Unboxing technology education part I – Starting point

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Abstract

The Boost for Technology (Tekniklyftet) is an on-going education program run by the House of Science (Vetenskapens Hus) and financed by ESF (European Social Fund) involving 28 secondary schools within the Stockholm region. The goal is to enhance the technology teachers' competence as well as strengthen the technology subject. In what way does this intervention influence the teachers' work with technology education?

A pre-test questionnaire has been launched in order to collect data concerning views and practice as well as official documents have been studied in order to find the starting points of the project. This paper will provide descriptions concerning the starting points.

Introduction

Numerous supervision reports of different municipalities conducted by the Swedish Schools Inspectorate (2009a, b, c) confirm that the situation for the mandatory technology subject is alarming. They even state that the teaching of technology is not even accomplished enough (in quantity) to give the students the opportunity to reach the targets in the national curricula. The supervision reports are in agreement with the report by the Association of Swedish Engineering Industries (ASEI, 2005) and Teknikdelegationen (2010). Teachers who teach technology often lack teacher training in the subject matter and many teachers feel insecure when teaching it (Teknikdelegationen, 2010; Nordlander, 2011; CETIS unpublished). The teaching in technology also varies among teachers and schools and it is not always aligned with the current steering documents (ASEI, 2005; Blomdahl, 2007; Bjurulf, 2008; Klasander, 2010). A survey among ninth graders showed that they felt that technology education was invisible and not so important for their future (Teknikdelegationen, 2009).

Prior reports have highlighted the technology subject as neglected (Fabricius et al, 2002; Skolverket; 2005; Teknikföretagen, 2005; Statskontoret, 2007). The government's appointed Teknikdelegationen (2010) highlights the importance of technology for the country and as Sweden's first astronaut Christer Fuglesang put it:

"Technology is everywhere – except in school." (Ny Teknik 2010-02-09)

This quote is particularly interesting and can be used as a starting point for the intention to un-boxing technology education in the Swedish compulsory school, which Hagberg and Hultén (2005) has identified as little investigated.

Description of the project

Tekniklyftet (the Boost for Technology) is a two-year (2011-2013) education program run by Vetenskapens Hus (the House of Science). The main purpose is to mobilize in the amount of youths in the further studies in technological or science educations and to strengthen the teachers' competence and self-confidence in technology in compulsory school. The project involves 28 schools from 5 municipalities within the Stockholm region. In order to strengthen the sustainability in the project all personnel at the schools are involved in the project in various amounts. Tekniklyftet is mainly focusing on the technology teachers in secondary grade. In addition to them, the whole structure with established contacts between schools, companies and science centres, are involved for mutual exchange.

The Swedish educational system is currently undergoing major changes; e.g. new national curricula with syllabuses for the mandatory subjects, teacher training, and new educational act, including stricter rules concerning who may teach which subject. E.g. from 2015 only a certified subject matter teacher can grade the students (SKOLFS 2010:800). This will have the effect that teachers teaching technology are at risk of getting un-employed when lacking a certificate. This is why the Tekniklyftet is financed by ESF (The European Social Fund). Tekniklyftet aims to build a platform for the mandatory subject technology and, in prolong, also contribute to create a teacher training in technology education in the European frontline.

When un-box the tutoring of the subject, different attempts to establish the starting points of the on-going educational program Tekniklyftet, have been undertaken and will be presented in this paper.

Prior and Current situation for Technology education in Sweden

Several reports show that technology education is not present to the extent in compulsory school which is needed for the students to be able to reach the goals stipulated in the curricula (ASEI, 2005; SSI 2009a; b; c;). When looking for the Swedish student´s educational position in technology education as a group, the information is somewhat limited (Teknikdelegationen, 2009; Hartell, 2011).

The national timetables for technology education are 800 hours together with natural science during the nine years of compulsory school. Every school head is free to plan the teaching of every subject to fit their organization as they please; as long as their student's reach the goals set by the national curricula (SKOLFS2010: 800; Klapp-Lekholm, 2010). The distribution of the minimum time varies and some schools choose to schedule the teaching of the technology subject an hour a week, in eight or ninth grade when the grading starts[1] (Hartell, 2011). Still, according to the national statistics compiled by the NAE in SIRIS, for pass or higher, technology education in ninth grade is among the highest of the 16 mandatory subjects (SIRIS, 2009).

Research questions

The overarching research question is

How is technology taught in schools before and after entering the Tekniklyftet?

In order to answer this question a starting point is needed. This is the purpose of the sub study described in this paper.

Method

In order to determine any effect of Tekniklyftet, the project will be studied in an explorative approach and adjustments in the data-collection will be undertaken with respect to the results from the data analyses along the way.

[1] Grading starts in eighth grade, from fall 2012 it will start in 6th grade.

In order to create the starting point for the project we have used two different kinds of data:

First, two different public databases (SIRIS[2] and SALSA[3]) compiled by the state agency Statistics Sweden (SCB) presented by the NAE have been used. We have chosen to describe the participating schools by means of the statistical tool SALSA and SIRIS since they are often used in various settings when describing results of schools in Sweden. These databases give access to general information concerning the schools and their students but data concerning information about the teachers and the teaching practice is hard to come by.

Second, to remedy the lack of information, the data from the official records was supplemented with a pre-test questionnaire to the teachers and the other school-staff launched on the day of the kick-off for the project in August 2011.

SALSA

SALSA is a used when presenting results of grading on municipality and school level with respect of the composition of the students. The merit points are compared with the background factors of (1) parents' education level, (2) percentage of students born in Sweden with foreign backgrounds, (3) the proportion of students born abroad and (4) the distribution of boys and girls. The greatest impact on the results from this model, have been identified as parental level of education (http://salsa.artisan.se).

SIRIS

SIRIS is a tool with statistical information on various levels e.g. municipality, school and country, about school's results, quality reports, regarding students, costs, various documents on different levels level. It is used to see changes over time and how different interventions affect different factors in school. (http://siris.skolverket.se)

A description of the questionnaire

The questionnaire consisted of 45 questions. Most of the questions were on a 5-grade Likert scale, concerning views, practice, teacher training, facilities, assessment and practice. The questions were selected from a "pool" of questions gathered from other technology education studies (e.g. Nordlander, 2011; Cetis unpublished; Skogh, 2004) complemented with new ones to fit the purpose of this study. The questionnaire was tested several times among other researchers, statisticians, relatives and friends. The guidelines provided by Statistics Sweden were followed for the layout and questions (http://www.scb.se; Cohen, 2007; Djurfeldt, 2003).

The questionnaire was constructed to cover and identify three different groups in Tekniklyftet. The three groups were;

i. School staff working as technology teachers (all 45 questions)
ii. School staff working as teachers in all other subjects (26 questions)
iii. School staff working in schools with non-teaching task (13 questions)

The questionnaire was distributed to the participants as they were arriving to the introduction of Tekniklyftet. They all answered the questions and returned the questionnaire before entering the kick-off activities/ lectures. The filled in questionnaire were then transformed to a web-file by means of the researchers and assistants. The resulting data file were organised in Excel and analysed in SPSS. Final diagrams were processed in Excel.

In total 651 people (teachers, school staff) participated, to different degrees, in the questionnaire.

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[2] SIRIS: the National Agency for Education's online information system on results and quality.

[3] SALSA: the National Agency for Education's online tool for Local Correlation Analysis.

Results

Description of the participating schools

According to the SALSA model, the schools participating in Tekniklyftet is similar to the rest of the country and region with respect to distribution of boys and girls, merit points[4] and parent educational background. The Stockholm region has a somewhat higher parent educational background compared to the rest of the country. The participating schools, as a group, have slightly lower values on this parameter than the region and thus are in parity to the country. The amount of students born abroad is about the same as the region, which is higher than the country. Tekniklyftet differs from both the country and region on respect of students with second-generation immigrant background. About 22 % of the students are second-generation immigrants, which are twice as many as within the Stockholm region and 3.5 times the whole country. To be conclusive the 28 participating schools considered as a group, does not by large, differ from the rest of the schools in the country or the region except from the amount of second generations immigrants.

When, where and by whom?

When?

Our data shows that technology is mostly taught in the school year 7-9. Please note that the amount of teachers, who teach in year 7-9, is more than those who teach in year 1-6 in the sample. When crosschecking with previous results such as ASEI (2005) and SSI (2009, a, b & c) this confirms the notion that technology is mostly taught in the higher years of compulsory school.

Where?

In the participating schools in Tekniklyftet, technology is mostly taught in regular classrooms or science classrooms. The data also shows that the students are taught in whole class and/or in some cases in half groups. Neither of the schools uses gender grouping and only one use ability grouping.

By whom?

From the data collected in the questionnaire we can see that the typical technology teacher with some academic credits in technology (TTAC) also teach mathematics and/ or biology, physics and chemistry (i.e. natural sciences). Diagram 1 shows the connection between formal teacher training in the subject and the tutoring of the subject. It shows that many teachers who teach technology do not have any formal training in the subject. This is more accentuated in technology compared to the rest of the subjects. The data also shows that the TTACs do not have so many academic credits in the subject, see diagram 1 and 2.

[4] The summary of all 16 grades is in total 320 merit points (20 per subject).

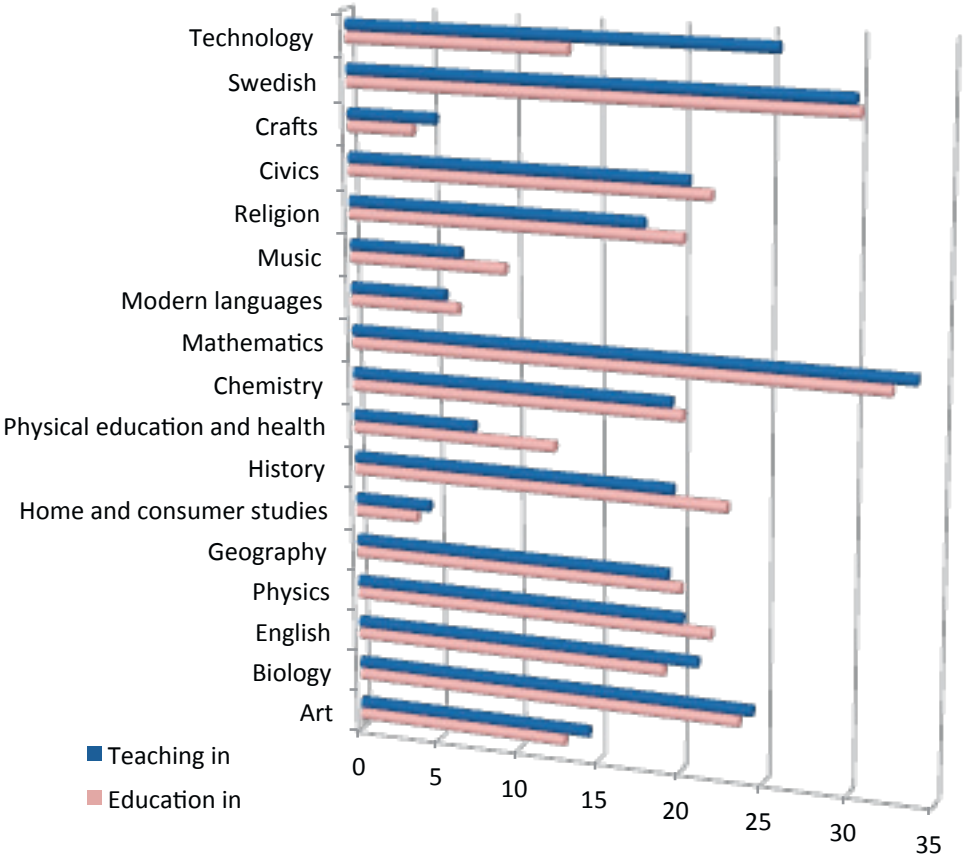

Diagram 1 shows the percentage of teachers teaching in the subjects and teachers with formal teacher-education in the subjects.

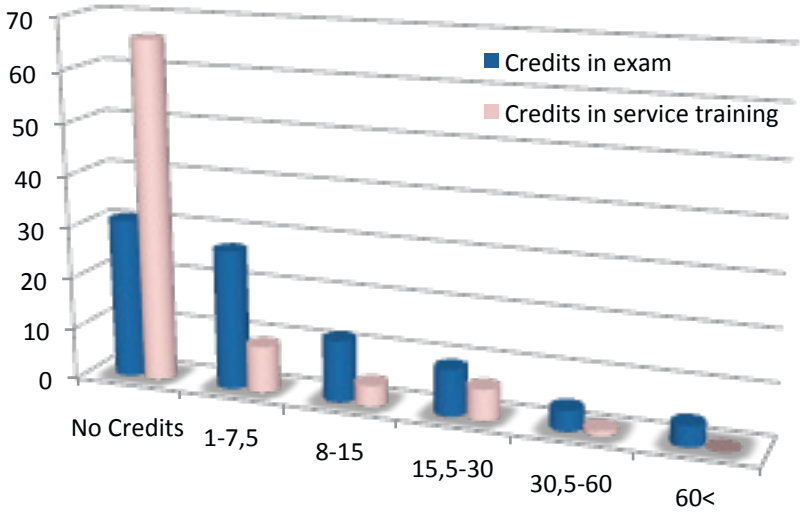

Diagram 2 shows the number of technology teachers and their amount of academic credits in technology. Please note 30 hp is one full time semester.

Grouping of teachers teaching technology

There are 533 teachers in total answering the questionnaire. 166 teachers answered the questions about technology. This group of teachers teaching technology has been divided into three sub groups on behalf of teacher training in the subject, in order to identify any differences. These groups are

1. All teachers in the questionnaire (All) (n=533).
2. All teachers who teach technology *(ATT All Teaching Technology)* (n=166)
3. Teachers with academic credits in the subject *(TTAC Technology Teacher Academic Credits)* (n=63).

Diagram 3 shows that the TTAC teachers' views about technology education are more connected

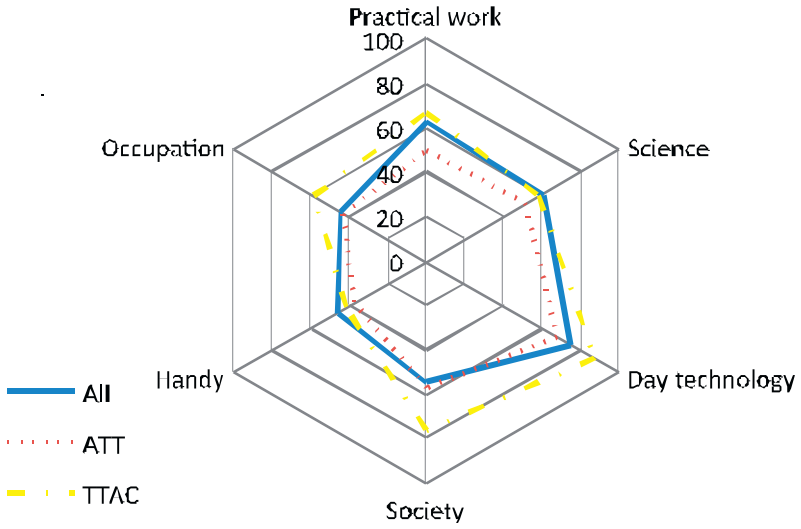

Diagram 3 Teachers' opinion about technology education.

Diagram 4 shows the informants' views on whether other mandatory subjects are more important than technology. The three core subjects Swedish, English and Mathematics differ out from the others. TTAC teacher are them who most see this difference.

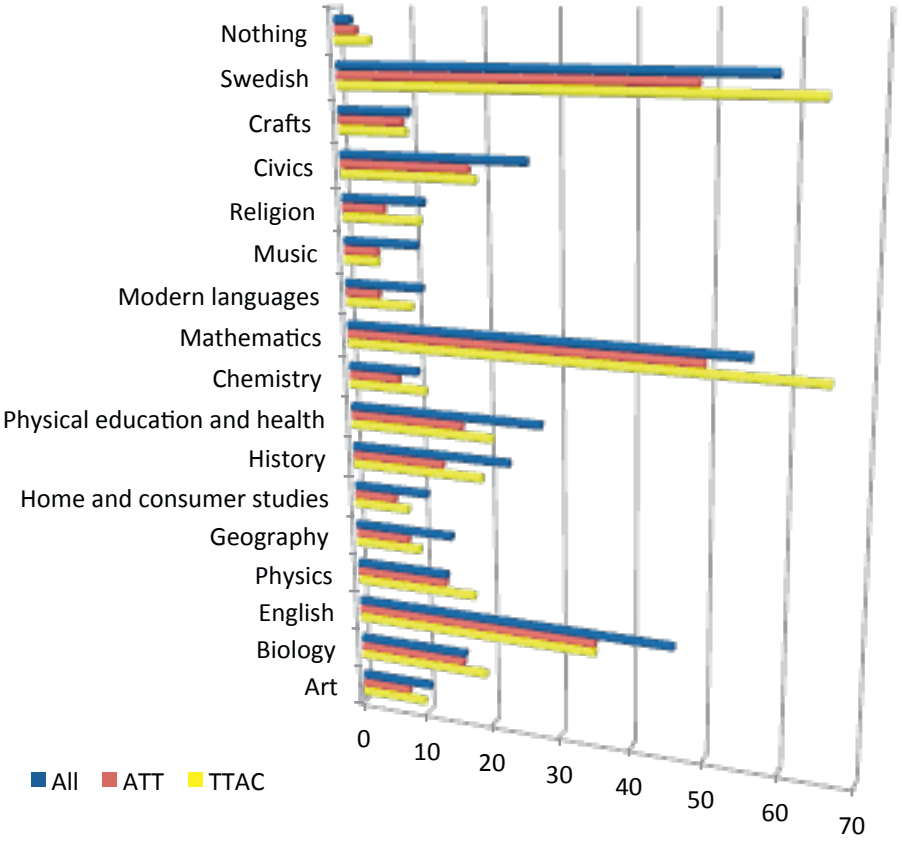

Diagram 4 Percentage of all participants' views on whether other mandatory subjects are more important than technology.

Satisfaction and influences

Diagram 5 shows how the technology teachers are mainly satisfied with their teaching surroundings such as premises, equipment and material. They are not equally satisfied with the storage facilities. The scale in diagram 5,6 and 8 goes from 1 to 5, where 5 is best or agree most.

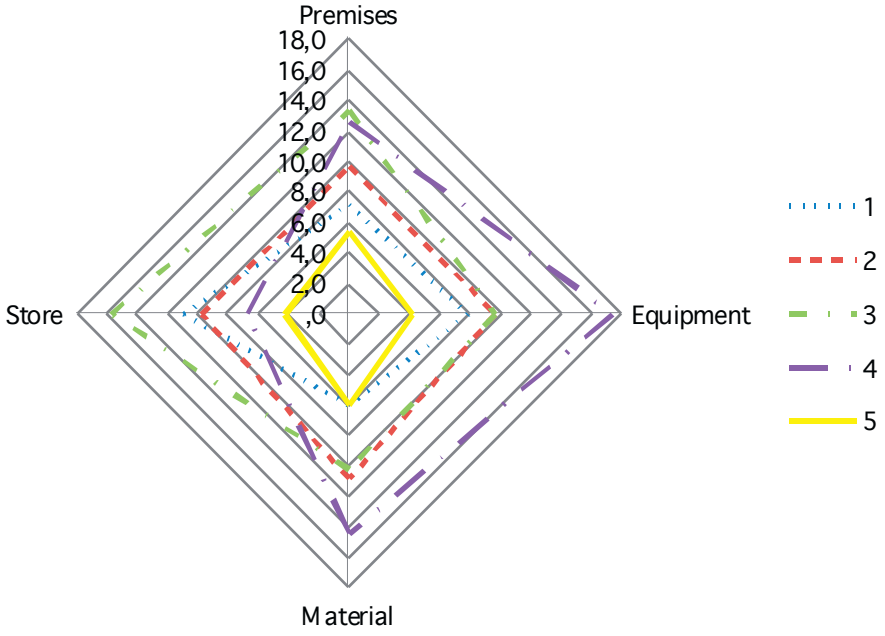

Diagram 5 Technology teachers' satisfaction with their teaching surroundings.

Our data shows that the technology teachers are more influenced by the national curricula than the local working plan. Diagram 6 shows that the teachers teaching technology (ATT) are not satisfied with either their timetable or the distribution of time.

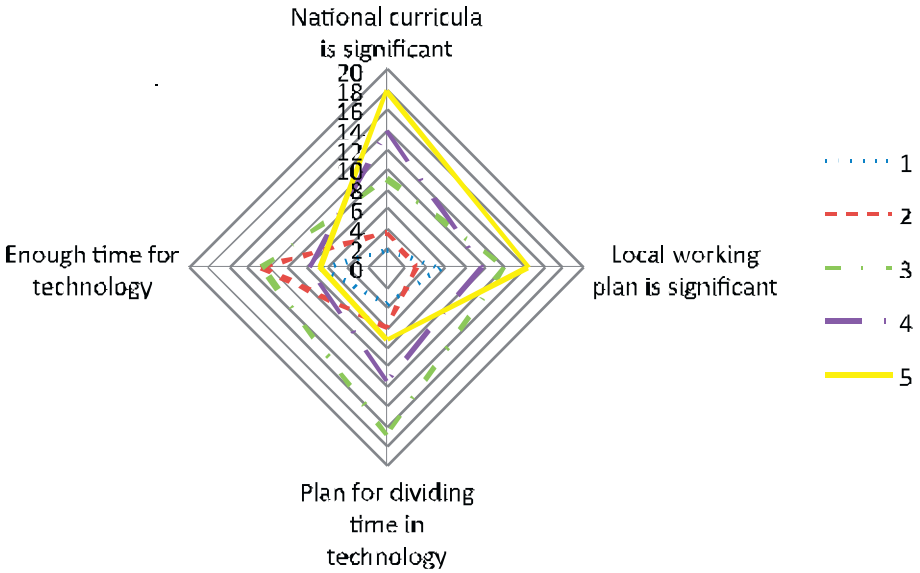

Diagram 6 Technology teachers' influence by curricula and satisfaction with time.

Integration of technology in other subjects

One of the aims for Tekniklyftet is to strengthen the subject technology education in all subjects e.g. to make teachers in other subjects, e.g. social sciences, aware of the connections with technology, to integrate and envision technology in their subjects.

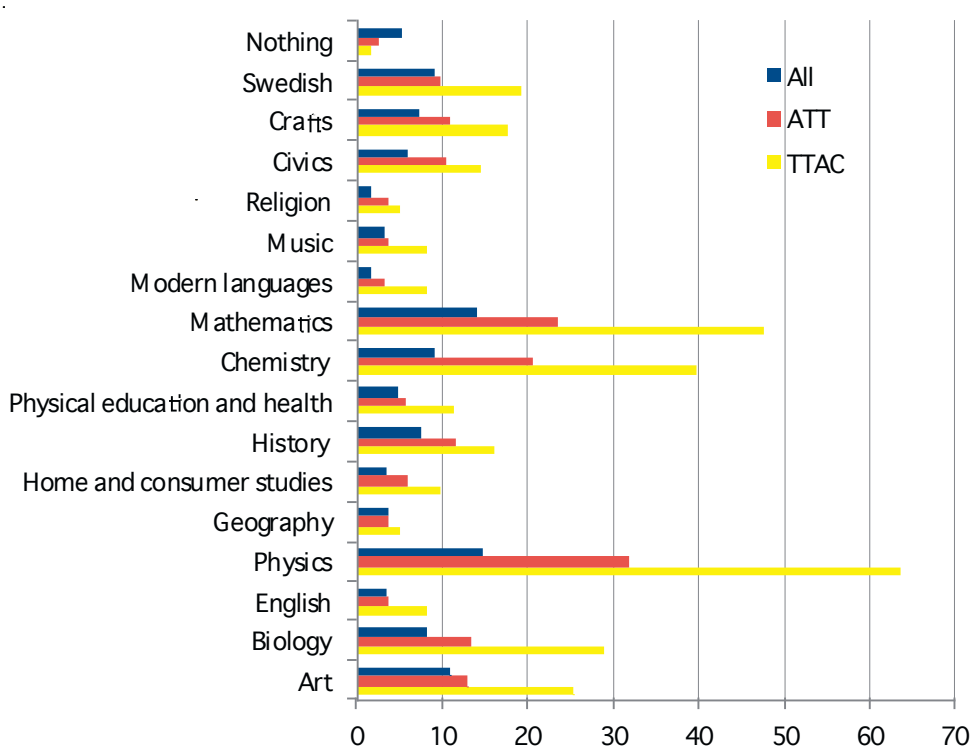

Diagram 7 Percentage of teachers' experience of integrating technology in other subjects.

Diagram 7 shows the experience of integration of technology in other subjects. It shows that technology is often integrated in the natural sciences and especially in physics. When crosschecking with previous results presented here, we find e.g. that the typical teacher in technology identified in this project teaches the science subjects as well. Is it possible that the teachers are integrating technology in their own subjects by themselves?

Assessment

Tekniklyftet started at the same semester as the new regulations was introduced (autumn 2011). The starting questionnaire included questions regarding the confidence of the teacher when assessing their students, describing the goals in the national curricula and so on with respect to the former curricula and syllabus (LpO-94). Diagram 8 shows how all the teachers in Tekniklyftet experienced confidence when informing their students about the curricula and how to concretize the (former) curricula. The diagram also shows their experience of the IDP[5] documents. This is a general overview. When including findings from the different groups of teacher and shortfall into the questions the results show that there are differences among the groups of teachers. E.g. technology teachers without academic credits seem less confident in general.

[5] Individual Development Plan with written assessment, a Swedish mandatory follow-up document (Hirsh, 2011)

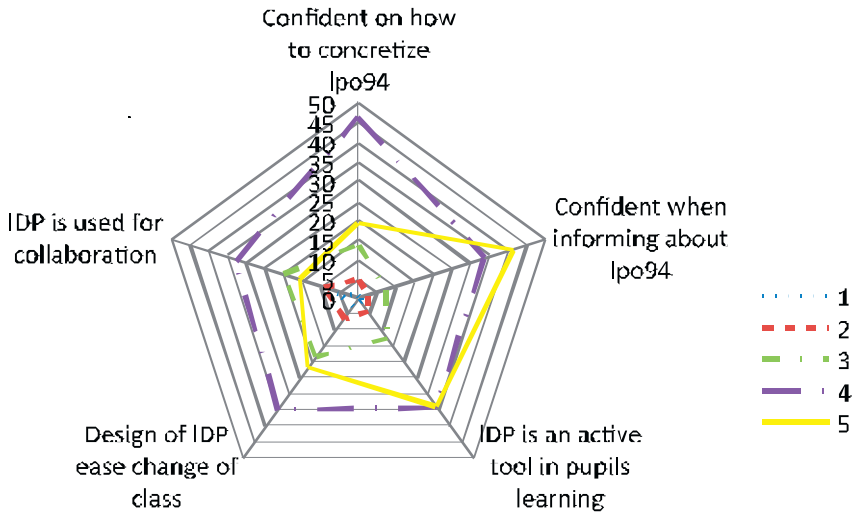

Diagram 8 Teachers experienced confidence when informing about and how to concretize the (former) curricula and their experience of the IDP documents.

Discussion

When the teachers in Tekniklyftet teach their pupils in technology, it is likely to be in the later years of schooling, in whole class or divided in half and in ordinary classrooms as they do in science. The students are likely to be taught in the subject by a teacher who also teaches mathematics and/ or natural science. When taught in technology the students are likely to be taught by a less certified teacher than in all the other subjects. When the subject is integrated in other subjects it is mostly done in science and/or mathematics. The results show it is most likely that these teachers are the same individuals as them teaching technology; thus it is very likely that the persons who integrate the subject technology are doing it by themselves in their own practice.

The technology teachers show a general satisfaction when it comes to teaching conditions such as premises and equipment but not with the storage possibilities or the timetable for technology. Many of the teachers lack training in the subject. When trained they are most likely to have less than half semester of training. These results are consistent with previous reports e.g. Teknikdelegationen (2010).

The teacher in technology generally seems to follow the rest of the teachers when it comes to confidence in interpreting the (former) curricula. Some differences within the group of technology teachers have been identified though between those who have academic credits (TTAC) and those who lack academic credits (LAC). The foremost difference is the willingness to answer the questions in the questionnaire. The shortfall is larger among the LAC-teachers all troughs the questionnaire but especially about those in assessment in technology. When regarding these issues it can be seen as a sign of a general insecurity among the technology teachers where LAC seems less confident than the rest. This results raises further questions and need more investigation.

The collected data have been used and presented here, as un-boxing the starting point for the project Tekniklyftet. The results from available official data-records show that as a group the participating schools does not differ from the rest of the country or the region on behalf of available statistic data. Views about their working condition and about technology have been investigated in the questionnaire for the teachers at the participating schools. Questionnaires have its limits as well as official data. Some results are presented on part of the starting points. There are socio economic differences within the group of participating schools and there are some differences between the different groups of teachers. What are they and in what way do Tekniklyftet affect them? There is a need for more data to provide answers. Data will be supplemented in triangulation with documents from the schools, photographs from the classrooms, interviews as well as questionnaires along the way during the project. The unboxing will continue and the findings will contribute to provide answers on how Tekniklyftet has influenced teachers' practice.

References

ASEI (2005), Association of Swedish Engineering Industries, *Alla barns rätt till teknikundervisning*, Teknikföretagen.

Blomdahl, E. (2007), *Teknik i skolan- en studie av teknikundervisning för yngre skolbarn*, HLS förlag. Stockholm

Bjurulf, V. (2008) *Teknikämnets gestaltningar. En studie av lärares arbete med skolämnet teknik*. Karlstad University studies, nr 2008:29 Doctoral thesis.

Cohen, Manion, Morrisson (2008), *Research Methods in Education*. Routledge.

CETIS (Centrum för Teknik I Skolan) (un-published)

Djurfeldt, G., Larsson, R. & Stjärnhagen, O. (2003). *Statistisk verktygslåda- samhällsvetenskaplig orsaksanalys med kvantitativa metoder.* Lund. Studentlitteratur.

Fabricius, T., Malm, I. & Pisilä, S. (2002). *Skolinspektörernas årsrapport 2001/2002:* Grundskolan (Utbildningsförvaltningens rapportserie, nr.2002:5). Stockholm: Utbildningsförvaltningen.

Fuglesang. C. et al (2009), Ny Teknik 2010-02-09

Hagberg, J-E. & Hultén, M., (2005). *Skolans undervisning och elevers lärande i teknik - svensk forskning i internationell kontext*. Vetenskapsrådets rapportserie 2005:6 (ORD&FORM AB)

Hartell. E. (2011) Hur sätter man betyg i teknik? In S-O. Hansson, E. Nordlander, I-B. Skogh (eds) *Teknikutbildning för framtiden – perspektiv på teknikundervisning i grundskolan och gymnasium*. P 75-87.

Hattie, J. (2009) *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*. USA: Routledge.

Hirsh, Å. (2011), A tool for learning? An analysis of targets and strategies in Swedish Individual Educational Plans. *Nordic Studies in Education* 2011 (1); 14-30. Universitetsförlaget.

Klapp Lekholm, A. (2008) *Grades and grade assignment: effects of student and school characteristics* http://hdl.handle.net/2077/18673 (Retrieved 11-12-02)

Klapp-Lekholm, A. (2010a), Lärares betygssättningspraktik, in S. Eklund (eds) *Bedömning för lärande – en grund för ökat lärande. Forskning för undervisning och lärande* (2010:3) 20-29.

Klasander, C. (2010) *Talet till tekniska system*. PhD thesis, Linköping University, Department of social and welfare studies, Norrköping, Sweden.

Nordlander, E. (2011), Vad tycker tekniklärarna? In S-O. Hansson, E. Nordlander, I-B. Skogh (eds) *Teknikutbildning för framtiden -perspektiv på teknikundervisning i grundskolan och gymnasium*. P 90-102.

SCB (2001). *Fråga rätt! Utveckla, testa, utvärdera och förbättra blanketter.* www.scb.se (retrieved 2012-05-05)

SIRIS (2009), www.skolverket.se (retrieved 10-10-21).

Skogh, I-B (2004) 'Swedish girls' and women's perceptions of technology'. In *Women Creating Technology*. (s.47-75, 116-117) EU/EQUAL-projekt FEMEVAL (Spain), Naoberschapsbank (Netherlands) och KomTek/Nutek (Sweden). European Social Fund, European Union (EU)

SKOLFS2010:800

Skolinspektionen (2009) "Kvalitetsgranskning", Rapport 2009:2.

Skolinspektionen (2012) ”Kvalitetsgranskning”, Rapport 2012:4.

Statskontoret (2007) ”Lärares utbildning och undervisning”, Rapport 2007:8, s. 64.

SSI (2009) National School Inspectorate Skolinspektionsmyndigheten (School Inspectorate) (2009) (2009-09-01)

http://www.skolinspektionen.se/Documents/Rapporter/Mora_Inspektionsrapport.pdf?epslanguage=sv). (2011-11-23)

http://www.skolinspektionen.se/Documents/Rapporter/Hofors_tillsynsrapport.pdf?epslanguage=sv (2011-11-23)

http://www.skolinspektionen.se/Documents/Rapporter/Falkenberg-inspektionsrapport.pdf?epslanguage=sv (2011-11-23)

Teknikdelegation (2010) SOU 2010:28 Vändpunkt Sverige- ett ökat intresse för matematik, naturvetenskap, teknik och IKT.