EVA HARTELL

12. LOOKING FOR A GLIMPSE IN THE EYE

A Descriptive Study of Teachers' Work with Assessment in Technology Education

INTRODUCTION

In order to position yourself with a Global Positioning System (GPS) device, you need (1) to have a GPS device with (2) accurate software, (3) the knowledge to use and interpret it, and last but not least (4) information from at least three different satellites in order to determine a position. Depending on the model and the coverage in the area, you can get different accuracy levels. Being a technology teacher myself, I can see many similarities between the traveller's need for milestones along the road and the teachers' need for several clear benchmarks to support the assessment work that supports the student's progress. The importance of navigating at sea is familiar to me, after years of sailing on our family boat. Teaching could, in my experience, be seen in many respects as a similar activity, which put demands on all the participants. Neither teaching nor sailing is an easy, laid-back activity.

To 'navigate' students towards the goals of the curriculum, while making sure to keep every student 'on-board', is a challenge worthy of a world sailor. Despite thorough planning, you still need to make frequent check-ups, since you know neither exactly what will happen during the journey in advance nor which way to take to reach the wanted destination. This, I find, is part of the excitement/allure with travel, both as a sailor and teacher. In this study teachers' day-to-day work with assessment to support the student's progress is highlighted from the perspective of technology education. How does a technology teacher gather information in order to position her/his students before deciding on what step to take next?

Assessment and evaluation of student performance and progress in school is an ongoing process and far from consisting of only grades and test scores. Teachers make assessments/assess their students all the time with the intention of moving their students forward on their learning journey (Kimbell, 2007). They ask questions and they look for signs of response ('a glimpse in the eye') in the faces of their students. This subtle evaluation and appraisal work, which takes place every day in every classroom, is the focus of this article.

I.-B. Skogh & M.J. de Vries (Eds.), Technology Teachers as Researchers, 255–283.

PURPOSE AND RESEARCH QUESTION

My research interest is to explore how teachers make sure that their students reach the goals in the national curricula, which the students, according to the regulations, are entitled to. The focus in this present study lies upon the participating teachers' (two primary school teachers) work with technology education. I am interested in their description of their assessment practice (interviews) as well as their work in the classroom (classroom observations). The question of whether the teachers are discussing assessment with colleagues is also highlighted. According to Pettersson (2009), such discussions increase the validity of assessments made. My intention, however, is not to question the validity of the studied teachers' assessments. Neither am I interested in the inter-reliability or the intra-reliability of their assessment (Gipps, 2004; Pettersson, 2009). The main purpose of this study is to observe the assessments which occur in the daily life within the classroom walls; the minute-by-minute, day-by-day part of assessment for learning (formative assessment). The following research question is put forth:

How is Teachers' Minute-by-Minute Follow-up Enacted in the Classroom?

The focus is set to capture and identify traces of the five key strategies for formative assessment (Black and Wiliam, 2009). The purpose is to find traces of them within the classroom walls, during some technology lessons referred to by Black and Wiliam as 'engineering effective classroom discussions and other learning tasks that elicit evidence for student understanding and feedback that moves the learners forward.

TECHNOLOGY EDUCATION IN SWEDEN

To provide a picture of the content in which this study is performed, I start with a short presentation of technology education in Sweden. A more extensive description is given in Inga-Britt Skogh's chapter in this book. I am aware of the fact that technology education in Sweden differs in various respects from technology education in other countries. I have chosen not to discuss those similarities and differences here.

Despite the fact that technology education has been a mandatory subject for 30 years, it is still lacking a strong teaching tradition and roots (Fabricius et al., 2002). The teachers in technology are not always aligned with the national curricula and syllabus (Bjurulf, 2008; Klasander, 2010). Numerous supervision reports from different municipalities conducted by the Swedish Schools Inspectorate (2009a, 2009b; 2009c) confirm this. The inspectors state that the teaching of technology is not even accomplished enough (in quantity) to give the pupils the opportunity to reach the goals. It should be noted that these inspectors talk about quantity, not quality! The supervision reports are in agreement with a study performed by the Association of Swedish Engineering Industries (Teknikföretagen, 2005). This study concludes

that the situation is most alarming, in particular in the early years of schooling. Nothing much (regarding technology education) is going on at all. This undoubtedly questions the students' possibility to learn technology. In order for students to consolidate concepts, principles and perspectives, they at least have to be given time to practice in different contexts (Lindström, 2006; Dakers, 2007). It should be noted that as of today (January 2012) no national statistics exist regarding younger pupils' performance in technology (school years 1–5) as marks are given from year eight.[1] Despite all the above-mentioned circumstances, students in Sweden are, according to national statistics compiled by the National Education Agency, performing 'well' in technology; 93.9% (above average) of Swedish ninth graders exceed the goals to achieve in the syllabus (SIRIS, 2009; Hartell, 2011). How can the situation be like this, one might ask? Very limited time and resources designated for technology education and still remarkably good grading. There is something not right!

MONITORING SYSTEM IN COMPULSORY SCHOOL

In this section a brief overview of the Swedish monitoring system in compulsory school in general and in technology education in particular is presented.

Decentralized School System

The educational system in Sweden is currently going through some major changes. In 2011 a new school law, a new curricula and syllabuses, and newly introduced teacher training were implemented. This study, however, was undertaken during the previous regulations.

According to the former and current regulations, each school can decide when, how and by whom a student should be tutored in any subject matter, as long as the student achieves the targets set by the national curricula. Each teacher interprets the syllabus and makes the student assessments in relation to their interpretation of the targets. Hence teachers have great freedom and responsibility to plan their teaching as they please (Klapp-Lekholm, 2010).

In Sweden the monitoring system is based on individual teachers' assessments of the students' positions in relation to the goals in the curriculum. In the Swedish assessment system most of the teacher assessments are made during 'teaching situations' in the classrooms (Klapp-Lekholm, 2010). As the Swedish school system allows teachers to choose methods and subject content instructions (and monitoring procedures), they vary from teacher to teacher. However, teachers' assessments of the students' positions compared to the national curricula are not to vary (ibid.). According to the regulations, teacher assessments should be based on the students' knowledge and abilities and nothing else. However, Klapp-Lekholm (2008) shows that grades are based on things other than students' knowledge (e.g., students' personality or background). There are small differences but these differences vary among students, subjects and teachers. The grading of pupils that are high achievers,

for example, seems to be more content-knowledge related than that of low achievers, who seem to be graded in a more compensatory manner (ibid.).

External Assessment Instruments

There are external assessment instruments – national tests – available to teachers in Sweden in some (e.g., mathematics, Swedish, science and English) but not all subjects. The tests are externally produced, but no external referees are involved in the grading process. Grading is undertaken by the teacher her/himself. The national tests are designed to support the teacher in her/his assessment work/grading (Skolverket, 2010). However, when there is an external test several reports show that there is a considerable difference between the grade on the test and the teachers' final grades (Forsberg & Lindberg, 2010). There is no national test in technology.

In Sweden there is yet another instrument called the Individual Development Plan with written assessments, IDP, available to teachers. It is to be used by teachers as a tool for the documentation of the pupils' development of skills and knowledge in all school subjects (Hirsh, 2011). Data collected in the IDP is to be presented and discussed with the pupils and their guardians during reoccurring meetings a minimum of twice a year.

TRAINING IN ASSESSMENT

According to Lundahl (2009), most teachers in Sweden lack training in assessment. Some interventions have been undertaken by the National Agency for Education, and in some municipalities local intervention initiatives have been undertaken. The target groups for these interventions has primarily been, however, teachers in secondary school, where grading is required. Teachers working in the early years of schooling are unfortunately seldom considered to be a target group (Fagerlund & Högberg, 2010; Holmgren, 2010).

ASSESSMENT FOR LEARNING

Formative Assessment or Not

According to Wiliam (2011), assessment is the bridge between teaching and learning. However, the aims and purposes of assessment obviously differ. Making sure the students are following the intended path towards the goals is one aim. Evaluative reporting to the authorities is another (Newton, 2007; Gipps, 2004; Pettersson, 2009). If the purpose of the assessment does not include the students' future progress, one might question the usefulness of it (Nyström, 2004). The focus of this study is assessment that aims to move the students forward on their learning journey, sometimes called assessment for learning or formative assessment. The framework for the study is the work of Leahy et al. (2005), Kimbell (2007), Black & Wiliam

(1998, 2009) and Wiliam (2009, 2011). Below I present their contributions to the understanding of formative assessment, which I have found useful for this study.

Wiliam (2009) suggests a difference between assessment for learning and formative assessment regarding intention and actual function. Assessment is formative when, and only when, the information gathered is used in order to allow for probable change in the gap between the current position and the desired one for the student on her/his learning journey (Wiliam, 2009, 2011).

> Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next step in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited. (Black and Wiliam, 2009a, p. 9)

Lots of information concerning student performance is gathered but is seldom used (Wiliam, 2009). Teachers often assume that they are able to determine if their students are 'on track' or not. This assumption is often based on what the teacher herself/himself thinks that she/he has (or has not) taught her/his students (Kimbell, 2007). This is somewhat problematic. Firstly, students do not learn everything the teacher has in fact taught. Secondly, students learn stuff in other surroundings as well (ibid., Wiliam, 2011). The teacher's interpretation of gathered information can also be biased by the teacher's prior view of the student. Both the teacher's and the learner's expectations regarding her/his potential to achieve the goals set up may also affect the results (Rosentahl & Jacobson, 1992; Gipps & Murphy, 2010; Kimbell, 2007).

The Time Dimension

In order to distinguish effective and less effective formative assessment it is valuable to distinguish between the long-cycle, medium-cycle and short-cycle formative assessments (Wiliam, 2009). The short-cycle formative assessment takes place in the minute-by-minute and day-by-day work in the classrooms. The medium cycle consists of, for example, tests and other not so frequent check-ups with the duration of a day or maybe weeks or a month. The time factor is also important in another sense. The effectiveness of formative assessment declines as time passes, and it gets increasingly less likely that the learner will move forward. Despite this, the long cycle of formative assessment is not to be disregarded. Wiliam (2009) argues that the effectiveness of long-cycle assessment can be useful on a strategic/comprehensive level. Within the Swedish educational context, the long cycle of formative assessment includes national tests, grading and, according to Hirsh (2011), the previously mentioned Swedish phenomenon, the IDP.

According to Wiliam (2009), the short cycle of formative assessment, the minute-by-minute work in the classroom, is the most effective for the learners and the only one considered as formative in its true meaning.

Five Key Strategies for Formative Assessment

Leahy et al. (2005) have identified different approaches regarding how to introduce assessment for learning to teachers. A set of five broad strategies was identified and named the five key strategies (Leahy et al., 2005; Black & Wiliam, 2009).

- Clarifying and sharing learning intentions and criteria for success;
- Engineering effective classroom discussions and other learning tasks that elicit evidence for student understanding;
- Providing feedback that moves learners forward;
- Activating students as instructional resources for one another; and
- Activating students as the owners of their own learning.

According to Wiliam (2009), not only the teachers are involved in the process of formative assessment and moving the learner forward. These processes involve the teacher, the learner and their peers as entangled agents with different roles on the learning journey. This entanglement is described in the grid in Figure 1, below.

RESEARCH ON ASSESSMENT IN TECHNOLOGY

In this section a brief overview of previous research concerning formative assessment in technology education is presented. The review has been made through Swedish and English literature and selected to fit the theme of this article. Accordingly, the presentation is not intended as a complete review of relevant research on assessment in technology education.

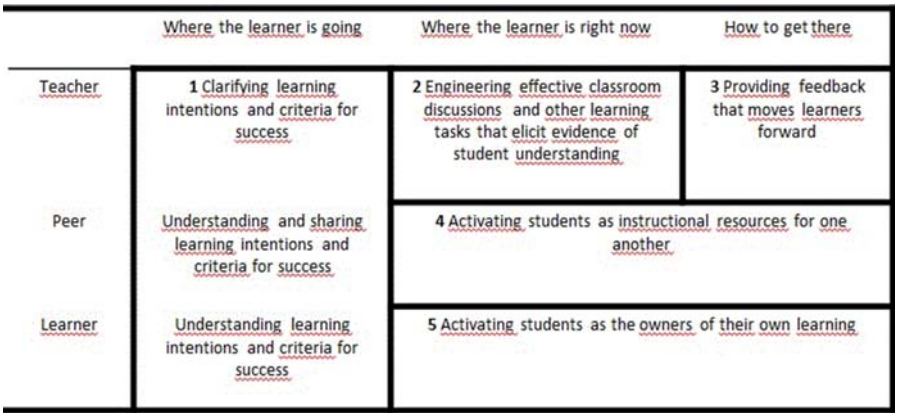

Figure 1. *Description of the five key strategies for formative assessment, and the interrelated relationship/entanglement between the teacher, peer and learner in the shared responsibility for learning. From Black & Wiliam, 2009a, p. 8.*

What is Assessed?

Technology teachers' assessment practices do not reflect technology classroom activities (Bjurulf, 2008). Most of the work undertaken in the technology classroom is 'hands on'. Still, teachers seem to value theory more than the 'practical work' pupils do during the lessons, especially when grading (Bjurulf, 2008). Teachers often emphasize criteria connected with 'the self' as a person, for example, working individually and being thorough in the so-called lived curricula (ibid.). Klapp-Lekholm (2008, 2010) supports this in her study concerning grading for personality instead of knowledge. Bjurulf (2008) questions the notion of praising theoretical knowledge rather than practical skills. This is, according to Bjurulf, a bit peculiar or even odd, since most of the time shared in the classroom is dedicated to practical work. Bjurulf suggests that there might be a 'hidden agenda' among technology teachers. Technology teachers also express the wish for their students to work individually, and this is understood, according to Bjurulf, by the students who aim for the higher grades. These students accordingly avoid asking questions of the teacher. Discussions about grading occasionally occur towards the end of a theme, but otherwise such grading discussions between teachers and students are unusual, according to the study undertaken by Bjurulf (2008).

In an article presented by Black (2008) and in a booklet by Moreland et al. (2008), the issue of assessment in technology education is addressed. In these studies the importance of discussions among students and the use of their questions are highlighted. The importance of giving students opportunities to ask questions, to receive feedback and to learn from experiences (including their own mistakes) is also emphasised. Black (2008) also highlights the importance of a permissive social climate in the classroom and of what he calls 'wait time'. He refers to a study by Rowe (1974) stating that teachers wait, on average, 0.9 s for pupils to answer a question. By increasing the amount of wait time to 3 seconds the possibilities for learning increase significantly (Black, 2008).

FEEDBACK

The Origin of Feedback

Feedback is an integral part of assessment for learning and suggested as one of the five key strategies (Leahy et al., 2005; Black et al., 2009; Lindström, 2009; Wiliam 2009). Feedback is provided not only by the teacher, but also by peers and by the learner her/himself through self-assessment (ibid.). What is feedback, then?

The concept of feedback has its origin in engineering (Wiliam, 2009). In engineering, feedback is only considered as feedback when the information is fed back into the system and used to make the process progress by altering the gap between the current position and the targeted one. The classic example is that of the thermostat, where reading it and finding *it is cold* is not feedback, in an engineer's point of view, unless some regulations have been undertaken.

Feedback has Lost its Origin

Wiliam (2009) argues that the concept of feedback is used, and too often misused, within the educational context, in which all kinds of information and comments given to the students are considered as feedback, that is, it has lost its origin. Lots of information is gathered and kept, but it is rarely used to change the situation around the student during her/his learning journey, and thus it is not to be counted as feedback, no matter what the intention was. Previous research concerning feedback in the classroom context shows that most of the feedback given in classrooms is not fed back into the system, that is, it is not to be considered as feedback (Wiliam, 2009).

Different Kinds of Feedback – the Focus

In a review of feedback, Hattie and Timperley (2007) have identified three questions to keep in mind for effective feedback.

1. Feed up. Where am I going?
2. Feed back. How am I going?
3. Feed forward. Where to next?

International research is concurrent about the findings regarding the effectiveness, for students' progress, of feedback and assessment for learning where feedback is an integral part (Black & Wiliam, 1998; Lindberg, 2005; Hattie & Timperley, 2007). They are also concurrent about related difficulties; not all feedback given improves student performance (Gipps, 2004; Wiliam, 2009). The importance of what is said and what is assessed is identified (Hattie & Timperley, 2007). Hence it is not always helpful; in some cases it even hampers learning.

Feedback falls into four categories: feedback about (1) the task, (2) the processing of the task, (3) self-regulations, (4) the self as a person (Hattie & Timperley, 2007). Information given to students which only consists of judgments or grading and therefore does not give any information regarding how to improve performance is not considered to be feedback. When feedback focuses on the person and not the task or process, the risk of hampering learning is increased. When feedback is focused on 'the self' as a person or given as praise it can even be counterproductive. It is indeed a problem that, according to research, most of the feedback given in classrooms is focused on the self as a person (no. 4; Lindström, 2006; Hattie &Timperley, 2007). Feedback should be linked to opportunities for improvement, including opportunities to work with the feedback. The most powerful feedback is focused on the processing of the task and self-regulations when it comes to mastering the task.

In conclusion, the assessor (teacher, peer, and learner) must focus on the task, process and/or self-regulation, instead of focusing on the self as a person or just give 'feedback' on routine (Lindström, 2006; Hattie & Timperley, 2007; Black & Wiliam, 1998, 1998b; 2009; Wiliam, 2009, 2011). Generally speaking it is better to keep quiet than to say something not completely thought through. If a child always,

no matter what, receives the response 'How nice, can you tell me more about it?' she/he will soon come to the conclusion that what she/he is doing is not important. For children criticism is much better received, as it proves that the teacher is taking them and their work seriously (Lindström, 2006).

METHOD

In this section a description of the collection and selection of data is given, including ethical considerations.

The study was performed in the school year of 2010/2011 when the 1994 curricula were mandatory (before the implementation of the most recent curricula in 2011). Data presented are based on observations and informal interviews with two teachers in primary school during their work with thematic studies in technology.

The study focuses on the teachers' work with assessment for learning during a number of technology lessons. The educational impact from the teaching (pupils' achievement and knowledge development) is not an issue here.

Selection of Informants

I have chosen teachers working in the lower years of schooling, due to my prior experience as a teacher in – middle and secondary school. The teachers themselves decided what theme/task of technology they would teach during my observations/data collection. By letting the teachers chose what task/theme, I acknowledge the teachers' privilege (stated in the curricula) to interpret the curricula and decide what path to take together with their students. I have tried to protect the identity of the informants by changing all names and places to fictional ones, and the municipalities are considered as one group, ABC, in order to further protect the informants.

In Sweden the municipalities are the entities for the schools. The selection of municipalities was made in accordance with statistics from the Swedish Association of Local Authorities and Regions (SALAR, 2007, 2008, 2009, and 2010). Three similar municipalities were initially identified and two were then selected. The similarities consist of four background variables; SALSA (30%), population (30%), standard cost (30%) and median net income (10%). These three municipalities are also similar in relation to the number of inhabitants and the number of students in year 9 (about 1000).

Finding Schools and Teachers

A top-down approach was used. I started by asking the school board in the two chosen municipalities to appoint schools for me/the study. The heads of the two schools suggested teachers at their respective schools. The appointed teachers were regarded as being competent representatives for their respective schools. To what extent they in fact are 'representative' for their school has not been questioned. My

intention was not to find a 'representative' teacher, whatever a representative teacher might be (?). My intention was to find teachers who were willing to participate in the study.

Case 1: Lake school

The school

Lake School is located in a multicultural housing estate location in a socio-economically challenged area. There are in total about 285 students ranging from preparatory class to year 5 (6–11 y olds). Most teachers are female and a majority of them have several years of teaching experience. Most teachers teach all subjects (with a few exceptions) in one class. The Lake School is known (in its municipality) for good results on external tests. No information was found on the school website about their work in technology.

Karen – the teacher

Karen was born in Sweden and has 30 years of teaching experience. She has been educated for teaching in primary school (years 1–3) in various subjects but not in technology. Karen has, however, two days in-service training in technology education. She teaches mathematics, natural science and technology to a group of 47 students. The students are 10 years old (4th graders). The group of children is divided into two classes. Karen shares the responsibility for the group with a colleague who teaches the other subjects. The decision to share responsibility for the group, instead of organizing the children into two separate classes, is their own. Most classes in Lake School are taught in the 'traditional' way, in which one teacher is teaching one class in all subjects for a two – or three-year period.

Karen expresses very high expectations of her pupils and sees it as her duty to make sure that her pupils learn what they are entitled to. She expresses awareness of the family background, situation and context they bring with them. She had taught the class for about three months when studied and will continue to teach this group over the next school year as well.

The premises

The classroom is located on the top floor (2nd) of a temporary school building (barracks). There are two regular classrooms; one is for mathematics, science and technology education, and the other is for English, Swedish and social science. The classroom visited is covered with books, inspirational material and the students' work (science, mathematics and technology). It is an ordinary classroom that is, not explicitly designed as a technology or science classroom. There are limited resources available. There is an evident lack of materials and tools. Karen's students mostly worked with papers, straws as materials and scissors as tools during the studied period.

There is no particular teacher's desk and no obvious front or back of the classroom. There is a whiteboard in one end of the classroom and a screen to show overheads

on the other end. Each student has a box of her/his own on a shelf and they share seats in the classrooms. The seats are arranged in groups, from four up to six or seven. Students seem to have a special place designated for them from which to start the lesson, but they also have the option to change seats when they feel like it. The students are encouraged by Karen to change seats and work with different partners. Occasionally other adults or pupils come into the classroom. This seems natural to all of them, both pupils and adults. The pupils are not disturbed in the sense that they stop working with the task. I experienced a welcoming, mutually respectful and tolerant atmosphere when visiting them.

Karen had chosen to teach about simple mechanics, pneumatics and hydraulics in the near vicinity during the studied period.

Case 2: River school

The school

River School is located in a multicultural area with both housing estates and private houses. The school has almost 800 pupils ranging from prep-class to year 9 (6–15 y old). The multicultural background could be described as dominated by one major cultural group. Most inhabitants are second generation immigrants. Most teachers are female and a majority of them have several years of teaching experience. Most teachers teach all subjects (with a few exceptions) in one class. The local work plan (found on school's website) states (regarding performance in S&T, grades 4–6): 'the student builds, makes and follows instructions.' The River School is involved in the NTA-program (www.nta.se).

Karl – the teacher

Karl was born in Sweden and has over 30 years of experience as a teacher. He was educated as a middle-school (years 4–6) teacher for various subjects not including technology education. Karl teaches 28 fifth grade students (11 y olds) in all subjects (including technology) except for sloyd and physical education. He has no in-service training in technology education. He expresses awareness of the different cultural backgrounds within the class. He has taught the current class since the beginning of the last school year and will continue to do so for the next year. He and his pupils are used to having teacher training students in the classroom.

The premises

The classroom is located on the top floor (2nd) of the main school building. It is a regular, quite small classroom not explicitly designed for technology or science education or any other subject. The walls are covered with student work: pictures and poems and such. There is an evident lack of material and tools. When, for example, demonstrating/showing that electricity can cause fire, Karl had to put a plastic bag over the fire alarm in order to prohibit it from going off. The 28 students have nine (!) batteries to share during the electricity experiments. During the plaster activity scissors and compasses were used to carve in the plaster.

All pupils have lockers in the narrow corridor outside of the classroom and they all have a school desk of their own in the classroom. The school desks are arranged (by Karl) in groups of three or four, sometimes in gender groups and sometimes not. In one corner of the classroom Karl has a teacher's desk. It is covered with a variety of material. During the lessons observed, he never sat there. There is a whiteboard at the front of the classroom and a projector in the ceiling. There is one computer in the classroom. I felt very welcome and experienced a creative atmosphere in the classroom when visiting.

Karl had chosen a historical theme concerning communication, transfer of information from past to present, and including some electricity, during the period studied.

Observations

A pilot was undertaken to test the design and the equipment. 'Ocular' observations and annotations were made during all the observed lessons, every tenth minute, together with snapshots. Inspired by Kimbell and Stables (2008), an observation chart with the focus on the teacher instead of the students was developed (Appendix 1). The chart helped me to organize the observations further. Initially, I intended to include moving pictures, but due to ethical considerations these plans were changed and I chose to not video record the sessions. The observations were complemented with some extra photos or annotations on some occasions.

All lessons were sound recorded using an mp3 sound recorder. The recordings have been carefully transcribed word by word with high accuracy. I have listened to the sound recordings while reading all transcripts several times and some of the transcripts have been cross-checked by another person. There was some shortfall with the sound recording, mostly of the students' voices, due to the limitations of the equipment and the activities in the classroom. Since the focus in this study is on the teachers and since the sound recording was combined with observations and photos, this shortfall has not affected the results presented here.

In total, six lessons, with the total length of 6.5 hours, were studied. Each lesson varied in length, from about half an hour to two hours. The lessons observed at Karen's were longer than at Karl's, and thus the data from Karen is larger in scope. This was not intentional but a result from the capturing of real-time education.

Observation Analysis

During the observation I used a specially designed observation chart (Appendix 1). My 'lens' was sharpened in the search for the five key strategies for formative assessment. The collected data was analysed in the following way. After concluding the observation sessions I analysed the data in four steps: (1) listening to the recordings of each lesson repeatedly. After this (2) all annotations/notes from the observations and from the listening sessions were matched and compared with the snapshots taken

Who/What	*Teacher*
Where the learner is going? *Where am I going?*	*(1) Clarifying learning intentions and criteria for success.*
Where is the learner right now? *How am I going?*	*(2) Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding.*
How to get there? *Where to next?*	*(3) Providing feedback that moves the learners forward.* *4) Activating students as instructional resources for one another.* *5) Activating students as the owners of their own learning.*

Figure 2. *The teacher column highlights the elements used as spectacles in this study.*

and the transcript of the recordings for every lesson. The next step in the analysis process was (3) to go through the data again using a 'check list' (Figure 2) based on the above-mentioned template presented by Black & Wiliam (1998). The check list was used as spectacles/raster when I looked for the key strategies and possible patterns in the procedure undertaken in the classroom. Finally, (4) I controlled my interpretation with the transcripts of the lessons.

Interviews

As a supplement to the observations, interviews were made. The two informants are busy, working teachers with a limited amount of time available for interviews. Despite this they agreed to answer my questions and bring clarity to what had happened during my observations. I met the teachers both before and after the observed lessons.

The interviews were informal and could be described as conversations rather than interviews. The interviews/conversations were semi-structured with some questions prepared in advance supplemented with new questions that emerged during the conversation and/or the observations (Kvale, 2008). Some of interviews were recorded and sometimes I took notes. The interview data (the recorded and annotated data) were compared to the findings from the observations.

Ethical Considerations

I have carefully followed the regulations presented by Vetenskapsrådet (2005). The teachers were informed about the study and agreed to participate. My main informants are the two teachers, but their students are indirectly involved. Since these students are underage, their guardians were informed, in writing, about the study as well. All students were allowed by their guardians to participate, one student with the exception that (s)he not be photographed and interviewed, which of course (s)he was not. The collected data is kept in a safe place to serve the ethical principal of confidentiality (Vetenskapsrådet, 2005). Finally, all names (persons and schools) are fictitious.

Concept Use – Pupils vs. Students

When translating the word pupil from English into Swedish, the translation will be student (elev) in this educational context. It can also be translated into the apple of the eye or even sweetheart (ögonsten). Throughout my study, I have had the privilege of experiencing how two teachers express and show love, trust and expectations, through small gestures, glimpses in the eye and so on, to their students themselves and their ability to learn. This is hard to capture and describe in a text (Eisner, 2007), and in order to somehow share this experience/moment with the reader I consistently use the word pupil instead of student in the following text.

RESULTS

Traces of the Five Key Strategies for Formative Assessment

There are many things going on in a classroom and many stories to be told. Findings from the study regarding how teachers work with assessment and how the minute-by-minute follow-up is reflected in the classroom will be presented by using the five key strategies for formative assessment. For each key strategy examples will be presented. The examples have been chosen with the intention of inviting the reader into the classroom situation. There are no boundaries between the five key strategies, and the examples are not chosen to be explicit only for each key strategy. The mutual respect experienced between the teachers and the pupils is presented by using *pupil* instead of student.

Key strategy no. 1 – Clarifying and sharing learning intentions and criteria for success (K1)

This key strategy is reflected in two ways. In the beginning of the work with a theme, relevant parts/goals in the national curricula were presented to the students, by the teacher reading them out loud. Other additional goals and criteria for success were then added by the teacher ‘along the way’. It appears as if the learning goals are primarily to ‘be creative’ and ‘to fulfil the task’, but it is not evident where the goals in technology are.

Illustrative examples:
Karl starts the first lesson of the theme/task by going through the curricula (reading the text out loud). The criteria for success are not explained explicitly, other than by stating that the pupils must 'complete the task'.

Karen also starts by going through the curricula. She adds 'being creative' as an additional criteria for success (in addition to the ones stipulated in the curricula). By 'being creative' she means for students to come up with their 'own ideas' (individually or in groups). Later on another criterion was added during the activities (clip below):

> Kl - CLIP FROM LESSON
> The pupils tell Karen that they have made Jumping Jacks with their previous teacher. This comes as a surprise to Karen, but she 'saves' herself/the situation by asking her pupils if they or the previous teacher did all the work. Karen continues to say that this will be a rise in severity, since they are now going to learn how to read a description with a blueprint and then work it out for them selves. The pupils have during previous lessons cut templates which they now use when following the instructions to make a Jumping Jack.

Key strategy no. 2 – Engineering effective classroom discussions and other learning tasks that elicit evidence for student understanding (K2)
Within K2 the planning and the execution of the activity in the classroom is included, as are the managerial procedures in the classroom (ensure a safe social climate among involved students and teachers). The results show an inviting and mutually respectful climate among the participants in the two classrooms studied. Both teachers frequently use gestures (big as well as small) and both teachers are constantly moving around in the classroom among their pupils to ensure that everyone is involved and task oriented.

Neither of the two teachers (both having more than 30 years of teaching experience) is trained in technology. Karen has had a two-day in-service teacher conference and Karl has experienced one day of NTA in-service training. As far as they recall they have not received any training in assessment or about the Individual Development Plan with written assessment. They also state that there are no organized discussions about technology education and/or assessment in technology in their schools.

A non-documenting practice is found in the study. Both teachers kept their knowledge (information) about the pupils' progress 'within themselves'. No notes of any kind were presented. When asked how they kept control over the progress they both stated that they base their assumptions regarding the pupils' position on their learning journey on what they see and hear during classroom activities. Karl says he sees the progress in 'the glimpse in the eye' of his pupils. None of them used written tests or diagnoses during the observed period.

Illustrative Examples – Non-documenting Practice

Karl presented a lesson plan in writing to me. The plan included a headline, a description of what to do during the theme, for example, historical exposé, construction, skills and experience. However, it is not evident what the pupils are expected to learn nor is information provided on strategies on how to follow up the results. Karl describes the planning and the preparation of the theme.

He first gathers the tools and materials needed. Some are (in this case) found in the school's supply storage and some he has had to get from elsewhere. Secondly, he makes preparations for the theme by making a form and casting the 28 rune stones (1 per pupil) in advance; he reads and prepares PowerPoint slides for the historical exposé. During the theme he takes pictures, which he included in the slides and then showed during the recapitulation in the next lesson.

Karen did not present a written plan of the theme or of the follow-up procedures. In her case the planning of content and work methods is implicit and not accounted for verbally or in writing. Instead Karen highlights the practical preparations. According to Karen, the planning process is dominated by efforts to collect the material needed. Karen borrows (in this case) needles from the sloyd teacher in the school. She collects pens, toys and other items from her own home for the pupils to investigate, disassemble and reassemble. She points out that there is a severe lack of material in the school. To ask the children to bring items from their homes due to the situation in school is not an option. She solves the problem herself by bringing material from home. A lot of time is spent collecting the material needed. She also prepares extramural activities included in the theme, for example, a visit to the fire station, looking at trucks. No extramural activities occurred during the observed lessons.

Both teachers perform their teaching in regular classrooms not explicitly designed for technology or science education. There is, in both classrooms, an evident lack of access to material and tools. The conditions for engineering effectively in order to elicit evidence for the pupils' understanding (K2) are, to say the least, in this respect limited.

The execution of the lessons follows a repeated pattern of activities. The lessons start with an introduction, during which the teacher introduces the theme/content/disposition of the session. After this the hands-on activities start. The lesson ends with a conclusive gathering before exiting the classroom. This pattern was found in both the classrooms.

Karl starts every lesson standing in the very same spot. He uses pictures and shows PowerPoint slides, while talking and asking questions, in order to recapture the previous lesson. His pupils express an interest and seem to be curious about what is said and shown. They are literally standing on their chairs and desks when watching the PowerPoint presentation, with their mouths open. Karl tries to put the lesson in context by using examples. He talks about Morse's SOS by connecting it to the song by ABBA and the Estonia tragedy. He asks the pupils to knock SOS on

their desks. Is it possible? He invites them to try and discuss it. Then he turns off the light in the classroom and flashes the SOS signal with the flashlight from his 'boat'. After the introduction the practical work starts, and the pupils seem eager to start working with their assignment.

Karen also starts her lessons located at specific spot in the classroom. She starts by recapturing the previous lesson by posing questions and statements to refresh the pupils' memories about what was going on the last time. She is evaluating and positioning the pupils' understanding and knowledge (where they are on their learning journey), hereby investigating from where she can 'take off'. She waits for her pupils and works a lot with language concepts as well. She is sorting out technology concepts like pneumatics and hydraulics, using both 'what' and 'why' recalls questions and tries to situates it.

Karen often repeats the pupils' answers with a clearer pronunciation. She says she has gotten into the habit of doing so due to her experience working with pupils with Swedish as their second language. She continues the lesson by reading a story from a textbook. She also pauses from time to time when she is reading the story. She reads out loud clearly and pronounces some of the technology-related concepts as well as words like *attic* which occur in the story. The majority of her pupils are learning Swedish as their second language and some of the pupils did not know what an attic was. They also discuss safety issues regarding visiting the attics at the pupils' housing estates. The pupils listen closely to Karen during the reading. They are quiet but occasionally, when Karen notices a pupil not paying 100% attention, she monitors him or her carefully. With small gestures, lowering her voice, she gets the attention of the pupil in question, who immediately responds with mutual respect. After the introduction phase, the lesson continues with the pupils working hands-on with the task/assignment. The pupils are instructed to work individually and to think for themselves. Karen encourages cooperation several times to pupils but also encourages them to think for themselves as well as to ask when they do not understand.

Both Karen and her pupils work very calmly and quietly, not in the sense of silence (there is a lot of talking and there are discussions going on between Karen and her pupils, in groups and individually, and also among different groups of pupils) but with low voices. The pupils appear focused during the observed lessons. Karl's pupils are task oriented and working and are verbally active (talking to each other and wanting to get attention from Karl). The pupils often nag at Karl for his attention. When asked about this, Karl expresses concern and some disappointment about this constant seeking for his attention. However, he claims to have the ability to discern when his attention is needed.

Key strategy no. 3 – Provide feedback that moves the learner forward (K3)

Due to the sound recording, some of the conversations during the activities were lost, but some results regarding the feedback provided can be presented. Two kinds of feedback deliverance are identified in the collected data; or rather the absence of them is identified.

K2 – CLIP FROM LESSON
Karen – We have talked a little bit about pneumatic ... what is it? (Pauses) Yes, air, it could move with some help from air, is that right?
Karen – Hydraulics, then? What is that? (Pauses)
Karen later – What have they changed the water into?
Karen – Why did they change it [water] into oil?
Karen – Eh ... We were away looking at the bus. What did it have? How was it that it could rise and descend?

- Was it pneumatics or hydraulics?
- And then we looked at the garbage truck. Correct/Right?
- How could it tip over the garbage cans? Because it could lift the garbage cans right?
- Was it hydraulics or pneumatics?
- OK .... What else have we done?
- Why did we build cars, anyway? What did we study/look at then?
- How did we start our work with the cars? We did not start building the cars, we did something else first.

The first kind of feedback is praise. Both Karen and Karl are sparse with praise. Karen often replies by repeating her pupils' answer in order to clear concepts and pronunciations. Karl elaborates on the pupils' comments and questions during the introduction. Karl sometimes answers his own questions in the same breath, before the pupils have a chance to reply. Secondly, there is the feedback Karen is supplying by not 'fetching' things the pupils are asking for. Instead she supports them by telling them to 'take a look for themselves' and/or then 'get it themselves'. (This is considered as a trace also for K5).

Wait time is part of giving feedback, and previous results have identified the importance of proper wait time. A rough estimate shows that Karen waits longer than 0.9 s for her pupils to answer her questions. When a pupil has answered a question she also waits before continuing. Estimates show that Karen waits longer for an answer to come than after the answer is given. Karen is deliberately waiting on her pupils. She has identified this as an area for improvement for herself. She has deliberately been working with this for a long time. She is somewhat surprised by my attention to this issue concerning wait time. She still finds it difficult and says she wants to improve even more with this and sees it as an ongoing process.

Key strategies nos. 4 and 5 –Activating students as instructional resources for one another and activating students as the owners of their own learning (K4, K5)
Karen encourages her pupils to 'think for themselves' and to discuss their work with a friend. She says herself that she chooses not to give complete answers to questions asked. When her pupils ask her, for example, where to find the scissors, she does not

facilitate by going and getting the tool requested. Instead the pupil has to look for her/himself. The pupils are also encouraged to seek partners with whom to collaborate and discuss their work and even to change seats to facilitate the conversation.

Illustrative example 1
Karen encouraging through voice/intonation – 'Christine if you need to talk with Saleh, it might be better to sit beside her.'

This comment can be interpreted as a smart comment, but her intonation says otherwise.

Karen does not lay the responsibility among the pupils. She does not leave them when stuck. She goes back after a while when she notices someone is still stuck. During the interviews she expresses the notion of making them owners of their own learning by doing this and not supplying them with the correct answer immediately or by providing the direction on where to find material and such. This is reflected in the classroom as well. She waits for the pupils and returns to the pupil after a while to make sure (s)he has got it. If the pupil still has not got it/understood or found a particular object (overcome the obstacle), she tries another way and then, if still needed, delivers the answer.

K4 and K5 – CLIP FROM LESSON
Karen – Then you look, Mario, how to get it [Jumping Jack] to flounlder.
(Inviting and prompted)
Karen – There are needles in the box?
Mario – Needle?
A little while later
Karen – Mario, watch the sketch carefully on how to do it. How can it work and flounder?
Kim – Look it flounders!
Karen – Can you (Mario and Kim) discuss this with each other?
Karen – Watch this! Here Mario … Sarah (another pupil) … look carefully … come closer … what have they done here? … Do you think? ... Between the legs (of the Jumping Jack) … Watch carefully! (Inviting and encouraging intonation)

She is identifying the pupil (Mario) who is stuck with the task. She first lets him know that she is there to support him without telling him what to do. She comes back after a while when she sees he is still stuck. And, finally, when she notices he is not getting any further by looking at the sketch she tells him to come and look at one of his peer's Jumping Jack and then guides him on where to look. Mario then continues his work successfully.

The examples presented are not only relevant to the particular key strategy. They have also been chosen to show the interactive relations between the key strategies for formative assessment through the interaction with feedback, providing feedback and

not, and at the same time elaborating by activating the pupils as learning recourses for others as well as themselves.

DISCUSSION

The results show that the teachers in the study work constantly with assessment. They ask questions, look for 'glimpses in the eye' and so on. They spend a lot of time and effort to, in various ways; establish a view of the status of their pupils' knowledge development. This is consistent with Kimbell (2007).

Traces of all five key strategies were found during the observed lessons. There are indeed many signs of the teachers' intentions to move their students forward (gestures, comments, intonation), but the effect on the pupil has not been investigated. However, prior research shows that they are not likely to be as successful as intended (e.g., Black et al., 2008). Although the results show that they are working with assessment in principle 'all the time', they are probably not always working with formative assessment or even assessment for learning. Let's look into some of the findings and see what can be learned from them.

Non-documenting

The results show that the pathway and milestones for the leaning journey are not evident to the teachers (and her/his students). The destinations are not explicit during the lessons observed. The overarching goal to enhance the pupil's interest in the technology is present in the way that the pupils engaged in the task. The results show that the teachers' conclusions on the pupils' progress are based on the teachers' own findings/reflections gained from of the activities during the lessons. This is conclusive with Klapp-Lekholm (2010).

Wiliam (2009) argues that even though teachers gather a lot of information, this information is seldom used. Hence the impact on learning from short-cycle assessment, which, according to the findings in this study occurs frequently, is becoming increasingly important. Neither of the two teachers in the study used tests and/or similar activities during the lessons observed which could have provided evidence for the importance of minute-by-minute follow-up. The documentation of the pupils' achievement is instead concluded with 'ticks in boxes' in the Individual Development Plan form indicating whether the pupil has or has not achieved the goals set in the curricula. This is done afterwards, and the template form is presented by the school head. The goals of the themes presented by the teachers in the study are vague, and the goals regarding the knowledge/skills to achieve are not clearly specified. So what are the consequences of this non-documenting practice? What happens when there is a change of teacher in the class? One consequence found in the data is the 'Jumping Jack situation'. A pupil in Karen's' classroom tells Karen that they (the pupils in the class) have already made Jumping Jacks in a previous lesson with another teacher. To Karen it is clear that the pupils have not gained the full understanding of the phenomena

illustrated in the example of Jumping Jacks. At least not the (unknown) learning objectives that she thinks are included in the task. Teachers sometimes expect that their pupils 'are' at a certain spot and that they will be 'travelling' at the same speed as the teacher is teaching. Kimbell (2007) argues that teachers need to be aware of the difficulties of assessment in order to deal with teaching properly and consciously.

Engineering Effective Classroom Discussions and Other Learning Tasks that Elicit Evidence for Student Understanding

First, for effective discussions to happen the social climate in a group needs to be safe enough for the pupils to reveal their thoughts and to take chances and even make mistakes to learn from. From the visits with Karen and Karl, the conclusion is that they have created a welcoming and mutually respectful atmosphere, both between teacher and pupil and between pupil and pupil.

This important perquisite is undoubtedly present in the observed classrooms. By stating this it is time to look for other aspects of importance.

Planning and Execution

Karen did not present a plan in writing to me. However, this is not the same as not having a plan. For her to be able to gather all the material and tools she needed she must have had some sort of plan. Moreland et al. (2008) emphasize that the structure of lessons and the embedding of assessment for learning strongly influence how the students undertake the task. A pattern of structure was identified in the collected data, as was the presence of a planning process (themes/lessons). However, the planning of themes/lessons did not focus on subject content, working methods or follow-up strategies. (Sic! They are not only teaching technology.) Instead a lot of time and effort was spent on gathering tools and material. The planning of the actual learning goals and the preparation of questions was not as evident. Asking questions, and also encouraging pupils to ask questions, is one way suggested to elicit evidence of learning; based on the answer the teacher decides what step to take next and in what direction. To be able to decide what step to take next and also deal with the unexpected answers, teachers must plan their questions in advance (Kimbell, 2007; Black & Wiliam, 2009b). The fact that there were no signs of the two teachers in the study planning their questions in advance is not surprising. With no training in technology and with no/limited resources (hereby forced to solve their supply needs themselves) nothing else is to be expected.

I argue for further studies concerning what teachers are able to use their time for. Highlighting the fact that in order to prepare the tutoring the amounts of time spend on 'getting stuff' is far too time-consuming for the teacher. Instead of preparing for technology education (content, questions and work methods) the evident lack of material and tools means that the teacher is facing an impossible work situation with very limited possibilities for planning the key strategies.

Questions and Answers

Both Karen and Karl start their lessons by rehearsing the previous lessons, in order to elicit evidence of where their pupils currently are in relation to the next milestone. Most of the questions they ask are questions of recall. This is consistent with previous research. The results, however, differ from previous research when looking at the long waiting time experienced in Karen's classroom (e.g., Black, 2008). Without having measured every single 'answer time' (the time between a question being asked and a pupil's answer and continuation after pupils respond) the conclusion is that she generally waits longer than the 0.9 s, which is the average 'wait time' experienced in classrooms (Black, 2008).

Wiliam (2011) points to the importance of making regular check-ups during the learning journey, by the teacher but also by the learner. One way of doing regular check-ups, for the teachers, is to use so called 'hinge questions' in order to decide where to go next during the lesson (Wiliam, 2011). A hinge question is to be asked at a crucial point during the lesson. Depending on the pupils' response to the hinge question, it allows for alternative ways of teaching. The continuance of the lesson pivots to better fit the students' needs. The result shows that most of the questions asked by the teachers in the study are questions of recall put forward to the whole group of pupils. A 'hinge question' is to be built on common misinterpretations concerning the subject matter in question. The teachers in this study are not trained in the subject matter and common misinterpretations are not, as far as I know, familiar to them. The teachers in the study are not trained and they are not attending any organized discussions concerning the subject matter of technology nor concerning assessment in general or assessment in technology in particular. What we ask for from our pupils is dependent on what we want out of them. Our prior experience and subject knowledge is influencing what we are able to ask for. This goes for both teachers and pupils. What implications does this have for the teacher's minute-by-minute follow-up practice? *I argue that there is a need for more research concerning teacher's minute-by-minute follow-up practice in technology education.*

In order to ask good questions you need to know the fundamental principles of the subject in question and have an understanding of the common misunderstandings that pupils might have and the creativity to formulate questions that promote thinking (Leahy et al., 2005; Black et al., 2009, Wiliam, 2009). The high-order knowledge gained from advanced studies is not needed (Hattie, 2009), but to be able to challenge the pupils the teacher needs an insight regarding the understanding of the fundamental principles of the subject and an understanding of the kinds of difficulties that pupils might have (Black et al., 2008; Wiliam, 2011). Asking hinge questions to decide which way to go during the lessons requires this kind of 'pedagogical' knowledge (Wiliam, 2011). Black and Wiliam (2009b) found that the ways which formative assessments manifest may vary in different subjects, even if the general principles apply across subjects. The only reasons for a teacher to ask a question are to either cause thinking or to elicit evidence on what to do next (Wiliam, 2011).

Based on the interview and the classroom activities, Karen expresses a notion that her pupils are inquisitive and questioning, working together and discussing their work with their classmates. According to Black et al. (2009) this is one of the main activities needed to engineer an effective learning environment (using activities that demand collaboration so that everyone is included and challenged) and also to create situations in which the pupils can tutor themselves, and to listen to and respect one another's idea (compare this with strategy no. 4, activating students as instructional resources for one another). According to Karen, the former teacher wanted them to do as they were told and work in silence with the textbooks. Karen's approach and interpretations of the syllabus are due to her prior experience. This causes different experiences for the pupils and is also a sign of different types of attitudes towards learning (Elwood, 2008). Karen's prior experience and background are reflected in her interpretation of the syllabus. With Karen the pupils are supposed to be questioning and actively working together, whereas the previous teacher wanted them to work alone in silence.

Teachers also need to be able to interpret pupils' responses to questions. And last, but not least, they also need the ability to interpret questions asked by the pupils (ibid.). This requires a thorough knowledge of the common misconceptions and student difficulties in learning the subject. My prior teaching experience tells me that content knowledge makes it easier to interpret the pupils' answers. The two teachers in the study have many years of teaching experience and a great interest in their pupils' well-being. From their 30 years of experience, it may be possible for them to rephrase and interpret the curricula for the pupils, but for most teachers this is a great challenge. To elaborate using the traveller metaphor presented at the beginning of the article, the hinge questions will, in this context, be regarded as milestones along the learning journey towards the desired destination. The teacher is the guide with some local knowledge about the surroundings, who might be able to elaborate on the pathways and surroundings during the journey. The importance of teachers sharing ideas and examples through discussions with each other is obvious. The sharing is not an end in itself, but the discussions are important for the alignment with the curricula. The pupils who have Karen or Karl for teachers are OK. They have a long history of teaching experience. But what of all the pupils who do not have teachers with this experience?

I argue that the school heads have to take greater responsibility when it comes to what happens (or does not happen) within the classrooms wall.

Both teachers are sparse with praise. Moreland et al. (2008) argue that when the teachers are focused on technological aspects they are more likely to provide feedback about that. They also highlight the fact that teachers who lack appropriate content knowledge risk not being able properly assess their students. Neither Karl nor Karen is trained in the subject, and they do not attend any organized discussions concerning the subject. Both Karl and, especially, Karen elaborate on concepts during the lessons. Leahy et al. (2005) question the amount of time used by teachers' instructional time in whole-class discussions; these sessions tend to rehearse existing

knowledge rather than create new. Leahy et al. (2005) suggest that when working with teachers and introducing the assessment for learning techniques, the teachers should also become more aware of the importance of planning their questions in advance. Kimbell (2007) highlights the importance of making adjustments 'along the way' towards the destination set in order to enhance the opportunity to elicit evidence.

I see a great need here for increasing knowledge about questioning in technology education. Questions, and in particular the so-called 'hinge questions' used during the lessons to decide what direction the next part of the lesson might take is vital (Leahy, 2005; Wiliam, 2011). By asking this kind of question, the teacher can and will make their teaching more adaptive to the needs of the pupils in 'real time', during the lessons, and accordingly make necessary adjustments 'along the way'. This is a sign of good practice (Black et al., 2009).

Encouraging the Pupils

Karen seems to be able to pick up when(ever) a pupil (e.g., Mario) is stuck. But when dealing with the reality of teaching about 25 pupils at the same time is it possible to know for sure that Karen is not missing someone? Although it seems that she keeps track of her pupils' progress in general and that they are not left alone, for too long, on their own during their learning journey, even though the destination is unknown to me. She encourages her pupils to talk to a friend, even to change seats to sit beside the ones they are talking to. She is touching K4 explicitly by encouraging the pupils to serve as resources for one another more explicitly than the teachers described in Bjurulf (2008). It is worth highlighting that the risk of certain interpretations of key strategy no. 4, activating pupils as learning resources (students as instructional resources for one another) is that the result will be the same as leaving the pupils working on their own and asking only their fellow pupils instead of the teacher (compare to Bjurulf, 2008).

No Training and Limited Resources; No Technology?

These two teachers teach whole classes of about 25 ten to eleven year olds, and they have limited access to material, tools and equipment. They are not trained in technology education and they are not attending organized discussions together with others teachers. I believe they are in control of the progress, and traces of the five key strategies for formative assessment are present. Without questioning their intention to move their pupils forward on their learning journey, I am confident that their ability to teach technology could be enhanced even more.

According to regulations, the head of the school is responsible for the quality of the teaching, and she/he must make sure that their staffs possess proper content and pedagogical knowledge. Neither of the experienced teachers in this study has received any teacher training in technology. When teachers lack knowledge

in a subject, there is an evident risk that they will not assess their pupils properly (Moreland et al., 2008).

This study also questions the limited amount of equipment accessible to the teachers and students, for example, nine batteries for 28 students. The question of all pupils being entitled to meet trained technology teachers with sufficient resources of different kinds available in school must be raised on both a national and local level. We know that teachers teaching technology in Swedish schools lack training (Teknikföretagen, 2005; Bjurulf, 2008; Klasander, 2010). We know that teachers who do not discuss their teaching with others are at risk of becoming unaligned with the current regulations and left to their own prior experience (Skolverket, 2008a, 2008b; Pettersson, 2009). We know that pupils' attitudes towards technology and technology education is influenced by the teacher (Blomdahl, 2007; Bjurulf, 2008; Skogh, 2012). How does all this affect the teacher/teaching and the learner/learning? And what happens to the important minute-by-minute follow-up in the technology classrooms? Further studies are needed, but it is probably safe to suggest that the conditions under which technology is taught today must be changed.

Input Versus Outcome

The focus in this study is the output of the teacher and not the input or response from the pupil/learner. Therefore I can only speculate on answers regarding the results of the learning outcome. Previous results show that working formatively (with the five key strategies) is successful. However, the misuse of concepts and the somewhat simplified discussions concerning the concepts of 'feedback' and 'formative assessment' should be taken into account. The outcome of the students in one of the classes is known through the results on external tests, for example, in mathematics and chemistry, but not in technology.

Feedback (K3)

When it comes to the feedback given in the classroom, it gets a bit tricky. When I Googled feedback, I got 2 450 000 000 hits (6 September 2011). I did not make any attempt to go through all this information in my search for the meaning of the word feedback. When going through literature, a variety of definitions are found, indicating the deliberate use and sometimes misuse of the word and concept of feedback. Feedback is feedback when it causes thinking and hopefully action by the learner and is not just delivered by the sender.

Wiliam (2011) stresses how important it is that the feedback provided should cause thinking in order to be considered as feedback. It should also provide more work for the recipient than the provider. The results presented here focused on the provider and thus cannot foresee the effect on the receiver. Previous results argue for the dual effectiveness of feedback regarding the impact on the individual pupil. It can both help and hamper, depending on the delivery and on the reception of it.

When feedback is focused on the self as a person or even given as praise, it stresses the notion of an ability being fixed and out of the control of the individual person instead of being something that can be developed (Black & Wiliam, 1998; Wiliam, 2011). Instead, feedback should be linked to opportunities for improvement and should encourage the notion that mistakes are a part of learning and linked to effort, not to a fixed ability (Black & Wiliam, 1998).

CONCLUSIONS AND FINAL REMARKS

In this article the question of how teachers' minute-by-minute follow-up is enacted in the classroom has been explored. Findings show that the teachers in this study constantly do minute-by-minute follow-up assessment during the lessons observed. Teachers spend a lot of time and effort establishing the 'current position' of their pupils in order to further the pupils' progress. However, findings also show that working with assessment does not necessarily mean working with formative assessment.

Based on the inviting, mutually respectful climate experienced in the classrooms observed there is no question regarding these teachers' intentions to move the learners (their pupils and sweethearts) forward on their learning journey. The somewhat problematic part is that the direction of this 'journey' seems to be somewhat unclear, and further studies are required.

The results show a disturbing lack of opportunities for common discussions among (technology) teachers. The two experienced, untrained (in technology) teachers in this study and their colleagues never discuss issues concerning technology education and/or assessment. To assume that this lack of discussion among teachers teaching technology is more of a rule than an exception is probably not controversial. But it is definitely both disturbing and alarming.

Also disturbing is the evident lack of material and tools available for the teachers, which causes a lot of effort to be spent collecting these, which in turn influences the possibilities for qualitative planning of the theme.

Assessment in technology is not frequently investigated, and I argue for the need of further investigations. This exploratory and descriptive study is a starting point for more, and the results create more questions to build upon.

So what about the GPS allegory mentioned in the beginning of the text? Well … the teachers in the study are definitely aware of the need to position the pupils, but are they properly equipped? Without having proper training and access to equipment in technology they have difficulties tuning in to the signals available 'in the air'. One could describe it as having a GPS device that is fully tuned in on satellites concerning 'general' pedagogical issues but with limited access to satellites sending 'technology education signals'. We all know that when using information from only one satellite the vulnerability increases of not being able to determine the position; add in not knowing the destination and it is even harder to decide what step to take next to decrease the gap between the current and the targeted destination. The extradition to educational context shows the risk of getting lost increases when the teachers are left

alone. We can't have that. Technology education is far too important to individuals and to society.

NOTE

[1] The Swedish school system is currently going through some overwhelming changes, and from autumn 2012 the students will be graded twice a year from school year 6.

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