Zukunftstag als Maßnahme zur geschlechterbezogenen Berufsorientierung,
Jugendhilfe und Schule, Bielefeld, 173 – 191.

Wentzel, W., 2007.
Die Berufsorientierung in der Altersentwicklung, Zeitschrift für Frauenforschung und Geschlechterstudien, 1, 88-109

Wentzel, W., 2008a.
Forschungsreihe Girls'Day 1, Competence Centre Technology-Diversity- Equal Chances, Bielefeld.

Wentzel, W., **2008b.**
"Ich will das und das ist mein Weg!" - Junge Frauen auf dem Weg in Technikberufe. Qualitative Interviews mit ehemaligen Girls'Day- Teilnehmerinnen in Ausbildung und Studium. Schriftenreihe Band 7, Competence Centre Technology–Diversity-Equal Chances, Bielefeld.

Information about the authors

Endepohls-Ulpe, Martina, Priv.-Doz. Dr.

Psychologist and academic director of the Institute of Psychology at the University of Koblenz-Landau, Campus Koblenz. Social Science Advisor to the Ada-Lovelace-Project and co-editor of the Ada-Lovelace-Project series. Work and research interests include: gender differences, technology education.

Fadjukoff, Päivi, PhD

Head of Planning & Development in the Agora Center of the University of Jyväskylä.
Agora is a co-operative network and an interdisciplinary research environment, emphasizing multidisciplinary, human-centred approach to information technology and to the future knowledge society.

Ikonen, Pasi

Research fellow in teacher education at the University of Jyvaskyla (Finland).

Kristi Paas, MA

Lecturer at the Tallinn University (Estonia). Her key activity is home economics education. Member of IFHE.

Rasinen, Aki Olavi, adjunct professor in technology education, PhD

Lecturer in technology education, Department of Teacher Education, at the University of Jyväskylä
His latest research has concentrated in curriculum development in technology education, gender equality in technology education and learning innovativeness.

Ruffer, Carmen, psychologist

Research fellow in Public Relations of the nationwide coordinating compaign Girls'Day.
Head of Communications Kompetenzzentrum Technik-Diversity-Chancengleichheit e.V. and Girls'Day.
Work areas: media relations, event management, design and planning, advice and information, knowledge management.

Schwarze, Barbara, Prof.

Sociologist and Professor of Gender and Diversity Studies at the University of Applied Sciences in Osnabrück. Member of the Presidium of the Initiative D21, D21-engaged in the topics "Digital Integration" and "digital literacy". Director and strategic advisor to the office Come, MINT. National Pact for women in STEM professions.

Turja, Leena, M.A.

Lecturer at the University of Jyvaskyla (Finland) with a focus on early childhood education. Girls and Technology Coordinator of the project.

Virtanen, Sonja Katriina, M.A., PhD student

Teacher in technology education, Department of Teacher Education, at the University of Jyväskylä. PhD research topic: Girls and Technology.

Wentzel, Wenka, sociologist

Assistant for public relations and networking of Kompetenzzentrum Technik-Diversity-Chancengleichheit e.V. Evaluation of the Girls' Day and future of Boys'Day – Neu Wege für Jungs. Work areas: Social science research, evaluation, gender-specific career guidance, career guidance projects.