TECHNOLOGICAL LITERACY – WHAT IS THAT?

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ABSTRACT

What should be included in technological literacy for pupils within compulsory school? What kind of abilities do we think it should be possible for our pupils to acquire, so that they can live in this quickly changing world, which requires man to be flexible and able to adjust to new situations, at the same time as he also has to be able to create meaning in these unstable times? In this paper, I try to elaborate my view as to what technological literacy in compulsory school could be like. By way of introduction, I describe an example derived from the practice at school. On the basis of this example, I proceed to a discussion concerning what content and working methods are proper to technology as a school subject, where I will also touch upon the abilities and qualifications that the suggested working method might grant to pupils.

1. INTRODUCTION

The somewhat incredible technological development that has taken place during the last century has provided us with an enormous amount of new facts and data. A consequence of this sudden increase in our stock of knowledge is that today, the amount of information available to us is so great that it is impossible for any single individual to get a grip of it all. This is no less true of the total amount of knowledge pertaining to the field of technology. For this reason, a discussion has arisen as to what kind of knowledge should be selected in order for pupils within compulsory school to get a liberal education in technology. The general debate concerning learning and knowledge that has taken place over the last decades has centred on the ability to handle information, whereas one earlier tended to focus on the ability to remember information. The ability to handle and classify information, to draw conclusions as well as to perceive relations and therewith to create meaning, is regarded as central, as well as of promoting a competence that will make one able to deal with different kinds of situations in the future (SOU 1994:92; Risberg & Madsén, 1997). But what does this mean specifically for technology as a school subject? What should be included in a liberal education in technology? What kind of abilities do we think it should be possible for our pupils to acquire, so that they can live in this quickly changing world, which requires man to be flexible and able to adjust to new situations, at the same time as he also has to be able to create meaning in these unstable times? In this paper, I try to elaborate my view as to what a technological literacy, or as I would like to say teknisk bildning, in compulsory school could be like. Teknisk bildning and technological literacy is not quite the same. The Swedish word bildning is equivalent to bildung in German or dannelse in Danish, but there is no exact translation in English. The inner core of bildning lies in the nature of knowledge and understanding. Bildning can be looked upon as a free activity where the individual develops in a life long learning process. It gives a sense of meaning, of being part of a bigger context. Teknisk bildning is a way of "living technology" rather than learning about it.

By way of introduction, I describe an example derived from the practice at school. On the basis of this example, I proceed to a discussion concerning what content and working

methods are proper to technology as a school subject, where I will also touch upon the abilities and qualifications that the suggested working method might grant to pupils.

2. AN EXAMPLE FROM SCHOOL PRACTICE

The example concerns sixth grade (100 twelve-year old pupils in 4 classes) and shows how a projected change in the local environment is used as basic material in a project within the education in technology. The project was going on during a period of six weeks and was under that time documented. The collection of data consists in observations, video recordings, documentation in the form of teachers' diaries as well as pupil's work, taped interviews with pupils and interviews with the teachers after the project was finished.

The background is that the local authorities planned to build a high-rise building in the vicinity of the school, which would change the scenery of the landscape. Various architect's offices had delivered their proposals in the form of sketches and models, which at the time of the beginning of the project were put on display in the lobby at the District council office. The papers were full of articles and letters to the editor devoted to the issue in question, regarding the exterior and structure of the projected house as well as its expected effects on nature. The different articles were used by the pupils at the beginning of the project, in order for them to get acquainted with the current issue. In what follows, I describe how the project was carried through.

2.1. Formulating the Assignment

The assignment was worked out together with the pupils of each class after they had acquainted themselves with the different articles, the letters to the editor and the proposals for a new high-rise building delivered by the architect's offices. The assignment was: Design your own version of a high-rise building.

During this phase of the work, the pupils had the opportunity to develop an interest in the assignment by asking questions, noting similarities and dissimilarities between the different suggested solutions, as well as by discussing and arguing for their respective standpoints and in virtue of being open to the views of others.

2.2. Analysis

The work began with a visit to the site of the projected building, and at this stage one also studied the surrounding buildings with respect to their history and design, as well as reflected upon what consequences the erection of a new high-rise building would bring with it as regards man's way of living, traffic problems, interventions in nature, etc. Among other things, one made a study on the traffic situation. Moreover, the pupils watched a film on house design from different epochs, and the film also touched upon modern house design with respect to the aspects of solidity, building-material and aesthetics. The film showing was followed by a guided tour in the city of Stockholm conducted by staff from the Swedish Museum of Architecture. Three technical systems connected with the building were examined (namely, water and drainage, electricity at home and waste management). The pupils could choose one of them and with help of questions that the teachers had made they seek information from different sources.

During this phase of the work, the pupils had the opportunity to develop their capacity to seek information from different sources, observe relations, and to acquire knowledge about different systems in the buildings as well as about different concepts, etc.

2.3. Construction/Visualization

The pupils were divided into groups with two, three or four pupils in each group. At first, they tried on their own to make outlines of their versions of the house. This occurred after the teacher had given an exposition of sketch technique regarding the features of perspective, scale, front-, above- and side-view of the building. The work on the model was conditioned by: the material at hand, the scale of the model, etc. The content of the technical report (documentation), of the presentation and of the evaluation was settled, together with a general time-table for the project.

The groups began drawing up different suggestions for solutions in order eventually to be able to choose the most appropriate one.

When working on their sketches, the pupils had the opportunity to develop, among other things, their creative powers and drawing skills, as well as their capacity to present and evaluate different ideas, etc.

The models were constructed after the previously finished sketches had been discussed and revised within the groups. The pupils were also briefed on different materials and how to fasten things together.

When working on the models, the pupils had the opportunity to develop their capacity to make use of technical principles and appropriate tools, to choose and use suitable material for the model, to make use of scale and to construe models.

When the work was finished, the pupils could simulate the townscape with the help of PhotoShop and with the group model fitted into it. Each pupil also got to document the finished work in the form of a technical report. The report included sketches, pictures of the finished model, a description of the working method, a description of the chosen technical system and history of the building one self lived in, as well as personal reflections on the project.

When working on the technical report, the pupils had the opportunity to develop their capacity to sort out, structure, complete and summarize the material, to write, to use the computer as a tool for presentation, to reflect upon their work and to suggest possible improvements.

The models were put on display at school together with the technical reports. Moreover, the pupils presented their models to the class and also to a wider audience, namely as the school on one occasion kept open house and invited parents, members of the District council and news reporters. The pupils' dedication to their work was later noted in the press.

2.4. Evaluation/Reflection

When the work was finished, it was evaluated together with the pupils. They proved to have gained an understanding of what the house meant to man and his life in general, as well as of how it had developed historically. They had also gained an understanding of one or some of the technical systems connected with the house. Moreover, they understood and were familiar with concepts such as "architect", "construction", "foundation", "frame", "window", "roof", "roof truss", "building material", "community planning", and they had also acquired an insight into the effects the house would have on nature and on the city environment.

The pupils were proud of their work but expressed self-critique as regards their model constructions. They knew what changes they would make if they ever were allotted the

assignment again. The pupils had also developed their ability to plan, organize, work systematically, cooperate and to be patient.

3. SHAPING OF TECHNOLOGY

If we now regard this example from school practice as containing an idea concerning what content and working methods should be included in technology education within compulsory school in order to provide the pupils with a liberal education in technology, or as I would like to say teknisk bildning, we could summarize the procedure followed in the realization of the project in the following way:

You take your point of departure from such technology that happens to be available in your environment, which also constitutes the pupil's reality, where the pupil's experiences and interests make up the point of departure for the choice of artefact or technical system (the place with different artefacts and technical systems). In the example above, this choice concerned a high-rise building that was about to be erected in the local environment. By employing technology available in the local environment as learning material, it also becomes natural to use the place as a space of learning. The choice between different artefacts or technical systems that the teachers and pupils are facing must take into account the age and interests of the pupils, as well as local conditions. The teaching process (The process of shaping of technology) is initiated as an assignment is drawn up by teacher and pupils together. In the example, the assignment was to model one's own version of a high-rise building. The pupils acquire knowledge about the current assignment. Each assignment presupposes a penetrating analysis of the product's or the system's development, function, constitution, as well as of the advantages or disadvantages as regards its effects on nature, the society and the living conditions of the individual. Different perspectives may here serve as tools for the teacher and the pupils with which to direct the analysis so as to situate the technology in question. Within the analytic phase of the work, they may analyze the learning material in the following different ways:

- from a perspective centring on the history of development, which may grant to the pupils an opportunity to understand different driving motives behind technological development,
- from a system- and component-based perspective, where studies on single technical solutions and their place within larger systems may give the pupils the opportunity to acquire important insights into the specific character and conditions of the technology selected,
- from a functional perspective, which can provide the pupils with the opportunity to achieve an understanding of and familiarity with technical principles, namely, by studying and practically testing how the selected technology is construed and what function it has,
- from a technological perspective including the aspect of lasting development. "Lasting development" refers to an appropriate use of technique, which consists in: improving, recycling, being economical with resources, material and energy,
- from a perspective centring on technology, man and the society. In order to understand the role and meaning of technology, the interplay between human needs and technology has to be elucidated. This perspective throws light on the consequences and effects of the use of some specific kind of technology as far as both the individual and the society is concerned.

These perspectives are guidelines. In the analytic phase, the teacher may of course together with the pupils use other approaches to the analysis of the assignment in question. The analytic phase will, thus, take on different forms depending upon the assignment and the context, and it may involve, for example, educational visits, briefings

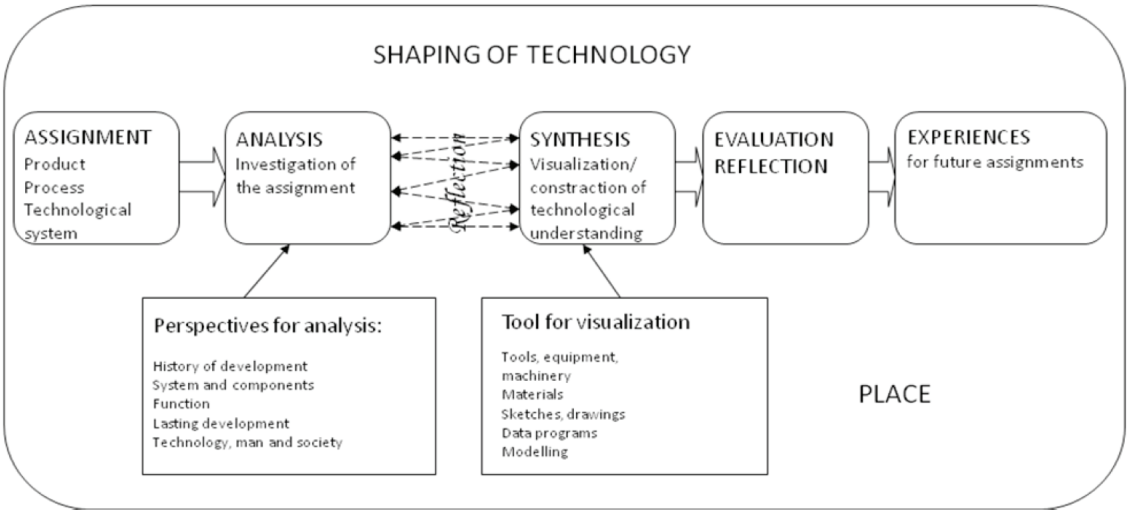
by the teacher, interviews with people within the selected area, collection of data, films and practical tests in the form of functional models which should make understanding easier for the pupils.

The third phase is visualization/construction of one's understanding with the help of sketches, descriptions, models, documentation and simulations, which thus reveal the pupil's understanding. At the same time as the pupil's understanding becomes visible, the teacher gets a basis for evaluating the pupil's way of creating experiences. By using different kinds of visualization, the teacher enables the pupils to make use of different ways of learning. Visualization after the project work has been accomplished can also assume the form of exhibitions, oral presentations to one's classmates, other classes, parents, invited guests, etc.

Reflection in connection with shaping of technology is of great importance for both the process and the result, since it makes up a central element in all learning. It makes possible reflective experiences on the part of the pupils. Here is embedded a challenge for the teacher in his or her practice at school, namely, to make room for common opportunities for reflection both before, during and after the work has been completed. Previous research shows that the challenge for the teacher is above all to have in one's pedagogical practice opportunities for common meetings and discussions (see e.g. Dysthe, 1993; Svärdemo Åberg, 2004; Blomdahl, 2007). Accordingly, reflection is involved in the entire process, that is, both before, during and after the finished work, at that point in the form of evaluation. When evaluating, the pupils can develop their capacity to reflect on their own way of learning. Finally, reflective experiences are brought from the shaping process that has been carried through, to the next project.

When the place is situated within the entire process of shaping of technology, the resulting model can look like this:

Table 1: Shaping of technology



In order for the above didactic model to give a fair picture of shaping of technology, it should be made clear that the different phases included in it do not illustrate any "step-by-step"-action. The danger with this kind of simplified model is that it may mislead the reader into believing that shaping of technology is a linear process, when it in fact rather consists in a kind of oscillation between analysis, visualization/construction and reflection.

Understanding is something that evolves over time. These pupils had worked for two years in a similar fashion on projects within other technological areas and were rather familiar with this way of working. That is to say, during their time at school they had improved their ability to work in projects. The teachers in the present example were functioning mainly as supervisors. However, when one tries to carry through technology projects in earlier grades, where the pupils for obvious reasons are not yet capable of this way of working to the same degree, the teacher's role is different. Here, the teacher is more of a co-constructor who within the project explores the environment, in this case the technical environment, together with the pupils (Dahlberg et. al., 2001). The teacher supervises the entire project, and eventually, small assignments are formulated together with the pupils within the project's framework, so that, at the end of their work, several projects have been carried out that have increased the pupils' awareness of the technology that originally was singled out for study. But the goal is the same, that is, to develop the pupils' ability to work in projects and to make sure that the pupils gain an understanding concerning the technology related to the place.

Hence, "shaping of technology" refers to the visualization or presentation of artefacts and systems of artefacts for the purpose of understanding them. Shaping of technology is a process that generates knowledge in which theory and practice are interwoven. In the actual course of teaching technology, the shaping process is reminiscent of the modelling working method employed by the engineer, the industrial designer and above all the architect. The architect does not build the house himself, but in the models and drawings which he supplies for future production there is much knowledge embedded. The projected house should be suitable for man, fit into the surrounding nature, stand the climate, fit into other buildings typical of the period, etc. Unlike the architect, however, the pupils will not invent, create or develop usable technical products but instead through analyses based upon different perspectives as well as upon physical models, sketches, simulations, documentation, etc., seek to understand the genesis and function of technology, as well as its effects on man, nature and our society. I have elaborated the philosophical foundation for this way of thinking about the content and working methods within technology education in previous articles (Blomdahl 2005; 2006).

4. GOALS FOR TECHNOLOGY AS A SUBJECT IN COMPULSORY SCHOOL

The goal that should be set for technology as a subject in compulsory school is thus, as I see it, that of developing a technological awareness concerning technology in the environment. By consequently working with different perspectives on one and the same learning material, the content is organized so as to provide a more holistic (general) view of the selected technology. These perspectives concern specifically technical knowledge about the design and mode of operation of artefacts, as well as their function within technical systems, but also knowledge about the way in which technology has evolved over time, as well as about the interplay between technology, man, the society and nature. Technological awareness also involves an understanding of technological concepts connected with the chosen technology, and is central to the understanding of our technical environment. During the years in compulsory school, different technological areas are dealt with, which means that in one sense at least, it is possible to say that the pupils' understanding will grow and expand.

Another goal for technology as a school subject is in my view that the pupil should develop his or her ability to work in projects. Project is the form of work characterizing the technical field in working life. It also plays a central role in higher education. For this reason, it is important to introduce project work already in compulsory school, so that the pupils' aptitude for this kind of work can be prepared for and developed. During the years spent in compulsory school, however, the pupils are in need of much support in order to develop their ability to work in projects, but this ability is one that will be useful

for them in the future. By working with projects where tasks of solving problems to which no previously fixed solutions are available, the pupil may develop a technological way of thinking. That is to say:

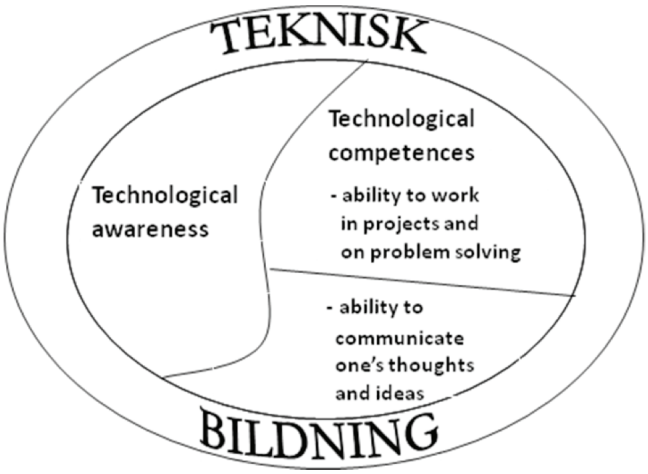
- a practical thinking concerning how to solve problems, use relevant material, tools and technical principles in connection with modelling.
- a visual thinking that involves displaying one's understanding in the form of sketches, simulations, three-dimensional models, and also understanding the ideas that others are communicating.
- an innovative (creative) thinking because there are different solutions.
- a conceptual and analysis/synthesis thinking, an ability to express one's understanding with the relevant concepts, to observe relations, etc. This is both an analytic and a synthetic thinking directed toward structure, function, aesthetics and ethics (Franus, 2000).

The pupils are also given the opportunity to develop their communicative powers, e.g. in the form of sketches, images, models and with the help of computer technology. These capacities are thus developed at the same time as the pupils are attaining an understanding of our technological environment.

On the basis of the above example from school practice, I am thus finally able to state what I see as central parts of technological literacy, or as I would like to say teknisk bildning, for compulsory school.

- technological awareness within various technical areas
- ability to work in projects and on problem solving
- ability to communicate one's thoughts and ideas with the help of different presentation techniques, such as speech, writing, sketches, images and models, both manually and digitally

Table 2: Teknisk bildning



The parts I have emphasized as essential to grant to the pupils the opportunity to acquire within technology as a subject in compulsory school are hopefully useful tools with respect to future work.

5. SUMMARY

The aim of this paper has been on my part to give a contribution to the discussion concerning the nature of technological literacy. On the basis of an example borrowed from the practice at school, I have described how I regard the content and working methods of technology education, and what abilities and qualifications I think are worth focusing on when teaching technology. I conclude with a quote from the writing Foretagsamma skolan, SAF (Risberg & Madsén, 1997, p. 21), regarding what one within the industry regards as central to develop in pupils within compulsory school.

> "A school that shall create an enterprising spirit as well as conditions for lifelong learning has to be based upon "problems that seek knowledge"! If the school is to provide its pupils with a human competence that grants to the individual an ability to cope with the role as a citizen in a complex society, this means that the school has to create situations where the pupils are able to develop this competence. Situations that provide conditions similar to those pertaining to life outside school. The task of the school will be to develop forms for supporting the pupils' efforts at taking hold of these situations."

6. REFERENCES

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