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Technology and Design as part of a public school from 1st to 10th grade

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Abstract: *Technology and Design was introduced as a multidisciplinary subject in Norwegian school in the context of the new curriculum in 2006. The topic should be a collaborative effort between the subjects of Science, Arts and Crafts, and Mathematics. In working with Technology and Design students develop a composite competence on product, process and context that we call Technology and Design expertise. There has been, and still remains, challenges associated with practicing the subject Technology and Design. The complex and many-facetted areas of expertise cause teachers within the traditional school subjects to experience the subject as strange, and it's challenging to establish a well-functioning multidisciplinary cooperation. In the desire to contribute to better practices in the subject the National Centre for Science, the National Centre for Mathematics and the National Centre for Arts and Culture in Education have in collaboration with the Oslo and Akershus University College of Applied Sciences developed teaching programmes in Technology and Design. Based on these challenges we will describe one of these teaching schemes and point to the challenges we met and still meet in our work with Technology and Design. Technology and Design expertise is a type of compounded knowledge that is in great demand in the labour market. We believe the subject would be a valuable contribution to the overall design education in primary school.*

Keywords: Technology and Design, Education, Design, Curriculum.

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Introduction

In Norway, Technology and Design as a multidisciplinary subject was introduced into the school curriculum (LK06) in 2006. The curriculum emphasizes that the topic should be practiced as an interdisciplinary cooperation between the subjects of Arts and Crafts, Science and Mathematics. Technology and Design is in today's curriculum (LK06) a separate main topic of science, while design is a main focus in the curriculum of Arts and Crafts. The description says that the subject is a multidisciplinary subject where Arts and Crafts play a big role, and where Mathematics will provide support tools. The introduction of the subject Technology and Design in Norway is part of an international process that has taken place over the last 20-30 years. In most countries, the introduction of technology has been central and design has only been included in a few countries (de Vries 2006).

As a mandatory multidisciplinary subject Technology and Design is a newcomer in the curricula, in Norway as in many other countries. This means that the topic lacks the identity and long tradition of a well-established subject. It has become obvious that one needs a framework and a fundamental idea for the subject in education. It needs to have a separate identity that defines what the topic is and what it involves. De Vries (2006) points out the need to develop a common understanding of the subject. If you get into the situation where neither teachers, teacher trainers nor curriculum developers can answer the question what the subject actually contains or provides, it will have great difficulty surviving.

The situation of Technology and Design in Norway today is the background for the work we describe here. We will describe our idea of the subject of Technology and design. We will also provide a description of the introduction of the new theme, the background for the work and a description of a work in progress in order to implement the multi-disciplinary collaboration across Science, Mathematics and Arts and Crafts. This is based on the understanding of the concepts of Technology and design, the intention of the subject in schools, the contents of today's curriculum as well as learner and society needs. We will present what we believe the subject should contain and point out which learning potentials are inherent in activities within Technology and design.

Describing an actual case of work with electronic communications systems, we will highlight the potential we see in interdisciplinary work for strengthening the work with design in primary school. We consider that Technology and Design has value in its own right and is a special kind of knowledge at the same time as the topic helps to enhance the overall design education.

Technology

Technology comes from the Greek word *techne* usually translated as art (as in carpenter's art), craft or skill. Aristotle distinguished between real-world knowledge, which he called *episteme* and action knowledge which he called *techne* (Hansson 2007). In the term technology, *techne* is joined with *logos*, which means "word" or "reason". *Logos* is also used as a term for all expressions of reason: thought, speech, learning, wisdom, etc. (Aschehoug, Gyldendal 1981). One can thus say that technology is the study, speech or thought of action.

There are several definitions of technology. Here are some examples:

> *Technology is the study and knowledge of the methods and tools used to transform raw materials into finished products. More in general, technology is defined as the application of science to the solution of practical tasks. Technology is the study of techniques and problem solutions"* (Wikipedia 2012).

> *"Technology is methods people have developed to achieve its objectives, work more easily and collaborate better. Technology provides utilities for creating and making things – cultivating soil, weave clothes, build houses, heal illnesses or travel by land, water or in the air*(LK06 2006).

> *The application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment* (Encyclopaedia Britannica online version).

These definitions give a varied picture of what technology is. The Wikipedia definition focuses on technology as the process of transforming raw materials into finished products. The second is taken from the curriculum of the Norwegian "Kunnnskapsløftet" (LK06) (Knowledge Promotion), where the first part of this definition makes technology a nearly all-encompassing subject. In its ultimate consequence it may include non-tangible "innovations" such as democratic elections arrangements or municipal parking regulations. In the second part of this definition, however, the term is more towards technology and utilities. The last of the three definitions associates technology to the application of scientific knowledge for practical purposes. One could say that technology is considered to be applied natural science. But to look at technology purely as applied science provides a very limited and sometimes inaccurate picture of what technology is (Bungum 2003).

Design

Design is an international word and comes from the Latin *designare* means to designate or appoint. It is also translated into the concepts "fabricate" and "image". At the mention of the main topic design in the curriculum for Arts and Crafts the concept of design is associated with design of artefacts and the handicraft tradition.

> *"Design includes both work directly in materials and working with sketches and models. Creation of working drawings, ideas, products, and usage are central. Knowledge of materials, problem solving and production can form the basis for innovation and entrepreneurship"(LK06 2006).*

The concept of design was first introduced in Florence around 1560ad to differentiate between drawing or planning of a product and the execution and production of the product. Today design encompasses both the creative part of the process behind an invention and development of a product (Aakre 2011). The aim is that the product should be both functional and aesthetically pleasing. The term is often used in crafts, industry and art industry, and has traditionally been placed at the intersection of craft and art *(Wikipedia 2012)*. Design involves creation of man-made things in terms of survival, relief and pleasure, sometimes all three things at once. The designer works in the conflict between the practical necessity and aesthetic opportunity (Møllerup 1998).

Design work is characterized by several subjects and disciplines coming together. This means that the term is used in different ways (Lundequist 1992). It can be a verb that means to create; it can be a noun referring to a specific shape. *Design* has become an "in-term" and covers everything from graphic design, designer furniture, designer hair, designer drugs, service design, etc (Nielsen 2009).

Earlier, design was an integral part of other activities and was not identified as a separate activity or linked to an occupational group. Industrial design appeared around 1950 when some practitioners began to use the English term *Industrial Designer* as a professional title. The Scandinavian countries have adopted the term, but there were such professionals until the mid-1970s. Industrial design is a process aimed at two goals:

1. To adapt a new product to the user and the environment
2. To give the product an expression of wholeness and context, individuality and personality.

In recent years the word design has also been adopted by creative professionals to raise awareness of skills and status of the profession. Interest for design is growing and there is a plethora of different directions in the field of design. These are e.g. industrial design, furniture design, interior design, fashion design, product design, web design, m. m. (Michl 2004). These professions are relatively new. The development of new technologies, attitudes and needs brings new design professions develop, such as experience design, interaction design, service design, packaging design and design for all.

In summary we can say that the concepts of "Technology" and "Design", despite their differences, are related and deal with much of the same. Both revolve around developing and creating tools that solve a functional problem to the user. Both build upon a development of the handicraft tradition. Specialists and practitioners in the two professions must apply their knowledge of techniques, materials and shape in order to solve the problem. The school depends on expertise both in Arts and Crafts, Mathematics and Science in order to cover the breadth of the subject matter content.

Introduction of Technology and Design in schools

One mission of the school is to educate and prepare students for the tasks and challenges they will face in life and their career. Teaching shall qualify for productive efforts in work, and provide the basis for later in life to be able enter professions that have not yet been created (LK06). This is nothing new in today's curriculum. In preparation for future professional life the school has since long time offered education in Technology and Design in the form of traditional crafts. The work consisted of textile craft and carpentry, and was aimed at practical benefit and future employment, both from an individual and a public-benefit perspective (Aakre 2005, Brænne 2011). This has been a non-academic, vocational aspect of a traditionally much gendered education. The first time we know of that the term technology was used to refer to a part of vocational education was in 1861. Then technology was proposed as a name for a topic within the Finnish teacher training in carpentry (Kananoja 2006).

In line with the technological development and diffusion of technological products, the need for education changed. The old handicraft subjects no longer reflected the modern society's technology. They gained lower status and problems with recruitment. Therefore, technology in a number of countries has been introduced as a compulsory

subject for all pupils (Bungum 2006b). One of the main goals of technology education is to contribute to the economic development of a country. Technology education was seen as a means to develop knowledge, skills, attitudes and values that make students flexible and adaptive to a future workplace (Pavlova 2006). In the United States, for example, it is argued that technology education is "*vital to human welfare and economic prosperity*" (ITEA, 2006 p. 1).

An important factor in technology education and in all activities related to design or technological development is creativity and ability for problemsolving. Problemsolving is strongly related to innovation, entrepreneurship and economic development (Robinson 2012). Technology education, training in problem solving, and working with design is considered an important tool in a country's technological and economic development (Starkweather 2006).

Technology education is not only justified by the importance of the economic development of the country. Technology skills are part of the general education and society needs a certain level of knowledge amongst the population in order to manage the technological knowledge as good as possible (Pavlova 2006). The general education perspective can be summed up in the English language term "*Technological literacy*". The International Technology Education Association (ITEA) provides the following definition of technological literacy:

> *Technological literacy is the ability to use, manage, assess, and understand technology (ITEA, 2006:7).*

Technology or *Technology and Design* is a newcomer in school context. As we have seen, the concepts of "design" and "technology" also have no clear definition. Together, this leads to the subject Technology and Design showing a high degree of variability, developing a different profile in the individual countries. Some countries put most emphasis on technology as a career preparatory practical subject closely related to the craft traditions. Others place most emphasis on the creative process from idea to finished product (design process). In yet other countries, such as United States, technology is seen as a public educational subject with strong emphasis on awareness of technology and society.

Multiple parallel development prosesses led to Technology and Design being introduced as a multidisciplinary subject in the curriculum in Norway (LK06) in 2006. The different prosesses had different development agenda and argumentation. Below we outline the development of three different processes:

- The need for technology in schools as initiated by engineering and business organisations
- The development of the Arts and Crafts subject
- The need for innovation and entrepreneurship

Technology in schools

In 1996/97, NITO (The Norwegian Society of Engineers and Technologists) established a primary school project Technology in schools. The project was established with contributions from industryorganizations, The Research Council of Norway, NHO (The Confederation of Norwegian Enterprise), Ministry of Education and Research and educational institutions (Smith 2007). The reasoning was, among other things (ibid):

> *Technology makes up an increasingly large part of our daily life, and today's technology is so advanced that many feel alienated from it. It is therefore important to increase the knowledge about everyday technology. At the same time it turns out to be necessary and useful to create a better understanding of the relationship between technology and natural sciences. Mathematical, scientific and technological expertise are key factors for future value creation and employment. Therefore, technology should be included as part of general education.*

The project was inspired especially from the English subject Design & Technology that had been compulsory since 1991. It was also in liaison with Sweden, which had Teknik on the curriculum as a separate subject from 1994.

In working with the new curriculum in 2006 it was proposed to create a new subject from 1st to 10th grade. However, this proposal did not receive support. Instead a solution was chosen in which Technology and Design was introduced into the Norwegian primary school as a new multi-disciplinary course (Aakre 2011).

NITOs motivation for getting involved in a project for technology in schools was the concern for the future value creation and employment. The recruitment for studies in the field of science and technology was declining and it was expected that introduction of Technology and Design in schools would improve this. The ministry and the Norwegian Parliament pursued this line of argument. A key argument for the introduction of Technology and Design was that it would serve as a research tool, which would help improve learning in Mathematics and Science and improve recruitment to technological studies. The subject's educational character was pointed out, but the strengthening of science subjects and better recruitment of science and technological studies were evident in the front line of argument.

Development of the Arts and Crafts subject

The technological development also has also impacted the Arts and Crafts subject. The rapid developments in ICT led to a reinforced and clearer appreciation that the subject should be revised. For the Arts and Crafts subject, two lines of development in particular prompted work with Technology and design.

Increased focus on design and architecture

Over several decades an *increased focus on design and architecture* had evolved. We find e.g. architecture and architectural related topics in the “Normalplanen av 1939” in study of local history and lore (the Ministry of Church Affairs and Education in 1965), and the plan from 1974 (the Ministry of Church Affairs and education 1974). In the 1990s, architecture was more strongly emphasised with the introduction of Arts and Crafts (Ministry of Church Affairs, Education and Research, 1996) (Fauske 2009). This was further reinforced with LK06 when both architecture and design became independent main topics in Arts and Crafts (Ministry of Education 2006).

Work with practical skills

Another development line stretching all the way back to the subject's origin is *the development of practical skills*. “Before the various handicraft subjects entered in the public school in 1889, the home was the main provider of practical training for children. Crafts were part of the work in the home. The kids got to learn working skills through

participation in family self-sufficiency and in some cases even in homebased industry" (Nielsen 2009). "The introduction of the subject in school was characterised by utility value and importance of developing practical skills for practical life." (Nielsen 2009). Developing good working habits, accuracy and diligence, eye-to-hand coordination as well as knowledge of the materials and tools were important elements of the work, although various trends have characterised the long-term development of the Arts and Crafts profession we see today.

One factor that may have had an impact on the introduction of Technology and Design is the change of the name of the subject from Forming to Arts and Crafts in 1997 (KUF 1997). Although art as experienced by many is far removed from the technological developments which have taken place, the name change of the subject from Forming to the Arts and Craft opened for a wider understanding of the subject, and has thus given room for a greater diversity in ways of expression, topics, techniques, and ways of working.

The need for innovation and entrepreneurship

The Technology Council also worked to strengthen technology in schools with the following starting point:

> *Norwegian youth is growing up in a high-tech society, but technology is not very visible on the school agenda. The school should provide an understanding of and experience with the development of technology to show that the technological products and systems are created by people who make conscious choices within the given contexts. This can stimulate students to appear curious, creative and critical towards technology* (Technology Council 2004: 1).

An important starting point for working with the new curriculum in 2006 was the Quality Committee's report "Quality first and foremost. Enhanced quality in a basic training for all" (NOU 2003: 16). The report recommends the introduction of Technology and Design as a separate subject at secondary level reasoning with the need for an innovative and creative youth. The report says, among other things:

> *The training system has a particular responsibility to promote young people's ability to think creatively and innovatively. Not to mention that innovation through the use of technology will be a requirement for future workers. In this case, the course content and organisation reflect these requirements.*

The same perspective appears in the Parliament white paper (Stortingsmelding No. 30, Kultur for Læring) where it is emphasised that the most important factors we have in society is no longer the capital, buildings and equipment, but the people and their knowledge, skills and attitudes (UFD).

Work today

An essential prerequisite for establishing good practice in a new topic is that teachers have an understanding of what the topic should include and the belief that it can contribute to valuable learning for students. Well-established school subjects have a long tradition to build upon, both in terms of content and justification for the subject. Those teaching the subject are socialised into the profession for many years, partly through own education and professional life, and know this subject. They have a

reasonably common understanding of the subject and an understanding why exactly this content has been selected as part of the general education. A new topic in the school such as a Technology and Design must create its own content and establish a common understanding of its didactics. Subject didactics deals with the considerations behind the selection and structuring of content, building a bridge between education and pedagogy.

What is Technology and Design as a school subject?

Earlier, we discussed the concepts of "*technology*" and "*design*", their basis and how they are being interpreted today. Both terms can be associated with craft tradition and describes the function and form of objects that surround us. But what is "*Technology and design*" as a school subject, and what capabilities do we want students to develop through working with this subject?

Technology and Design expertise

The goal of technology is to develop products or utilities to solve practical problems (Sjøberg 2009). The same objective applies to working with design. "Technological literacy" means to *be able to act*, *create* and *produce something* and *use*, *evaluate* and *understand* technology. The purpose of all technological operations are to expand human opportunities to satisfy needs and wants, solve practical problems or function as expression of creativity and artistic urge. To get the product to work or solve a practical problem it is necessary to draw upon knowledge and expertise from different disciplines. We have, according to a model from Sjøberg, divided Technology and Design skills into three different *dimensions*. These are *products* and knowledge about their behaviour, *processes* with methods and ways of working, and finally the societal *context*.

PRODUCT

Characteristics of technological and design products are that they have a function and they have been given a physical form or structure. The physical structure has been designed, produced and used by people to meet a need and realise a function. Knowledge about a technological product consists of knowledge both of physical form and function.

Knowledge of the physical design of a product includes knowledge about assembling items, techniques and materials. One must e.g. decide whether to use gluing, soldering, welding or screws to assemble the product. Should it be a casting or woodwork, be light or heavy? All of these choices must be based on knowledge of the physical shape of the product, but also on the use of the product.

A technological product cannot be described from the physical design without also including the function the product shall fulfil (Kroes 2002). Product knowledge includes understanding function in view of design. Thus we understand that a pitcher can be filled up with something and that the handle is to carry it around. We also realise that we get light when we press a light switch if it's designed the right way.

PROCESS AND METHOD

The design process is central to Technology and Design and is about transforming an idea or a task into a concrete and physical product. The end result may be in the form of a prototype, a model, a description or drawing. Knowledge of process and method encompasses the choices you make in the process of solving the functional

problem, it be technical solutions, design, working techniques and choice of materials. You must have sufficient knowledge and skills to make choices in a good way. Or use existing skills and apply them in a novel way. This can be illustrated by the story of how Jac. Jacobsen designed the famed Luxo-1 lamp. Ordinarily, he produced the textile machinery in Oslo when he in 1937 received a box of equipment for sewing machines. In one of the boxes were two crane-like spring balanced armatures. Jacobsen had good knowledge of process and method and thus was able to fabricate and develop a brand new lamp with new functional solutions. The Luxo-1 lamp was so successful that it became a big international seller and has since inspired other technological products. In 2012, the original Luxo-1 lamp was re-launched as a 75th anniversary celebration of what has been perhaps one of Norway's most internationally renowned design icons and today also has become part of the film company Pixars logo.

CONTEXT

Technology and technological development has great significance for our social structure and way of life. Technology plays a major role in economic development and has a number of consequences for our society. The starting point for technological development is to resolve a functional problem, but this development is in a societal context and often has consequences beyond resolving the problem as such. For example, the introduction of machines for spinning and weaving during the industrial revolution had major consequences for development of other mechanical industry, transport, settlement, population density, economic development, social structures, etc.

A core part of the Technology and Design expertise is also to know the consequences of the technological development. There will always be a trade-off between what is practical and what is socially desirable. In addition, new ethical discussions and positions are raised. This includes, for example, environmental impact and pollution. We have now become more aware of the harmful effects of some kinds of production, e.g. textile production. And we have gained insight into how our ever-increasing production and consumption impacts energy use, global warming and climate change.

VARIOUS FORMS OF KNOWLEDGE

The three dimensions in which we can view Technology and Design skills are all based on compounded knowledge. In the following we call this knowledge of action.

In his time Aristotle also spoke about several types of knowledge that can be linked to action. These forms of knowledge, as we see it, both complement each other and overlap. Aristotle emphasized the types of knowledge by giving them separate names as for instance: Khrêsis, Praxis and Pathos (Eikeland 2006). Aristotle's forms of knowledge are necessary and relevant in Technology and Design, and we use the forms of knowledge more or less consciously in our daily chores. We highlight four knowledge forms related to concrete issues in Technology and Design and give a short description:

Khrêsis, or usage skill, is being able to use different tools, know the names of similar tools and know when they should be used.

Poíêsis comprises the knowledge of various types of materials, being aware of properties and uses of the materials, how they behave and how they can be processed and joined together. In order to form a material one should be able to use various tools. Here the Poíêsis knowledge overlaps Khrêsis.

Episteme in Greek means "to know". This is knowledge how to acquire various theories such as reading facts. Epistemic knowledge is a direct form of knowledge and could be described as theories of one thing or another. Such knowledge may be stored and transferred from one person to another. Episteme in many contexts can be translated as knowledge of understanding or scientific knowledge, i.e. the true knowledge about the world.

Praxis or performer and competitor knowledge is knowledge that is the result of training at something over and over again to be a knowledgeable and good performer. The skill lies in the ability to practice. When both techniques and skills are rehearsed and practiced several times, the skill becomes more and more automated.

The forms of knowledge we have described here, are all essential in varying degrees and at different times in the different work phases in Technology and Design. A goal must be that the school helps students develop multi-faceted and versatile Technology and Design expertise. This means that students both acquire a degree of knowledge of action and that they gain knowledge of technological products and their behaviour. Furthermore that they are trained in problem-solving and design processes and that they are given an insight into the social contexts of these.

We summarise the Technology and Design skills in the following manner:

- be able to develop utilities which fix an issue or cover a specific need
- be able to translate a functional problem into a concrete, physical and practical solution (design process)
- be able to apply materials, behaviour, mechanisms, tools, techniques, etc. which are needed in order to obtain something to work well
- meet the functional requirements without too many side effects and with the required safety for the user
- be able to assess societal context and consequences

Technology and Design as a multidisciplinary subject – Challenges in the face of traditional academic cultures.

We have seen above the broad and complex skills we desire students to develop through working with Technology and design. Technology and Design expertise is complex and multidisciplinary in nature. Through LK06 the school has solved this by introducing Technology and Design as a multidisciplinary subject integrated into the subjects of Science, Arts and Crafts, and Mathematics. It is not necessarily a clear correlation between Technology and Design expertise and the contents of the three subjects which have been given responsibility for the multi-disciplinary subject.

Arts and Crafts teachers are familiar with much of the knowledge of action we have named Technology and Design knowledge. But they have little experience with behaviour and mechanisms related to e.g. transmission and electricity and feel unfamiliar with the concept of "technology". Engineering organisations have been key drivers to introducing technology into the school, and in this context the Arts and Crafts subject does not have experience as a key player. Engineers and artists/designers have probably also different cultures and approach product development in different ways.

Science and Mathematics are absolutely central subjects as the basis for technological education. But traditionally technology had no place in the school's science subjects and therefore involves new subject material. Teachers have primarily education in a scientific tradition and therefore have little experience with technological principles. One cannot expect the science teachers to be familiar with the practical use of materials and tools. Science and Mathematics has been an important basis for technology subjects, but not vice versa. Technological principles have to little extent been part of the basic science or mathematics education. Thus, both science and mathematics teachers will be largely alien to the compounded and practical Technology and Design expertise.

Development of teaching programmes in Technology and Design

It is obviously challenging when different cultures work together to introduce a whole new range of knowledge. This was the motivation for collaboration between the three National Centres; for Art and Culture, for Science, for Maths, and the Oslo and Akershus University College of Applied Sciences, where the authors took part from the beginning. The partnership was established in 2008. The intention of the collaboration was to develop cross-disciplinary teaching programmes in technology and design, and to facilitate a real, practical, interdisciplinary cooperation in Technology and design, where each discipline is represented by its academic content and its traditions and values.

In this collaboration teaching material for the various competence goals of Technology and Design in the science plan has been developed and tried out. These have been coupled with appropriate competence goals of Mathematics and Arts and Crafts. The aim has been to develop programmes that build on each other and lead to progress in the development of Technology and Design expertise, with the intention that the projects should be included as part of the regular school subjects and so contribute to academic learning. For more information on these training schemes, see The Science Centre's (Naturfagsenteret) website, the Science Centre's magazine "Naturfag", and the blog of the National Center of Art and Culture in Education. One of our projects in the multidisciplinary cooperation, related to electronic communication systems, was employed as a tutorial in Science, Technology and Design at 10th stage.

Goals for the tutorial are that the student should be able to:

- Account for an electronic communications system at the system level and discuss societal challenges related to the use of such (Science)
- Design products based on specifications for form and function (Arts and Crafts)
- Describe the various solution options in the design of a product using sketches and computer software (Arts and Crafts)

Most teachers experience the competence goal regarding electronic communication systems as difficult, and that has been the background for developing and piloting this educational program.

The educational program was tested at Alværn comprehensive school, 7th to 9th November and 2nd December 2011. The students were introduced to various topics and issues in Technology and Design and in electronic communication systems. This included:

- What is an electronic communications system
- How does an electronic communications system work, what are the consequences for the environment, sustainable development and value creation
- Design and concept development
- Introduction and drawing in GIMP
- Presentation of the development of digital presentations and brochures

The students designed a three-part folder containing narrative text, facts and digital artwork for their product, a future mobile communications device, in addition to the digital description of the network map. The students delivered a presentation of their work, with assessment, at the project days at Alværn comprehensive school.

Through the project, we found that there was a lot new material for the students to relate to. Students had no notion of the concept of specifications and were unsure of its contents. They did not have sufficient drawing skills nor sufficient experience with the drawing program used. In addition, all knowledge of communications systems and networks was new to them and had to be communicated during the project period. The result was that there was too much new information for the learner to deal with. The project should have been better placed in a learning chain of systematic preparation in the subjects, particularly science and arts and crafts. Students should have been introduced to parts of the material earlier. Then the students could have concentrated on the product they were designing - namely, the new communications equipment. And we could have challenged them to go further and possibly experiment with new forms.

Our experience shows that the project has great potential to integrate various aspects of a topic that is important in today's society. We will continue to work to improve the program and try it out.

Summary

Technology and Design has existed as a subject in schools only since the introduction of the Knowledge Promotion in 2006. The intention of the topic was to give students experience from our technological world and strengthen the work of design and problem solving in school. Also the students should gain experience in exploiting knowledge in Science and Mathematics in a practical context.

In working with Technology and Design you apply knowledge and skills from multiple disciplines and areas of expertise. We speak of the compounded expertise that is developed for competence of action. This type of combined knowledge is in great demand in the labour market.

There has been, and still are, challenges associated with the practice of the subject Technology and Design. The complex and many-facetted areas of expertise cause teachers within the traditional school subjects to experience the subject as strange, and it's challenging to establish a well-functioning multidisciplinary cooperation. Still we strongly believe that there is a large unexploited potential for developing valuable skills through multidisciplinary collaboration in Technology and Design. And the topic will be a valuable contribution to the overall design education in the primary school.

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