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Transfer in Technical Vocational Education

– A Narrative study in Swedish upper secondary school

Abstract In vocational education, teaching and learning are expected to take place in the different learning arenas; schools and workplaces. In such a dual school system, the question of transfer is vital, i.e. how to use knowledge learned in previous situations in new situations. This article is an empirical contribution to research concerning transfer, by means of results from semi-structured group interviews with teachers and supervisors who educate students in the Energy program and the Industry program in Swedish upper secondary school. The interviews were analysed by analyses of narratives. The results show four themes of transfer in the interviews: (1) transfer of basic knowledge, (2) transfer of principles and skills, (3) transfer of written materials and real life and (4) transfer of experiences. The results also show three factors that are crucial in order to create possibilities for transfer: (1) communication, (2) financial resources and (3) reflection. These factors demand close cooperation between the teachers and supervisors during the students' vocational education.

Keywords Analysis of narratives; Phenomenology of the life-world; Technical oriented education; Transfer; Upper secondary school; Vocational education

Introduction

In order to meet the need for well-educated citizens and for qualified labour, there are demands for vocational education systems that function successfully. In the last decades, there have been discussions about how vocational education should function. One of the most important and recurring issues is the interaction between school and the workplace (e.g. Al-Ali & Middleton, 2004; Berglund, 2009; Lindberg, 2003; Skolinspektionen 2011:2). School and workplaces often have different interests and ideas concerning the goals and the execution of the education process (Caravaglia, 1993; Meijers, 2008; Skolinspektionen 2011:2; Tanggaard, 2007). There are indications of problems concerning bridging the gap between school and workplace training in dual school systems¹, where education is conducted *both* at school and at different workplaces (Caravaglia, 1993; Meijers, 2008; Skolinspektionen 2011:2; Tanggaard, 2007). There is also a challenge for assessment, where various interpretations between school and workplaces are usual (Gulikers, Baartman, & Biemans, 2010). Previous vocational education research has dealt with questions concerning learning in several arenas, primarily school and workplace training (e.g. Aarkrog, 2005; Al-Ali & Middleton, 2004; Bjurulf, Submitted; Caravaglia, 1993; Meijers, 2008; Tynjälä, 2009). However, earlier findings also shows that school and workplace training can complement each other, since each learning arena offers students specific opportunities for learning (Aarkrog, 2005; Bjurulf, 2010).

How to use knowledge learned in previous situations in new situations is a fundamental question in education. This phenomenon is known as transfer (e.g. Bransford & Schwartz, 1999; Marton, 2006). Taking transfer into consideration is especially important in vocational schools, where a large part of school time is concerned with workplace training. Earlier work has discussed, problematised and criticised the concept of transfer (compare Beach, 1999; Bransford & Schwartz, 1999; Lobato, 2003; Marton, 2006). For example, aspects of criticism have concerned the narrow approach of simply discussing transfer as applying knowledge from *one* situation to another *similar* situation (Beach, 1999; Bransford & Schwartz, 1999; Marton, 2006). Marton criticises previous transfer research that focuses on similarities, without taking differences between situations into account.

¹ We use the concept dual school system, in order to emphasise that the vocational education is conducted both at school and workplaces within ordinary educational time.

Marton (2006) also agrees with Bransford and Schwartz's (1999) view on transfer as a preparation for future learning, where people can relate their learning to previous experiences. According to Marton (2006), variation in teaching is crucial for the learner in order to be prepared for unknown future situations. This variation is needed for the students in order to discern critical differences between situations and thereby "be able to adjust to new situations" (p. 521). He also argues that "transfer effects may increase with time, experience, and differences" (Marton, 2006 p. 512).

In vocational education research, there have been earlier studies focusing the transfer between schools and workplaces. There are also different ways of problemising the transfer concept in this research area (e. g. Helms Jørgensen, 2011; Tuomi-Gröhn & Engeström, 2003). For instance, Helms Jørgensen (2011) has replaced the concept of transfer with the concept of "learning as transformation" in order to emphasise that there is not only a question of applying what has been learned in one context (school/education) in another context (workplace), but a more complex process where both mental, social and organizational changes are involved. Tuomi-Gröhn and Engeström (2003) have edited a book on perspectives in transfer and boundary-crossing, focusing on transfer in vocational education and training. As per the studies mentioned above, they have also criticized the view of transfer as transfer of knowledge from one task to another task. The authors in Tuomi-Gröhn and Engeström's (2003) book suggest different alternative approaches to transfer and focus on "learning as boundary-crossing between organizations" (ibid. p. 6). The examples given in the book both refers to suggestions of new conceptions, such as transition aiming at how knowledge for example can be generalized over time. Furthermore, like in the works of Marton (2006) and Bransford and Schwartz (1999) mentioned above, there are also suggestions of more complex meanings of the concept of transfer focusing on learning processes.

Transfer of knowledge between different learning arenas is a challenge for vocational education, where learning is supposed to take place both at school and at workplaces. Therefore, it is important to study how people working in vocational education experience transfer.

The aim of this article is to study teachers' and supervisors' told experiences of transfer by answering the following research questions:

- What themes of transfer appear in teachers' and supervisors' narratives about technical vocational education?²
- What factors in the narratives are crucial for providing transfer possibilities in technical vocational education?

This study is part of a three-year project termed the *LISA*-project (*Learning In Several Arenas*), where arenas refer to where the learning takes place; the learning arena. Arenas can relate to places such as schools and workplaces, it can also refer to and include other arenas such as written materials, TV-programs, recreational activities etcetera. The *LISA*-project focuses on teaching and learning at vocational school and workplaces, especially in the Energy Program and the Industry Program³ at upper secondary school in Sweden.

² This question is a further elaboration of "Different Kinds of Transfer in Technical Vocational Education" by Kilbrink and Bjurulf, presented at the *PATT 25* conference in London 2011.

³ In the Energy Program trainee plumbers are educated and the program specific education concerns heating and sanitation. In the Industry Program becoming industrial workers are educated and the program specific education concerns for example welding and turning.

Theoretical framework

Previous research has discussed how to educate practitioners, and how experienced practitioners' knowledge, often expressed as tacit knowledge, can be communicated/demonstrated to learners (cf. Dreyfus & Dreyfus, 1986; Göransson, Hammarén, & Ennals, 2006; Kvale & Nielsen, 2000; Schön, 2003). When it comes to learning for a concrete occupation with a practical focus and professional knowledge, this kind of research is important. Dreyfus and Dreyfus (1986) have suggested a five-step-model in order to explain the stages that learners pass through from novice to expert, through practical experience. In the first stage, learning is contextualised and the learner often learns by instruction. Throughout the five stages, the learning becomes more and more holistic and less contextualised, in order to be integrated within the learner himself. This model is inspired by the philosophy of Merleau-Ponty's being-to-the-world (Dreyfus & Dreyfus, 1986; Merleau-Ponty, 1962/2002). During learning, knowledge becomes embodied through practical experience. Merleau-Ponty's being-to-the-world builds on Heidegger's being-in-the-world (Heidegger, 1927/2004), which emphasises mutuality between the human and the world. This philosophy is included in the phenomenology of the *life-world* (Bengtsson, 1999; Kilbrink, 2008), which forms the ontological point of departure for this study. According to the phenomenology of the life-world, we all live in the same world, but we experience it differently according to our own perspectives and earlier experiences. Phenomenology of the life-world research focus is the world where people live and experience their lives (Bengtsson, 1999; Bjurulf, 2008; Kilbrink, 2008; Kroksmark, 1987). Based on this phenomenological ontology, it follows that empirical studies are needed in order to obtain knowledge about the experienced world. Our view of transfer as it pertains to this study is based on the transfer theories articulated by Bransford and Schwartz (1999) and Marton (2006). In this regard, transfer is seen as a learning process and a preparation for future learning where experiences from different situations are used in order to handle new unknown situations by discerning similarities and differences between situations. From this perspective, transfer is permeated by variation, in the way variation is expressed in variation theory (Marton, Runesson and Tsui 2004). On this score, Marton et al. (2004) state that, "Learning, for instance, to solve a problem in different ways requires experiences of variation in solving strategies" (p. 15). Another assumption underlying the present study is that people can convey experiences through narratives (Polkinghorne, 1995; Ricoeur, 1993).

Method

A qualitative methodology was deployed to investigate the appearance of transfer and factors providing transfer possibilities in teachers' and supervisors' narratives.

Participants and data collection

This article reports semi-structured group interviews (Cohen, Manion, & Morrison, 2000; Kvale 1997) conducted with two teachers and three supervisors who all work with students in vocational study programs in a Swedish upper secondary school (see Table 1). The teachers in this study educate the students in subjects specific to the programs at school and the supervisors supervise the students during their workplace training. The school in question is part of an experimental project with trainees in upper secondary education, which includes half the time as education at school and half the time as workplace training (Sveriges Riksdag, 2009). Both the Energy program and the Industry program in question are thus in-school programs, and not workplace programs, organized as dual educational systems with about half educational time in school and workplaces respectively. The supervisors are workers at the workplaces, who supervise the pupils during their workplace training. Thus, the supervisors are not teachers from school, but plumbers and industrial workers.

Furthermore, the teachers in this study have worked as a plumber and as an industrial worker, before they made a choice to retrain to teachers.

Table 1 Participating informants and length of the conducted interviews

Interview and Informants	Length (minutes)
Energy program (teacher Erik and plumber Ernst)	87
Industry program (teacher Ivan, industrial workers Ingemar and Ingvar)	54
Supervisors (plumber Ernst, industrial workers Ingemar and Ingvar)	64
Teachers (Erik at the Energy program and Ivan at the Industry program)	60

The informants are involved in the three-year *LISA*-project, where a deliberate selection process of informants was used (Cohen et al., 2000). The informants teach or supervise in the Energy Program or in the Industry Program. All informants were informed of section 16 of Act 2003:460 on research involving humans and gave their written consent to participating in the study (SFS 2003:460, §16). Research ethics principles as defined by the Swedish Research Council are followed in the project (Vetenskapsrådet, 2002).

In the present study, interviews were conducted during a two-day seminar during fall 2010 (see Table 1) and were recorded with a voice recorder and transcribed verbatim.

In order to obtain narratives about transfer in vocational education, the interviews were conducted with the following points of departure with respect to the following three topics:

- What are the students expected to learn during their vocational education?
- How can this learning be induced?
- What are the roles of the school and the workplaces in the students' learning process?

The teachers brought the current syllabi to the interviews with both teachers and supervisors, as a starting point for the interviews. The method used allows for the modification of questions to the individual informants and for exploration of the responses. The narratives related in the interviews will be seen as a co-production between the interviewer and the informants in the interview situation, since the narratives are framed by the questions from the interviewer (De Fina, 2009). Therefore, the results reported in this article are based on what the teachers and supervisors chose to tell in the interviews. The results do not claim to answer what really happens, but to answer peoples' told experiences of the delimited part of the life-world, defined by the research questions.

Data analysis

The interviews were analysed by *analysis of narratives*, which means looking for common themes, concepts or categories, emerging in the data (see e.g. Goodson, 1996; Lieblich, Tuval-Mashiach, & Zilber, 1998; Polkinghorne, 1995; Riessman, 2008). In this study, we listened to the recordings and read the transcripts several times and then constructed a common narrative about what the teachers and supervisors expressed about teaching and learning, in a dual school system. Based on the research questions, the common narrative was written in order to describe different themes of transfer that appeared in teachers' and supervisors' narratives about technical vocational education and to describe factors in the teachers' and supervisors' narratives that are crucial in order to provide possibilities for transfer in technical vocational education. Thus, the teachers' and the supervisors' narratives were synthesised into a common narrative. Hence, we use the concept

narrative for what the informants tell in the interview and then we merge their narratives in to a common narrative in our presentation of the results.

We used a model (Table 2), inspired by Liblich et al (1998) and Mishler (1997), in order to structure the empirical material, when analysing the interviews.

Table 2 Analysis model

<i>Theme</i>	<i>Transfer/Factor</i>	<i>Interview</i>
The theme, to which the transfer or factor relates.	What transfer and/or what crucial factor for transfer are/is discussed in the interview?	Which interview, who and where in the interview?

When listening to the interviews and reading the transcripts, we focused on the informants' narratives concerning content relating to *transfer*, *factors providing transfer possibilities* and *teaching and learning in different arenas*. Thereby different themes appeared during the analysis of the interviews. Accordingly, the themes only concern the experiences of transfer occurring in the narratives. Therefore, the results do not claim to present all kinds of transfer appearing in vocational education, but the kinds of transfer the informants choose to tell about in the interviews in this study. When presenting the results, we start with a summary of all themes and thereafter we present the different themes as a common narrative. The common narrative consists of a merging of the experiences from all informants with the point of departure in the emerging themes. With the point of departure in the method chosen, we aim to keep the voices of the informants visual in the presentation of the results and therefore use quotations from the interviews in the common narrative as illustrating examples. All the verbatim quotes from the interviews are the authors' translations from Swedish into English and they are indicated by quotation marks and embedded in the narrative.

Results

The results are presented as a common narrative, where the teachers' and supervisors' narratives about transfer from the interviews are synthesised into one common narrative. It is introduced with the following summary:

This is the narrative about transfer in technical vocational education, where teachers and supervisors spoke about *transfer of basic knowledge*, *transfer of principles and skills*, *transfer of written materials and real life* and *transfer of experiences*. Since no-one can be taught to be an expert during education, school and the workplace training must complement each other in order to help the students in learning to learn. This presupposes continuous and appropriate *communication* between supervisors and teachers. It also presupposes possibilities for *reflection* about how to develop the knowledge with the point of departure in previous experiences. *Financial resources* can be an obstacle for transfer when the lack of resources prevents teachers and supervisors from creating fruitful learning environments or letting the students take an active part in the daily work. But, financial resources can also promote a close cooperation between the two arenas, school and workplaces, in terms of using each other's resources, which supports further possibilities for transfer.

Themes of transfer

The four themes of transfer, which emerged from the data analysis, are: *transfer of basic knowledge*, *transfer of principles and skills*, *transfer of written materials and real life* and *transfer of experiences*.

Transfer of basic knowledge

Before the students enter the workplaces they require basic knowledge: “the theory is the first thing they need”, says the supervisor Ingemar, and “the school must provide them with basic knowledge” since there is no time at the workplace to start from scratch. When the students have learnt the basics at school, they are able to apply the knowledge at the workplaces, according to Ivan, the teacher. He says that “all machines have an elementary code, an ISO-code”. If the students understand the ISO-code, they are able to manage different machines, even if and when there are differences between the machines. Additionally, there is no possibility for the teacher to teach about all the machines. “It is hard for me to provide them with a precise training”, says Ivan, “because then I would need to have all the control systems in the world at school, and that is impossible”. If the students know the basic ISO-code, they can build further on this knowledge and adjust their knowledge to the machines they meet in the workplaces.

In order to understand if results are probable, there is also a need for basic knowledge and to be able to use this knowledge in different arenas. The supervisor Ingvar says that they have supervised students at his company “who get values in the mill that are unrealistic without reacting”. They cannot relate the result to anything. The teachers and supervisors agree on the importance of being skilled in mathematics as a plumber or industrial worker. Therefore, the students need to have a sound knowledge of mathematics in order to be able to perform their work properly and successfully. “If they can’t calculate, they are out”, says the teacher Ivan. His experience is that students today are lacking in knowledge and therefore he “goes on about mathematics” from the first day at upper secondary school. According to the teachers and supervisors, mathematics is one example of the basic knowledge the students need to learn at school, the previous knowledge they need in order to be able to carry out the work they are supposed to do at the workplaces. Other examples of basic knowledge the students need to learn at school is the use of tools, knowledge about materials and measuring. Thereafter, they need to transfer this knowledge to new arenas and build further on the acquired knowledge.

Transfer of principles and skills

In order to learn principles and skills, for example how to bend pipes, the students use a cheaper material at school than that is normally used at the workplaces. The teacher Erik talks about how he is “a bit stingy”, and suggests that “it is easier to practice with a steel wire, there is no point in starting with pipe directly; I think it is ‘chic’ with this steel wire”. It costs a lot to let all the students practice bending pipes at the same time, since they then require many tools, but “I can give everyone a steel wire, and then we can bend together”, says Erik. The materials have different properties, so the students have to translate their knowledge about bending principles to other conditions, by using other tools and/or between different situations.

The teacher Ivan also tells that the tools are dependent on the type of material you are working with and “what is important between different materials is the cut speed”. The students need to learn what to look and listen for during working with engineering materials, in order to understand how to

handle different materials with different tools and measurement instruments. In this instance, the principles of how they work with the materials are the same, but the materials and tools may differ.

The teacher Erik talks about “tacit knowledge” or knowledge “that are hard to articulate”, that the students have to learn during their education. The teachers Erik and Ivan articulate that, when the pupils are learning to weld for example, they have to learn to use different senses. For example, Erik suggests that you have to listen carefully when you are welding, in order to “hear when it is right” and when you have “learned this skill”, you “know how to weld”. The materials and the way of welding can differ, but the senses can be used similarly in relation to these different engineering materials in new situations.

Transfer of written materials and real life

In order to become a plumber or an industrial worker, there is a high requirement to be able to transfer content from written materials into concrete action or situations. For a plumber, understanding the isometric cube is fundamental, since it explains the “routes you have” to choose between when bending pipes, the supervisor Ernst says. When a plumber is going to install pipes, the alternatives are “up, down, right, left, right forward, right rear, left rear, left forward”, which he illustrates with the isometric cube. “It is included in textbooks”, says Erik the teacher. Erik and Ernst are in complete agreement about the importance of the students’ understanding of the isometric cube. “If they can draw this cube, as Erik says, half the job is done”, says Ernst. Furthermore, Ernst means that the students may practice the isometric cube both at school and at the workplaces.

As a plumber or industrial worker, you need to be able to transfer drawings into real life. The teacher Ivan exemplifies this by saying that he “can make a drawing in CAD, run it through a cam module, and then there will be a program of the drawing for a specific machine”. It is also important to be able to transfer real life into documentation, “it facilitates a lot”, the teacher Erik says, and continues “because sometime you step in on, or let a job go, and if you can make a drawing, then you can explain in real detail”. Erik also says that this is hard to learn, but the supervisor Ernst states that “if you know this, an awful lot of the work is done”.

Students can also be induced to understand complicated connections in real life by drawing pictures of these complicated connections. The supervisor Ernst says that the pupil “who does not understand the first time, he sits and makes a drawing of the pipe” and then by studying this drawing he understands how it works and “acquires a picture of the thing and sees the problem, but cannot explain it directly in words”.

Transfer of experiences

Once the students have obtained the basic knowledge, they need to acquire practical experience. The more experienced they are, the better they are able to perform more advanced tasks. Ingvar, the supervisor, describes a pupil in the third year, who “handled a controlled mill by himself”. The pupil just “asked if it was something he did not understand, but otherwise he handled the machine independently, and that is great”, says Ingvar. The supervisor Ernst also provides an example of a pupil who had a certain degree of experience. The pupil was to perform a job where he needed five pipes and Ernst gave him eight. “Well, what do I need those for?” asked the pupil, to which Ernst answered “to make mistakes”. After four hours, the pupil gave Ernst three and a half pipes back and the result of the work “looked great”, says Ernst, who is of the opinion that the possibility of making

mistakes stimulates the pupil to reflect. The pupil in the example “considered carefully”, since he wanted to succeed.

The supervisor Ernst says that a new plumber does not get all kinds of jobs an experienced plumber can get, and that some things you have to learn by experience, “these are things that you learn during the years”. Ingemar, the supervisor, says that there is no point in the students “just standing and watching someone press the button, because it is worthless”; they need to obtain their own practical experience. Thus, according to the teachers Erik and Ivan tell, in order to become skilled, the students need to practice independently and conduct the work in different situations.

Factors

The three themes that appear in the interviews concerning factors that are crucial for providing transfer possibilities are: *communication*, *financial resources* and *reflection*.

Communication

In order to foster transfer, communication between teachers and supervisors is crucial according to the informants in this study. Since schools cannot afford to buy all of the required machines that are used in different industries, it is important for the school to have a good cooperation with companies, because “then I can tell Ivan that today it is convenient”, says the supervisor Ingemar, when they are going to do something that he wants the pupil to participate in. This demands flexibility at school. “I have of course small groups and classes, so I can adapt myself at short notice, if something crops up, and also bring in other students”, says Ivan, the teacher. But, if they could afford it, he also adds that he would prefer to have a machine of his own at the school.

According to both the teachers and the supervisors, for effective cooperation between the school and the workplaces, communication is fundamental. Through good communication, they can also cooperate in creating conditions for the students’ learning, as well as use one another’s arenas and resources in order to create further conditions for learning. The supervisor Ingemar says that Ivan, the teacher, can request his students’ participation in certain tasks at the companies. This is a way for the teacher to cover all the components contained in the syllabi. Ivan also says that he checks “what details” the students have been a part of, by talking to the supervisors, for example – “have they performed measurements for the purpose of checking?”. The supervisor Ingemar says that they, as supervisors, are not aware of what the students are supposed to do at the workplace, with the point of departure in the syllabi, and “we don’t have the course in mind and what they are supposed to do and where they are” in their learning process. Therefore, communication between the supervisors and the teacher is important in order to provide the students with the opportunity of fulfilling the course objectives in order to obtain a “pass”. However, the teacher Erik says that he does not discuss the course content with the supervisors, but obtains information about “how he conducts himself and whether he has been participating”. Erik grades what he can see the students do at school, and has been working on his own tool for grading, in order to have a better summary of what the students learn in the workplaces, in support of his assessment.

If the teacher and the supervisor know each other and have been working together for a long time, and/or if the teacher and supervisor have a good communication repertoire, they also have a clear understanding of what is being done in each other’s arenas. Consequently, they can build further on what the other person has done in their teaching before, and let the students use their knowledge learned from previous situations. Erik says that his and the supervisor Ernst’s situation is unique in

this way, since “Ernst’s mentor is my mentor /.../ we have had the same one”. But Ernst says that he and Erik communicate “anyway of course”. They thereby have a good understanding of what is expected and done in each other’s arenas. Erik can also talk to Ernst in order to update his knowledge, since he “has been out of the trade for some years” and things are changing. This keeps Erik’s plumbing knowledge up to date and he can relate to the field during his teaching.

Financial resources

There are many factors that influence the teaching at school and in the workplaces, and one of them is financial resources. In the school, specific skills are developed with help of cheaper materials than the materials used at the workplaces, because it would be too expensive to use the original material. Then, these skills ought to be transferred into other conditions. Furthermore, there are no financial possibilities of buying new machines and tools in order to practice all the course components at school, which would constitute the everyday work of a plumber or industrial worker. In that way, the vocational school can be dependent on the vocational workplaces in order to afford the students’ learning in accordance with all the objectives presented in the syllabi. Ingemar, the supervisor, tells the teacher Ivan that “what we can contribute, or what we can help you with, as I see it, it is the resources, with machines and things like that, that you find difficult. You can do the theory”. The teaching is carried through in the arena where the resources are available, and the students ought to transfer the knowledge between the arenas.

Financial resources are also an obstacle for students’ opportunities to participate in the daily work, while as new beginners, they working at a slower pace, and therefore sometimes, as the supervisor Evert says, “remain seated, with their hands in their pockets”. Subsequently, the students have to often learn to do something on their own, by watching the supervisor at the workplace. Hence, the students have to transfer what someone else does, by adapting what they see into their own actions.

Reflection

In parallel with new technologies and the development of tools, a lot of the technical trades is embedded in the machines and do not appear to the user/worker without reflection. Ivan, the teacher, exemplifies the importance of basic knowledge by describing the process of making a program for a specific machine from a drawing in CAD (computer aided design). He says that if “you do not have the basic knowledge you are not able to trouble-shoot or optimise; you must know the basics in order to use these tools which are great and efficient today”. The supervisor Ingvar says that they have both manual programming, and automatically generated code at his workplace and the supervisor Ingemar says that for the “lathes” at his company, “they code manually”, which requires the workers to understand the coding, even if they do not always generate it themselves.

The teacher Erik uses steel wires at school when the students are practicing to bend pipes. But even in realistic work situations, it is useful to “take a welding wire or something”, he says. It helps the plumber to “check before you start”, says the supervisor Ernst, “am I thinking right?”. The folding rule is also helpful in verifying and to reflect before bending the pipes. Erik explains this checking as “being confident”, that “when you bend the pipe, than you know it is correct”. When you have reflected upon your work before you perform it, you can transfer principles and skills or knowledge from written materials into real life for example.

Ernst tells, that above all, it is important to be allowed “to make mistakes”, during the education, and to reflect on the mistakes you made, in order to learn. Reflection takes place if the students

receive explanations of what they are doing. Hence, this makes demands on the supervisors and consequently, not just anyone can be a supervisor. Some workers “are really good at what they are doing, but cannot teach”, says Ingemar, the supervisor. The supervisors need to be able to reflect themselves, but also to be able to help the students to reflect upon their work.

Transfer and factors

In the result, there are four different themes of transfer: *transfer of basic knowledge*, *transfer of principles and skills*, *transfer of written materials and real life*, and *transfer of experiences*; and in the result, there are three factors that are crucial in order to create possibilities for the different themes of transfer: *communication*, *financial resources* and *reflection*. The four themes of transfer and the three factors are described and exemplified in Table 3, where the relationship between them also is described. In this table we also add a column for where, between which arenas the transfer appear in the interviews. The themes obtained from this study are not occurring separately and can sometimes be overlapping.

Table 3 Transfer and factors appearing in the result

Transfer	Factor	Examples	Arena
Transfer of <i>basic knowledge</i>	Communication	Teachers and supervisors communicate in order to facilitate students' learning in different arenas; teachers and supervisors communicate in order to understand what students learn, or should be able to learn in different arenas. For example, students need to be able to perform mathematical calculations in order to know if things they do on the workplace are probable.	Transfer between school and workplace training
Transfer of <i>principles and skills</i>	Communication	In order to know what knowledge students have learned in one situation, the teacher can test the students, but also communicate with the supervisors. For example, the teacher can ask the supervisor if a student has participated in certain tasks at the workplace.	Transfer between school and workplace training
Transfer of <i>basic knowledge</i>	Financial resources	Teachers have to cooperate with supervisors in order to teach certain things, because of a lack of resources at school.	Transfer between school and workplace training
Transfer of <i>basic knowledge</i>	Reflection	Students need to learn certain things, especially the basic knowledge, at school in order to be able to perform certain tasks	Transfer between school and workplace training

		at the workplaces. In order to do trouble shooting for example, students need to reflect in relation to their basic knowledge.	
Transfer of <i>principles and skills</i>	Financial resources	Cheaper material is used in order to practice for well-defined situations.	Transfer between education and working life
Transfer of <i>principles and skills</i>	Reflection	A model of the planned work can be made by using a material which is smaller and easier to handle, in order to know what to do when it is performed in a real work setting.	Transfer between education and working life
Transfer of <i>written materials and real life</i>	Reflection	Textbooks and other written school materials are used in order to explain things from workplaces.	Transfer between written materials and real life
Transfer of <i>written materials and real life</i>	Reflection	When working as a plumber or an industrial worker, you need to be able to transfer drawings into real life, and conversely, in order to understand descriptions and manuals, and also in order to document your work.	Transfer between written materials and real life
Transfer of <i>experiences</i>	Reflection	The students need to be able to use collected prior knowledge and practical experiences from previous situations in order to perform more advanced tasks on their own.	Transfer between education and working life
Transfer of <i>experiences</i>	Communication	If the teacher and the supervisors communicate about the learning content, they can let the students use previous knowledge and experiences, in order to build further on the knowledge and experiences, when creating new learning conditions.	Transfer between education and working life

The different themes of transfer and factors are described in the result. The examples, presented in Table 3, can represent more than one theme of transfer/factor. This means that the different themes of transfer/factors do not occur separately, but exist in a mutual relationship with another. Depending on the teachers' and supervisors' narratives, the themes also differ in voluminousity. The different arenas, where transfer appears are often related to what the teachers and supervisors tells that students learn in the school and workplaces respectively, and how knowledge learned in previous situations are used in new situations in each others' arenas during the education (*transfer*

between school and workplace training). But the arena where the transfer appears is also related to how the students are supposed to use knowledge from written materials in real life and vice versa (*transfer between written materials and real life*). There is also transfer appearing in the result concerning how the knowledge learned during vocational education can be useful for new unknown situations in future working life (*transfer between education and working life*). The transfer between school and workplace training and the transfer between education and working life can be included in transfer between education and working life. All these themes of transfer can be seen as components of a continuously ongoing process of learning.

Discussion

Since this research is conducted with the point of departure in the phenomenology of the life-world, this empirical study aims to obtain knowledge about the experienced world. Therefore, the results do not claim to answer what really happens, but to contribute with knowledge about transfer in technical vocational education based on the teachers' and supervisors' narratives. The themes and factors, which emerged in the data, are discussed below.

The theme of transfer that we define as *transfer of basic knowledge* is about how basic knowledge learned in previous situations is useful in and can be applied to new situations. According to the informants in this study, the students need to learn things at school before they can participate in workplace training. Hence, the students in workplace training are expected to learn to use the knowledge acquired from school in new arenas. This corresponds to Marton's (2006) emphasis on variation between situations as crucial for transfer, i.e. "transfer effects may increase with time, experience, and differences" (Marton, 2006 p. 512). Variation can also be used in teaching in order to discern similarities and/or differences of the learning content and to be able to adjust previous knowledge to new situations. The teacher and the supervisor may facilitate this process by systematically employing variation in their teaching and supervising. The teachers and supervisors emphasise the importance of the students' need to learn basic knowledge at school in order to be able to carry out the work expected at workplaces. Consequently, this has a risk in cementing a criticised view of transfer as a dualistic concept where one arena refers to learning (school in this case) and the other arena refers to where the knowledge is applied (workplace) (compare Helms Jørgensen, 2011). It is important to emphasise both arenas as learning arenas, where the learning builds further on previous knowledge. As an implication, the result can then be compared to Aarkrog's (2005) work, which shows that each arena offers students specific learning opportunities. According to the teacher and supervisors in our study, one of the specific opportunities that school offers students, is basic knowledge. The teachers and the supervisors point to certain basic knowledge as a prerequisite for the students' success in the workplaces. However, our study does not investigate if the students are able to apply the basic knowledge they are supposed to learn in school in the workplace training. The result shows that content connected to different objectives can be taught in different arenas, depending on available resources, which means that then the content is similar, but the arena varies. A similar result is reported by Bjurulf (Submitted), where a pupil at the Energy program says that "he *learns the basics at school* and at the workplace training he just *learns more and more*" (p. 6).

Another theme of transfer in the results is *transfer of principles and skills*. The financial resources factor requires teaching to focus on allowing students to practice on cheaper materials than those used in the actual work. For example, they use steel wires in order to practice the principles for bending pipes in different directions. By bending steel wires, students receive practical experiences of the isometric cube that is fundamental to a plumber, according to the teachers and supervisors in

this study. The models of cheaper materials also constitute a tool for transferring understanding about how to act in an actual working situation and provide the students with practical experience. This experience is what Dreyfus and Dreyfus (1986) point out, as being important in order to get a more holistic understanding. The learning of tacit knowing discussed by the teachers in this study is related to the five step model suggested by Dreyfus and Dreyfus (ibid). In order to learn a skill such as welding, you need to use different senses and practical experiences. It follows, that these senses need to be used and applied in new situations in order to perform the skills. Different materials and ways of learning different tasks may be seen as a way to prepare students for future learning, i.e. students get different kinds of experiences and are thereby more prepared to handle unknown future situations (Marton, 2006). In the latter, the principles and skills are then the same, but the working tasks, the engineering materials and tools can differ in different situations. To achieve this kind of transfer, the students need to learn these principles and skills, and then recognise when they are applicable in order to solve new problems in the future.

Transfer of written materials and real life is a third theme of transfer obtained in this study. This theme concerns transferring drawings into real life, for example in situations where a worker has to “hand a job over” to a colleague. This theme of transfer presupposes the capability to discern similarities between drawings and real life, which is also of importance to the students in order to be able to learn from drawings in their future learning, due to the rapid change in the field of technology (Al-Ali & Middleton, 2004). The technology the students will meet in the future is probably different from the technology they have come across during their vocational education.

The fourth theme of transfer that emerged in the study is *transfer of experiences*. The teachers and supervisors emphasise the importance of certain levels of previous knowledge in order to perform different tasks at the workplace. They also provide examples of how more experienced students are able to perform more advanced tasks. In this study, we do not examine if the knowledge is actually used or not, but rather how the informants’ experience the use of previous knowledge in new situations. The result shows that owing to their practical experience, the students can become more and more independent during the vocational education, and thereby develop in accordance with Dreyfus’ and Dreyfus’ five-step model (Dreyfus & Dreyfus, 1986). During their training, the students need to perform exercises at school, which can often be adjusted in order to understand something about a task connected to the work as a plumber or an industrial worker. Nevertheless, according to Dreyfus and Dreyfus (1986), practical experience is not enough in order to become an expert; as the informants in our study express, the workers also need to be talented. By using experiences from previous situations in new situations the transfer of experiences could lead to continued learning and the learning to learn become focused. If the students obtain experiences of how to solve different problems, hopefully they can use these experiences in new situations in order to solve new problems. In this respect, the learning itself becomes the object of learning, and subsequently, the transfer of knowledge becomes transfer of learning. Awareness about these four different themes of transfer is important in order to bridge the gap between different learning situations (Kilbrink & Bjurulf, 2011) and in order to help students to be better prepared for future learning demands (Bransford & Schwartz, 1999).

The *communication* factor is central in the result presented above. In the interviews, both teachers and supervisors spoke about communication as an important part of the cooperation between the two learning arenas, companies and the school. If the communication between supervisors and teachers is sufficient, the teaching and the supervising can take as point of departure what the students’ have learned in both arenas and build further on these previous experiences and knowledge. Thus, the results indicate that good communication between the teacher and supervisor

is an important factor that promotes transfer. In this regard, this result challenges the previous research of Caravaglia (1993) and Meijers (2008), who point at the gap between school and workplace training. Communication can also be a way to bridge the problem addressed by Tanggaard (2007), in that students experience school and workplace as having different norms and guidelines. A close cooperation between school and workplaces is also seen as a promoter of transfer in the work of Tuomi-Gröhn and Engström (2003) as well as Tynjälä (2009).

If schools cannot afford expensive machines, they may teach specific course components at a workplace – which is facilitated by suitable cooperation and communication with companies. According to the results in this study, the relationship between the teachers and the supervisors is important in order to create conditions for learning in both arenas, school and workplace, that build further on previous knowledge and experience. In this study, the collaboration does not appear to comprise assessment, which supports Guliker et al.'s (2010) statement about assessment as a challenge in a dual school system. The teacher in the Energy program has been working on a tool for assessment, in order to bridge this gap, which illustrates the teachers' need for assessment instruments in vocational education, as a complement to communication between the learning arenas.

Another factor revealed in this study is *financial resources*. Financial resources can sometimes be an obstacle for transfer, when a lack of monetary resources prevents teachers and supervisors from creating fruitful learning environments. Supervision is prevented when there is no time for students to actively participate in the practical work due to a high speed of production. Thus, slower beginners would represent a financial constraint to the company and therefore, the students have to remain passive observers during the workplace training. However, the lack of financial resources can sometimes be a reason for cooperation between school and workplace, in order to use each other's resources and meet the students' need to learn different parts of the course objectives. One such example in this study is when the teacher in the Industry program communicates how he needs to cooperate with the companies in order to be able to teach about certain machines and processes. Accordingly, the students are offered variation and may be able to discern critical differences between the situations of importance to them in order "to be able to adjust to new situations" (see Marton, 2006 p. 521).

The third factor, *reflection*, relates to how students use previous knowledge and experiences when reflecting on what to do in new situations. In order to be able to reflect, they need practical experience to relate the new situation to. According to the informants, the students should be given time to explore and try things and also make mistakes during their training, in order to get such practical experience. According to the interviews, these mistakes elicit a good grounding for reflecting and learning. Reflection can take place if students get explanations of what they are doing, which at the same time makes special demands on the supervisors. Consequently, this means that not everyone is suited to be a supervisor. However, students also have to show an interest and be active participants in order to learn, and thereby also be able to prepare for future learning, as Bransford and Schwartz (1999) propose. When something goes wrong, the students also require certain basic knowledge in order to "troubleshoot". Reflection is also related to how written tasks can be a way of reflecting on another part of real life, in order to understand how things are connected.

The transfer between school and workplace training as well as between written material and real life are learning processes which can be seen as starting points for lifelong learning. Furthermore, on a

more general level they can be used as building blocks in future learning to learn, and to transfer between education and working life.

Conclusion

The results of this study have revealed four themes of transfer: (1) *transfer of basic knowledge*, (2) *transfer of principles and skills*, (3) *transfer of written materials and real life* and (4) *transfer of experiences*. The results also include three factors for providing transfer: (1) *communication*, (2) *financial resources* and (3) *reflection*. These factors demand close cooperation between the teachers and supervisors in different learning arenas during students' vocational education. The factors can be seen as possible obstacles for learning, if there is a lack of communication between teachers and supervisors, or if the financial resources prevent the possibilities to conduct the education desired. But, if the teachers and supervisors use and engage satisfactory and productive communication, they will discover new kinds of learning arenas and, as Ivan and Ingemar in this study confirm, collaborate in order to let the students visit the workplace to experience different machines that the school cannot afford.

Since there is a mix of constituents in both learning arenas in this study, school and workplaces, the themes of transfer identified in this study could be reciprocal. The result presented is the common narrative from the informants and thereby an empirical contribution to the research field of transfer. An awareness of the different themes of transfer, and of which factors are crucial in order to provide possibilities for transfer, is a feasible starting point to plan teaching in dual educational systems. Our findings can serve as a contribution towards a basis for understanding where to focus teaching, in order to create plausible possibilities for transfer and to bridge the gap between school and workplace training. If teachers and supervisors use variation in order to teach the content (cf. Marton, 2006) and build further on the teaching from each other's arenas, the students will obtain a good grounding in their education in preparation for their future working lives – including future learning. Thus, upper secondary vocational education must prepare students to handle new situations. Preparation for future learning must be viewed as the goal since vocational education cannot cover all possible situations in order to foster skilled experts. If students "learn to learn" they will be able to become experts in the future. The object of learning then becomes the learning itself, which means that the learning content is concerned with *how to learn* in order to be able to learn in new situations. By implication, the transfer of *knowledge* becomes transfer of *learning*.

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