ABSTRACT
Numerous studies have demonstrated that there is a lack of certified technology teachers in Swedish schools.

In this study we explore possible differences between teachers with and without subject-specific education in technology didactics. The research question highlights to what extent teachers with subject-specific training (1) are using steering documents and (2) assessing students differently compared to teachers without academic subject-specific training. The collected data consists of a survey within a large teacher-training project ‘Tekniklyftet’, a technology initiative in which 28 schools in the Stockholm area have signed up for an ambitious technology education development program in their school.

The results show that teachers with subject-specific training perceive themselves as more secure in their professional (technology) teacher role and express greater confidence in how to assess pupils in the subject of technology and also in how to use steering documents compared to non-subject specific trained teachers.

Keywords: assessment, teacher training, technology education

INTRODUCTION
Technology has been a mandatory subject in the Swedish school system for more than three decades. Despite this fact, there is still no consensus regarding the content and practice of the subject (Norström, 2011; Skogh, 2006), resulting in insecure teaching (Association of Swedish Engineering Industries ASEI, 2005; Nordlander, 2011) and varying knowledge among students.

There are several reasons for this troublesome situation in the context of teaching technology subjects in the Swedish school system. For example, the syllabuses for technology classes have been vague and imprecise (Norström, 2011), which has resulted in difficulties in achieving a common national base of technology education for teachers to rely upon. In 2011, however, a new curriculum was introduced that featured new syllabuses for all subjects in the Swedish school system. The new syllabus for technology is stricter and contains knowledge demands for year six and nine as well as core content in three time spans (years 1–3, 4–6 and 7–9), which will hopefully lead to higher achievement among all pupils.
There are no strict regulations regarding how much time should be spent on technology education. Although other subjects generally have their own timetable (except social sciences), there has been and still is a joint national timetable for technology and science education (800 hrs minimum). Although some regulations about time-sharing have been suggested (Skolverket, 2010), no restrictions regarding the exact amount of time for technology teaching have been determined.

There has been a dramatic decrease in the amount of certified teachers in compulsory school in Sweden. Many teachers lack formal teacher education (Andersson, Johansson, & Waldenström, 2011). The situation is particularly problematic in technology where the shortage of subject-specific trained teachers is greater than in other subjects (Skolverket, 2013). Thus, there is an evident lack of trained teachers in technology in the country. Even though this has been known for many years, two recently published reports (ASEI, 2013; Skolverket, 2013) show that it is difficult to accomplish a change and so far the situation in Sweden becomes worse as time pass.

The abovementioned challenges have resulted in many students receiving little or no technology education; in some known cases, technology is only taught one hour a week in year eight or nine when the grading starts (ASEI, 2005; Hartell, 2011; Teknikdelegationen, 2010). As teaching in technology varies among teachers and schools, neither teaching nor assessment is always aligned with the current steering documents (ASEI, 2005; Bjurulf, 2008; Klasander, 2010).

Many initiatives have been undertaken in Sweden in order to solve the troublesome situation for technology education. One of the largest investments is called ‘Tekniklyftet’ (The boost for technology), a project which is run by the House of Science in Stockholm and funded by the European Social Fund (ESF). The project started in 2011 and the main purpose is to educate teachers in technology and boost the status of the subject in schools in the region. The aim of this effort includes the ambition to increase the interest in technology among pupils. The project works as a pilot programme involving 20 secondary schools (school year 7–9) during this first run in a three-year period.

The project has approached this challenge by involving people, institutions, industry and organisations representing different levels in society that are all profoundly affected by the quality of technology education. Activities that boost the schools and train the teachers have been and will continue to be developed during the project period. Strategic collaboration (in a broad sense) was built into the project from the very beginning in order to secure its efficiency and continuation.

Researchers and evaluators will evaluate the project during the three-year period. The research questions that will be examined during this evaluation focus on, if and how it is possible to increase the quality of technology education during the project period. As previous studies has shown that trained teachers are important for the quality of teaching (Andersson et al., 2011), we wanted to perform an initial study of the project in which we highlight possible differences between subject-specific trained (technology) teachers, (technology teachers with academic credits in technology TTAC) and non-subject-specific trained teachers in technology (teachers with no academic credits (in technology) TTNC) with respect to their ability in teaching and assessment in the subject area of technology.

In the very beginning of ‘Tekniklyftet’, a questionnaire was distributed to all teachers and administrative personnel in the 28 participating schools.

**ASSESSMENT IS A LINK BETWEEN TEACHING AND LEARNING**
Assessment is a crucial factor in students’ learning. In general, the aims and purposes of assessment vary within different educational contexts. For example, one purpose of assessment
is to make sure that pupils follow the intended path towards the curriculum goals (Wiliam, 2011). Another purpose of assessment is grading the pupils in order to evaluate and report results to the authorities (Gipps, 2004; Newton, 2007; Pettersson, 2009). However, if the purpose of the assessment does not include the students’ future progress, one might be justified in questioning its utility (Bennett, 2011; Black & Wiliam, 2009; Gipps, 2004; Newton, 2007; Nyström, 2004).

It is common for assessment to be performed continuously in the classroom. Whether intentionally or not, teachers assess their students all the time by asking questions or looking for ‘glimpses in the eyes of the pupils’ (Hartell, 2012). Continuous assessment is used in order to be able to plan the next step of teaching where the goal is to develop the pupils’ understanding as much and as efficiently as possible (Wiliam, 2009, 2011). In such a formative approach, assessment can be seen as the link between teaching and learning.

**THE IMPORTANCE OF TEACHER QUALITY IS A COMMON SUBJECT FOR DEBATE**

The importance of teacher quality is often debated in Swedish society. While many people claim it is important to have certified teachers, there are still few studies that prove that having more formally educated teachers will result in higher pupil achievement. Some studies show that teachers who teach technology and lack subject-specific training feel insecure when teaching this subject (Nordlander, 2011; Teknikdelegationen, 2010). Andersson et al. (2011) showed that having certified teachers will result in higher achievement among pupils in the Swedish compulsory school system; in their study, pupils with highly educated parents profited the most. On the other hand, Williams (2009) has questioned the efficacy of long teacher education programmes, and others (Hattie, 2009) have argued that teacher training does not matter very much with respect to pupils’ achievements. Instead, such researchers claim that experience is what matters most, and experience, as Wiliam (2011a) argues, does not come by itself.

**RESEARCH QUESTION**

Our study is a contribution to the overall investigation regarding how subject-specific teacher education affects teachers’ ability to teach according to stated regulations.

Gipps (2004), Bjurulf (2008) and Moreland, Jones and Barlex (2008) argue that a teacher’s own view about technology is reflected in their teaching practice and has implications for assessment. We believe that teachers who perceive that they know how to use the steering documents and how to assess the subject possess a better ability to do so.

Therefore, our specific question is as follows: *Is there a difference among subject-specific trained teachers and non-subject-specific trained teachers regarding their perception of their own ability to teach and assess technology?*

**METHOD**

In order to deepen understanding of the situation regarding the subject of technology in participating schools a questionnaire was distributed among the participants as they were arriving to the kick off seminars for Tekniklyftet (August, 2011). All teachers and all management in the participating schools were asked to answer the questionnaires. There were 682 attendances registered. The informants returned the questionnaires before entering the introductory lectures. In total, 651 individuals (school staff e.g. teachers, principals etc.) all employed at 28 participating schools answered the questionnaires to different degrees.

The questionnaire consisted of 45 questions about attitudes towards the subject of technology, about teaching and assessment and about available resources and equipment. The guidelines provided by Statistics Sweden were followed for designing both the layout and the questions
In this study, 6 out of 45 questions regarding teaching and assessment of technology were quantitatively analysed. The result can be viewed as statistically pledged variations between the teachers with subject-specific training and those with no subject-specific training.

**Participants**

Different groups of informants where presented with the questionnaire (teachers, principals, subject teachers, etc.). In this study, only answers from those who stated that they teach technology were analysed. The informants belong to the following groups:

I. School staff working as technology teachers with academic credits (TTAC) (n = 60)
II. School staff working as technology teachers without academic credits (TTNC) (n = 28)

In order to investigate if participating schools are somehow representative of the Swedish education system as a whole, the participating schools were compared to schools throughout the country (table 1). Official records (SIRIS and SALSA) compiled by the state agency Statistics Sweden (SCB) and presented by the National Agency for Education (NAE) were used, as these records are often used in various settings when describing the results of Swedish schools.

As a group, the participating schools could be seen as representative with regards to available school background variables, with the exception of the average grades in technology and the higher amount of second-generation immigrants (Hartell & Svärdh, 2012).

**Table 1: Official school data regarding the schools in ‘Tekniklyftet’ compared to the schools in the country.**

<table>
<thead>
<tr>
<th>Imigrant background</th>
<th>Country</th>
<th>Boost for technology</th>
<th>Stockholm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Born abroad</td>
<td>8%</td>
<td>11%</td>
<td>8%</td>
</tr>
<tr>
<td>Born in Sweden</td>
<td>6%</td>
<td>22%</td>
<td>10%</td>
</tr>
<tr>
<td>Boys</td>
<td>51%</td>
<td>52%</td>
<td>52%</td>
</tr>
<tr>
<td>Parents' education</td>
<td>2,15</td>
<td>2,15</td>
<td>2,19</td>
</tr>
<tr>
<td>Merit values</td>
<td>206</td>
<td>210</td>
<td>209</td>
</tr>
<tr>
<td>Teachers with exam per 100 pupils</td>
<td>7%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Average grade in Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass</td>
<td>42%</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>Pass with distinction</td>
<td>38%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Pass with special distinction</td>
<td>14%</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>Failed</td>
<td>6%</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 also shows that the reported grades are similar in ‘Tekniklyftet’ (Boost for technology) and for the country. A closer look reveals, c.f. table 2, a large variation in grading (almost 70%) and the fact that many schools in Tekniklyftet do not use the whole grading scale.

**Table 2: Variation between schools’ grading in technology.**

<table>
<thead>
<tr>
<th>Variation of grading in technology</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>74.7%</td>
<td>4.8</td>
</tr>
<tr>
<td>Pass with distinction</td>
<td>58.2%</td>
<td>11.4</td>
</tr>
<tr>
<td>Pass with special distinction</td>
<td>47.7%</td>
<td>0%</td>
</tr>
<tr>
<td>Failed</td>
<td>37.1%</td>
<td>0%</td>
</tr>
</tbody>
</table>
RESULTS
The data consists of a questionnaire (45 questions, five-grade Likert scale). The results are presented at a group level as descriptive statistics in order to provide an ocular overview. Mann-Whitney U-tests are used to look at significance (Cohen, Manion, & Morrison, 2008). In this paper, we have chosen to present results from the six questions most significantly related to assessment in technology.

Question 1:
The national syllabus for technology is of great importance for how I teach.

According to the questionnaire results, the teachers in the TTAC (technology teachers with academic credits, dark grey) group emphasise the importance of the steering documents more than the teachers in the TTNC group (technology teachers with no academic credits, light grey). The differences are significant at a level of 5%.

Question 2:
My school’s local syllabus for technology is of great importance to how I teach.

According to the questionnaire results, the teachers in the TTAC (technology teachers with academic credits, dark grey) group emphasise the importance of the steering documents more than the teachers in the TTNC group (technology teachers with no academic credits, light grey). The differences are significant at a level of 5%.
The TTAC group with academic credits has a stronger tendency to use the school’s local plan for technology than the TTNC teachers. The differences are significant at a level of 5%.

Question 3:
*I can describe the student’s level of knowledge in the written assessments in a structured way.*

![Diagram 3: TTAC Mean 3.81, Std. Deviation 0.891, TTNC Mean 3.05, Std. Deviation 1.504 Mann-Whitney P = 0.070](image)

Part of the teacher’s job is to assess the students by describing each pupil’s current position and where they should go next. This information is gathered in the Individual Development Plan (IDP) document, which is stipulated in a written form together with the student and their guardian during the teacher-guardian meeting every semester (Hartell, 2013).

The TTAC group expresses greater confidence (significant at a level of 10%) than the TTNC group when it comes to describing their students’ knowledge in technology in the IDP documents.

Question 4:
*This school year, I can clearly describe to the students the skills needed for various grades in technology.*

![Diagram 4: TTAC Mean 3.80, Std. Deviation 0.910, TTNC Mean 2.95, Std. Deviation 1.545 Mann-Whitney P = 0.040](image)
The TTAC group expresses greater confidence than the TTNC group when it comes to describing the skills needed for various grades in technology.

Question 5:
*I was able to award informed grades in technology according to the Lpo-94 curriculum.*

![Diagram 5: TTAC Mean 3.74, Std. Deviation 1.136, TTNC Mean 3.28, Std. Deviation 1.526 Mann-Whitney P = 0.315](image)

The differences here are not significant, but the trend is that the teachers in the TTAC group have more self-confidence when it comes to assessing the former syllabus in technology.

Question 6:
*During the past school year, I felt confident when I informed the students about the skills and knowledge qualities that should be assessed in technology.*

![Diagram 6: TTAC Mean 3.75, Std. Deviation 0.957, TTNC Mean 3.00, Std. Deviation 1.170 Mann-Whitney P = 0.010](image)

The teachers in the TTAC group felt more secure in providing information on grading criteria in 2011 than the teachers in the TTNC group. The differences are significant at a level of 5%.

**DISCUSSION**

In this study we examined possible differences in teachers’ perceptions of their ability to use steering documents and their ability to assess students in the subject area of technology. The
study shows a difference in attitudes and self-confidence between our two examined groups of teachers (TTAC and TTNC). According to the questionnaire results, the teachers with subject-specific education (TTAC) appeared to use steering documents as a base for their teaching to a greater extent than the non-subject-specific educated teachers. The study also demonstrated that TTAC teachers are more secure regarding what should be included in technology education and what needs to be assessed in order to award the students the correct grades.

It is interesting to consider these results since one could argue that teachers who are not educated would need to adhere more strictly to the available steering documents than teachers who are educated. This study shows that this is not the case, at least not in terms of how the teachers responded when asked about their views regarding their own teaching. Instead, it seems like teachers that are educated are also more likely to utilise the available directions, which in turn indicates that formal education results in wider teacher capacity.

This uncertainty among non-educated teachers in using the steering documents probably leads to an uneven quality of education for the pupils as previously reported. If this is the case, more uncertified teachers means more teachers that do not use the syllabus as their base for teaching technology and more teachers that are unsure how to assess their pupils, which in turn leads to uneven and unfair assessment.

In the background analysis of this study we showed the variations in average grades in all participating schools (table 1). We also found huge variations within the distribution of grades (table 2). Some schools reported almost no pupils that did not achieve the goals, while some schools reported the opposite. It was common for many schools not to use the whole grading scale. It would be interesting to analyse these differences in a future study.

In the future we want to study whether the beliefs expressed by the teachers in the studied questionnaire also align with the reality in the schools. We are currently in the midst of several on-going studies in which we are analysing, comparing and investigating what is taught and assessed by examining the collected tests and the IDPs in order to deepen the understanding about teachers’ ability to assess the technology subject. Complementary interviews will be undertaken to obtain a deeper understanding of the teachers’ views on and knowledge about how to teach and assess technology and, furthermore, how (and if) the ‘Tekniklyftet’ project has affected them.

Another question that arises in this context is how to resolve the difference between the subject-specific trained teachers and the teachers without such training. One aim of the ‘Tekniklyftet’ project is to find out if training the teachers during this project will accomplish a change. The teachers who teach technology and participate in the project will be educated by taking academic courses and by attending seminars where local work plans for the subject are developed. In future studies it will be interesting to examine how teachers not just express themselves but actually behave in the classroom and compare this reality with the results achieved in this study.

REFERENCES


http://salsa.artisan.se

http://siris.skolverket.se