

Learning to weld in technical vocational education: the first cycle of an action-oriented study



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Abstract

Creating efficient learning environments where students learn what they are supposed to learn, as well as understanding the relations between teaching and learning are recurring issues in educational settings. The importance of studying these issues in school practices is highlighted in different studies, but in relation to technical objects of learning in vocational education, there is an evident lack of such studies. By implementing an action-oriented study in iterative cycles, inspired by the Learning Study method, this study aims to redress this lack by focusing on learning processes involved when a vocational teacher and upper secondary students interact with tools and materials in relation to the object of learning to weld. We combine two different perspectives in the project (cf. Asplund & Kilbrink, 2018); variation theory analysis (VTA) (cf. Bjurulf, 2008; Marton & Tsui, 2004) and conversation analysis (CA) (Schegloff, 2007; Sidnell & Stivers, 2014). The study will be conducted as a collaborative project between a vocational teacher and two university based researchers and is funded by The Swedish Institute for Educational Research. During spring 2018 we will conduct the first cycle of the study and at the conference we will present this ongoing project and data from the first cycle.

Key Words: Action research, Conversation analysis, Technical vocational education, Variation theory, Vocational learning.

1. INTRODUCTION

Recently, the demand on collaborative research in actual school setting has been raised to develop and implement teaching on a scientific basis at school. The use of research-based methods in practice-centred school research is emphasised as an important part of improving teaching and learning at school (cf. Carlgren, 2017; Skolforskningsinstitutet, 2018). Furthermore, creating efficient learning environments where students learn what they are supposed to learn, as well as understanding the relations between teaching and learning are recurring issues in educational settings. The importance of studying these issues in school practices is also highlighted in

different studies, but in relation to technical objects of learning in vocational education, there is an evident lack of such studies. Still, it is rare that studies on collaboration between teachers and researchers are made in this specific area (cf. Kilbrink, 2018; von Schantz Lundgren et al., 2013). In a previous study on welding in technical vocational education we saw the possibility to understand the process of vocational learning in relation to the specific object of learning (OoL) to weld by using methods based on variation theory (cf. Bjurulf, 2008; Marton & Tsui, 2004) and conversation analysis (CA) (Schegloff, 2007; Sidnell & Stivers, 2014) to reach both the what- and how-aspects of learning (Asplund & Kilbrink, 2018; Kilbrink & Asplund, 2016). Therefore, we aim to take this research one step further and implement an action oriented study in collaboration with a vocational teacher, based on these two theories, and the study presented in this paper is the result of the initiated process with this work. More precisely, the aim of this paper is to examine the experiences and results of the first cycle (of a total of 9) of an action-oriented study focusing on learning processes involved when a vocational teacher and upper secondary students interact with tools and materials in relation to the OoL to weld.

2. LITERATURE REVIEW

Learning in technical as well as vocational education is considered as something specific in previous studies. Handicraft, practical experience and the bodily aspect of learning are highlighted as typical for this type of learning (cf. Bjurulf, 2008; Björkholm, 2015; Kilbrink, 2018; von Schantz Lundgren et al., 2013). However, there are few studies investigating learning of specific learning content in these areas and research pinpoints a need for how teaching and learning of different content is done in relation to technical objects of learning (cf. Asplund & Kilbrink, 2018; Hallström, 2018; Kilbrink, 2018). There are even fewer studies focusing on this area in practical settings, hence the need for studying technical objects of learning in actual teaching. Studies on how different learning contents are taught has been made previously using the Learning study method in collaboration between teachers and researchers, aiming to bridge the theory – practice divide between research and teaching in practice (cf. Kilbrink et al. 2014; Lo, 2009). Learning study is a form of action research with a specific focus on the learning content and is normally based on the variation theory of learning. Variation theory pays specific attention to the content of learning, described as the OoL. There are only a few Learning studies in the area of technology education (Björkholm, 2015; Kilbrink et al. 2014) and the area of vocational education (von Schantz Lundgren et al., 2013).

In vocational education, objects of learning are often taught in interaction between teacher and learner. For that reason, the strict focus on the learning content, without taking into account the aspect of how learning is done in interaction, is too narrow in order to understand the process of learning (Asplund & Kilbrink, 2018). In order to reach both the what- and the how-aspects of learning, we combine a variation theory perspective with a conversation analytic approach to learning in interaction (cf. Emanuelsson & Sahlström, 2008). Hence, this action-oriented study is inspired by the learning study method, but adapted to the context and the two theories in use (see below).

Currently, there is a growing number of CA studies on learning, and the majority of these studies argue that CA's understanding of participation and social organisation can contribute to a better understanding of learning in interaction (Gardner, 2012; Lee, 2010; Sahlström, 2011). Recently, many researchers have been interested in further studying issues of content from a CA point of view, by showing how learning is something that is established in interaction, and how issues of content can be integrated in the analysis of interaction (Melander, 2012a, 2012b; Melander & Sahlström, 2009a, 2009b; Sahlström, 2012). Research studies combining CA with other theoretical perspectives in order to clarify the content being taught and towards which participants orient in interaction have been done before (Asplund & Pérez Prieto, 2013; Asplund & Kilbrink, 2018; Emanuelsson & Sahlström, 2008), although to a small extent, and our research should be seen as a continuation of this research.

3. METHODOLOGY

As described above, we implement an action-oriented study by focusing on learning processes involved when a vocational teacher and upper secondary students interact with tools and materials in relation to the OoL to weld. We combine two different perspectives in the project (cf. Asplund & Kilbrink, 2018); variation theory (cf. Bjurulf, 2008; Marton & Tsui, 2004) and conversation analysis (CA) (Schegloff, 2007; Sidnell & Stivers, 2014). The study will be conducted as a collaborative project between a vocational teacher and two university based

researchers. During spring 2018 we have conducted the first cycle of the study and in this article we present this ongoing project and data from the first cycle.

3.1. Action-Oriented Study

This study is described as an action-oriented study while it is conducted in collaboration between two researchers and a vocational teacher at an upper secondary school, and the teaching is planned and analysed by using the two theories mentioned above. The teaching will be planned, implemented and analysed in iterative cycles, inspired by the Learning study method (cf. Kilbrink et al., 2014; Pang & Ling, 2012). In a Learning study, there is a specific focus on the learning content (referred to as the OoL), and the use of variation theory. The teaching of this OoL is planned and analysed in specific steps in iterative cycles; pre-test, planning, teaching, post-test, analyse and revise. In our study, however, we have removed the pre- and post-test, and instead added a CA approach in order to analyse how welding competences are displayed, developed and learned in the social interaction. Approaching the data from a CA's understanding of participation and social organisation can help us to reveal the learning processes that take place in the interaction from an emic perspective (see a further description of this below). The CA perspective can also add another aspect of how the OoL can be varied in interaction using different semiotic resources (cf. Asplund & Kilbrink, 2018).

3.2. VTA

Variation theory is a learning theory which emphasises the learning content as the OoL (cf. Marton och Tsui, 2004). The OoL can be divided into the intended OoL (what the teacher planned for), the enacted OoL (what was possible to learn in the teaching/learning situation), and the lived OoL (what the students actually learned). Aspects of the OoL that are important to know in order to know an OoL are called *critical aspects*. For example – in order to know that a triangle is a triangle, you need to know that it has three angles and three sides, which makes the angles and the sides critical aspects. Those critical aspects can vary. For example, a triangle can be a right angle triangle or not, but is still a triangle. If the figure has four sides instead, it is no longer a triangle. This variation can be described in patterns of variation, which has been described as necessary conditions for learning. In order to see something, the critical aspects of this something also need to be discerned by the learner. The first example – when comparing different kinds of triangles, *generalisation* as pattern of variation is used, while the pattern of variation used when comparing three sides to four sides is *contrast*. When separating one critical aspect at the time, the pattern is called *separation* and when comparing all the critical aspects at one time the pattern of variation *fusion* is used (cf. Marton & Tsui, 2004). Furthermore, fusion can relate to how the critical aspects of the OoL interrelate (internal horizon of fusion) or to how the OoL as a whole relates to the context (external horizon of fusion) (Lo and Chik, 2016).

In the study we use the variation theory together with CA as a basis for the teaching, and as a tool for analysing the teaching and learning. We use the concept *variation theory analysis (VTA)* for this analytical tool. The focus in the VTA is on what patterns of variation appear in the actual teaching situation – in the interaction between teacher and student in relation to the enacted OoL, where the CA can help us with a close and detailed analysis of the interaction itself (cf. Asplund and Kilbrink, 2018).

3.3. CA

In our study, we view learning as situated in social situations and contexts, where participants, in our case a teacher and his students, are engaged in mutual social actions (e.g. Enfield and Levinson, 2006; Lave, 1993; Sahlström, 2011). We use the methodological tools provided by conversation analysis in order to analyse and describe how aspects of teaching and learning evolve through the participants' orientations in the situated activity of learning how to weld. In our analysis, we understand both verbal and non-verbal language as resources that people use to produce and reproduce social reality; thus not only speech but also other semiotic resources such as body movements and physical objects are seen as constitutive of the activities being analysed in our study (Goodwin, 2000). In line with the CA strive for an emic perspective on both data construction and analysis, our analysis focus on how the participants understand the situations, there and then, and how they orient to these situations (e.g. Lee 2010; Melander 2012b; Rusk, Pörn, Sahlström & Slotte-Lüttge, 2015). This means that we examine which actions are made relevant at a specific moment in the interaction, and how they are made relevant, from the participants' point of views, and the method involves the use of the participants' demonstrated understanding of each other's actions, and thereby provides material for analytic explication (Schegloff, 2007).

In doing so, video recordings are transcribed in great detail according to specific conventions (e.g. Mondada 2006).

Our approach is thus in line with the content-centered CA-studies that aim to capture interactional practices linked to learning a specific content or practice (see Rusk et al., 2015). This means that our focus is on how the teacher and the students orient to the specific OoL of how to weld, and how the teacher and students adapt and change their participation in the unfolding interaction regarding how to weld, where the VTA can help us understand the enacted OoL in detail.

3.4. Implementation of the first cycle

Before implementing the first cycle, the teacher read our previous research on welding (Asplund & Kilbrink, 2018) and a text on variation theory (Carlgren, 2017). Thereafter, the cycle started with an interview conversation with the vocational teacher, conducted by the two researchers. The overall purpose of this conversation was to give the researchers some insights into the vocational teacher's didactic approach to the teaching of the specific welding method (TIG welding) that was going to be conducted and video filmed during the first cycle lesson. Another purpose with the interview conversation was to give the researchers insight into the specific teaching context. During this conversation, the teacher also described the main/most central features of the welding method TIG and reflected on the challenges students have to deal with when learning to weld TIG, based on his previous experiences of teaching this welding method. Based on this conversation the researchers identified some possible critical aspects of TIG-welding. However, for this first cycle, we did not go into planning these critical aspects in detail using the CA and VTA, but rather asked the teacher to teach as he was used to (possibly influenced by the texts he had read through).

Two weeks after this conversation, the researchers visited the participating school and informed the teachers in the working team, the school principal and the focus students chosen by the teachers to participate in the first cycle of the project. Everyone was positive about the project and all four students agreed to participate. The week after that, the first cycle lesson was conducted and the teaching was videotaped. The video recordings were analysed by the researchers at a primary stage, then analysed by the researchers and the teaching vocational teacher together. Three students participated in this lesson (one was absent). Based on these analyses, based primarily on a variation theory analysis and conversation analytic perspective, the teacher, together with the researchers, has worked on new teaching strategies that are to be incorporated into the teacher's didactic approach towards cycle 2.

4. Results

The first cycle started with an interview conversation between the researchers and the teacher. The possible critical aspects of TIG welding that emerged during this interview conversation with the teacher concerned aspects from seeing the melt and handling the tools, to ergonomics and cleaning. This means that we could expect a very broad area of teaching with regards to how to weld in the actual first cycle lesson, which was also the case. The video recorded lesson in the first cycle lasted for two hours. The class started with a teacher led introduction lasting for about 70 minutes. During the introduction the teacher raised a plurality of aspects, relevant for learning to weld TIG welding. This also meant that there were many different OoL in relation to TIG-welding present in the introduction, also concerning the variety of aspects that emerged from the introducing conversation with the teacher. The teacher's introduction then ended with the teacher instructing how to weld TIG, and the students were asked to stand behind the teacher one by one to watch him weld. Hence, the results show that there are many aspects of welding in the introductory session.

After the instruction and demonstration made by the teacher, the students got some time to weld on their own, where the teacher alternated supervision of the different students in their welding booths (see Figure 1).



Figure 1. Teacher and student involved in welding

In this phase we interpret the OoL to be narrowed down to the actual making of a TIG-weld. This OoL (the making of a TIG-weld) is also our focus in the analysis of the interaction between the teacher and the students. In our analysis we can see that some critical aspects emerge in the interaction in relation to the enacted OoL. Those critical aspects are oriented to and made relevant by the students, and the teacher, in the interaction. This means that the critical aspects that emerge when the teacher interacts with the different students are not identical. Thus, they differ between the students, but can be summarized as:

- The melt (the most central aspect)
- Welding mode (weight drop and how the melt flows in relation to welding mode, as here, position B)
- The material welded on
- The additive material
- The movement
- The speed of welding
- The body position
- The current (amperage)
- The distance to the welding material
- The substrate welded on

During the lesson, the teacher was using different gestures and patterns of variation (generalisation and contrasting) to emphasise those critical aspects that were oriented to in the interaction (cf. Asplund & Kilbrink, 2018). One example of teacher and student interaction can be seen in Figure 2 below.

1. ((the teacher grabs the student's right shoulder
and squeezes it))
2. Student: but I don't know how I hold. I don't actually know
3. how I should hold
4. Teacher: it is like I said, find yourself a: (.) keep
5. searching for your way forward
6. some ho:::ld ((leans forward and grabs the welding
7. tool))the burner like this:
8.



9. Student: mm: ((nods))
10. Teacher: some use a pen hold (.) that is you take it
11. like this



12. Student: ((nods. looks at the teacher))
13. Teacher: and for those of you who are right-handed it is like
14. (.) this you know instead



15. Student: ((nods))

Figure 2. Teacher and student interaction

One time the teacher asked the students to take a break and gather outside the welding booths for a short common briefing, but this brake was not related to the narrowed OoL, but to the welding material and how to handle this in order to save costs. Hence, there was an alternation between internal and external aspects of the OoL as well as between internal and external horizon of fusion (Lo & Chik, 2016). The teaching shifted between focusing on the wholeness and the details – from whole to parts and vice versa.

Based on the analysis we made after the first cycle, we aim to focus on the narrowed OoL – the actual making of a TIG-weld and to include the VTA and CA theories in the planning of the second cycle together with the teacher. Thereby we hope to reach a more detailed understanding of the process of learning a specific technical vocational content in interaction.

In our first preliminary analysis we can see that there is a clear orientation towards the activities as teaching and learning activities. By using CA methodology we can validate our claims based on what the participants orient to and make relevant in the interaction here and now. This means that we can also see processes of explicit longitudinal orientations. In these examples, both the teacher and the students, orientate not only towards the welding that takes place here and now, but also towards the welding that has been done, and the welding that shall take place next. This content-integrated longitudinal orientation is one aspect that makes it possible for us

to describe the studied situations as learning situations (Sahlström, 2011), and make claims about the learning processes that take place.

5. DISCUSSION

Already after the first cycle in this project, we can find many different results that can be studied further to get a broader knowledge on both the teaching of the object of learning to weld and of this way of working with an action-oriented approach in collaboration between teachers and researchers in relation to specific objects of learning in teaching. These results could assist in understanding the OoL in more depth and finding concepts and words for what teachers and students do in the actual learning interaction of the OoL. Thereby, this research can contribute to teachers' professional learning and in the longer run also to improving teaching and learning.

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