



Éducation et didactique

9-1 | mai 2015
Varia

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Electronic version

URL: <http://journals.openedition.org/educationdidactique/2204>

DOI: 10.4000/educationdidactique.2204

ISBN: 978-2-7535-4191-7

ISSN: 2111-4838

Publisher

Presses universitaires de Rennes

Printed version

Date of publication: 20 May 2015

Number of pages: 143-159

ISBN: 978-2-7535-4146-7

ISSN: 1956-3485

Electronic reference

Ingrid Carlgren, Pernilla Ahlstrand, Eva Björkholm and Gunn Nyberg, « The meaning of knowing what is to be known », *Éducation et didactique* [Online], 9-1 | mai 2015, Online since 20 May 2017, connection on 20 April 2019. URL : <http://journals.openedition.org/educationdidactique/2204> ; DOI : 10.4000/educationdidactique.2204

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THE MEANING OF KNOWING WHAT IS TO BE KNOWN

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The aim of this article is to contribute to an articulated language of knowing, which we consider as a key aspect of teachers' professional work. We describe three examples of how the meaning of knowing some specific learning objects can be studied and described. The three learning objects are: to be able to evaluate technical solutions, to be able to perform a house-hop and to be able to act with presence.

Phenomenographic analyses of data from the pre-tests carried out within the frame of so called Learning Studies resulted in descriptions of different ways of knowing as well as different aspects of the specific knowns that must be discerned in order to develop the knowing.

Keywords: subject specific knowing, school subject knowing, learning object, learning study, phenomenography, physical education, technology education, theatre education.

Le sens du savoir enseigné

Cet article a pour objectif de contribuer à un langage articulé du savoir, que nous considérons comme un aspect central du travail des enseignants. Nous décrivons trois exemples de la manière dont on peut étudier et décrire le sens du savoir dans le cadre d'objets d'apprentissage spécifiques. Les trois objets d'apprentissage sont : la capacité à évaluer des solutions techniques, la capacité à effectuer une figure appelée « house-hop » et la capacité à agir « avec présence ».

Les analyses phénoménographiques des données issues des tests préliminaires qui ont été menés dans le cadre des études sur l'apprentissage ont permis de mettre en exergue différentes formes de savoirs ainsi que différents aspects des connaissances spécifiques que l'on doit discerner afin de construire le savoir.

Mots-clés : savoir disciplinaire spécifique, savoir disciplinaire scolaire, objet d'apprentissage, étude des apprentissages, éducation physique, enseignement technique, enseignement théâtral.

INTRODUCTION

What must the teacher know in order to teach someone something? Teaching is always about *something* – some specific knowledge/known that the students are expected to learn. The object of teaching is the development of student knowing, and teaching practices are organised to produce *knowings of specific knowns*. The content of school subjects is often described (sometimes in great detail) as subject matter and skills, while what it means to know this content remains silent and implicit. Even teachers with a thorough knowing of their subjects will have great difficulties in answering the question “what must you have to discern and be able to do in order to grasp the prescribed known?”

The invisibility of the meaning of the knowing of specific knowns has not been conceived as a problem. Teachers have somehow been able to teach the subject matter and assess students’ knowing without being able to formulate what it is that the students know. This knowing is taken for granted as expressed in e.g. performance in a test. However, at least in Sweden, there is a growing pressure on teachers to be able to communicate the grounds for their assessments of student knowings. At the same time there is a shift of focus in teachers’ work – from teaching prescribed subject matter to teaching certain ways of knowing (Carlgren, 2007).

The last two curriculum reforms in Sweden have introduced new ways to (re)present the content of schooling. Previously, syllabuses were organised around content areas in terms of subject matter to teach, while the new kind of syllabus is organised in relation to content areas (not as subject matter) as well as *subject-specific capabilities*¹ for the students to develop. Teachers are expected to plan their teaching of the subject in order to make it possible for the students to develop specific ways of knowing corresponding to the prescribed subject-specific capabilities. This change of how the curriculum texts are formulated can be regarded as expressing the shift from a focus on *knowledge (in terms of subject matter)* to teach to a focus on *ways of knowing (subject-specific capabilities)* mentioned above (Carlgren, 2011a).

Teachers are thus asked to accomplish student learning in terms of subject-specific capabilities and ways of knowing. The teachers are also asked to communicate to the students how these capabilities will be assessed. All this creates a pressure to expli-

cate what the students must be able to do in relation to what is to be known.

Teachers do not, however, have access to a body of articulated knowledge concerning subject-specific capabilities and ways of knowing which, in turn, creates a need for research so that teachers can develop a professional language to use when talking and analysing knowing. This is even more important in school subjects that are not in the form of propositional knowledge, such as practical and aesthetic subjects. The learning of practical knowledge outside of school is mostly accomplished through some type of apprenticeship model, where it is possible to imitate experts and gradually become acculturated into the knowledge traditions. By being situated in the school, practical school subjects are, however, transformed into a content to be taught and communicated between teachers as well as between teachers and students.

The aim of this article is to contribute to the development of teachers’ professional language concerning some aspects of student knowings that can be used e.g. when designing lessons or assessing levels of knowing. We will give examples from three practical and aesthetic subject areas: technology, physical education and theatre education, by describing and discussing some of the results from a specific research approach – what is termed Learning Study (Lo & Marton, 2012, Marton & Pang, 2006, Pang & Lo, 2011). The Learning Study is a way to study the meaning of knowing specific *objects of learning*, i.e. the knowledge at stake (compare Sensevy, 2012) – as well as how teaching can be designed to enhance the knowing of these specific objects of learning. Here we will confine our description to the results of the pre-tests (the notion of pre-test will be explained below), which are an important aspect of a Learning Study. The three learning studies were carried out in relation to what the teachers considered as important objects of learning;

Evaluating technical solutions

Within technology education in primary school in Sweden the students are supposed to develop the capability to evaluate everyday technical solutions in terms of fitness for purpose. Although there is limited access to research on this specific content in technology education, results indicate that this gene-

rates certain difficulties for students in primary as well as secondary education (Compton & Compton, 2013; Oboho & Bolton, 1991). In this study students evaluated technical solutions intended for opening and closing in terms of how effectively they supported their intended functions. In the pre-test the students were asked to evaluate everyday objects such as zippers and bottles with screw caps.

Performing a specific movement

The subject Physical Education and Health (PEH) in Sweden aims at developing students' movement capability. However, practical knowing such as knowing how to move in specific ways is difficult to articulate and there is a need for exploring the meaning of movement capability and develop ways of articulating it as well. In this study, the students were expected to learn a specific new movement called house-hop, and the aim was to explore what it may mean for them to grasp the movement in the most complex way possible. In a pre-test the students were asked to imitate this movement as performed by one of the teachers.

Acting with presence

One of the main aims proposed in the theatre syllabus for upper secondary schools in Sweden relates to the capability of acting and being able to communicate. Even if we do not train students to become professional actors, as further education is required for this, acting develops subject-specific capabilities which are important from a formation perspective. Being able to act with presence is an important aspect of acting. The pre-test chosen for this study was an exercise in improvisation and the object of learning was *the capability to express presence when in an indoor swimming pool*.

THE LEARNING STUDY

In a Learning Study, focus is on a particular *object of learning* which the students are supposed to learn or grasp, as well as on the related teaching-learning process as it is practised in the classroom. What is critical for learning something specific is explored

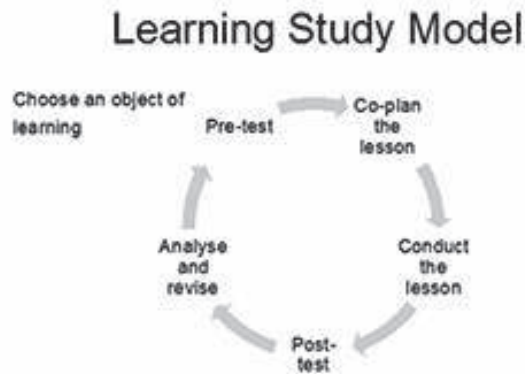
through a systematic and iterative process (see e.g. Marton & Pang, 2006).

The Learning Study is a *collaborative* (teachers and researchers work together), *interventionistic* (research lessons are designed and tried out) and *iterative* research approach. As such it belongs to what Van der Akker has called the family of developmental or design-based research approaches (Van der Akker & al. 2007). However, it has also been described as action research (Elliot, 2012; Somekh & Zeichner, 2009) as well as "clinical" subject didactic research (Carlgren, 2012). The Learning Study has often been presented as a hybrid of the Japanese Lesson Study (Fernandez, Cannon & Chokshi, 2003; Lewis, 2000) and a design experiment (Brown, 1992; Marton & Pang, 2006). In contrast to many design studies, where interventions often are designed in universities, the teachers in a Learning Study are given theoretical tools in order to help them design the interventions themselves.

A Learning Study is a cyclical process of planning and revision, as shown in Fig1. A group of teachers and researchers develop research lessons with the aim of accomplishing a specific type of learning. The research lesson is evaluated and revised often 2-4 times in an iterative process. Starting with choosing an object of learning, the next step is to design a pre-test. The pre-test and the following steps describe a cycle carried out with a teacher and a group of students. The next cycle is carried out in another group of students and with another teacher, etc. In each cycle the lesson is analysed and evaluated in relation to the intended object of learning and the lesson is revised. By working iteratively on planning, evaluating and revising the lesson dealing with the object of learning, knowledge is generated about teaching and learning as well as the meaning of knowing the specific object of learning.

In a Learning Study the teachers and researchers together select an object of learning to be studied. Then the teachers and researchers begin to unpack the meaning of the learning object (i.e. what it means to know it). Based on this, a pre-test is designed in order to find out about the pre-knowings of the students. Sometimes the pre-tests are quite similar to formal tests (especially in mathematics) but often they are in the form of interviews similar to Piaget's clinical interviews (Piaget, 1929/51). These interviews are analysed qualitatively to find out the different ways of pre-knowing among the students.

The design of the pre-test is therefore an important part of a Learning Study. Although it is carried out before the actual teaching it is in itself an interactive event between the teacher or the researcher and one or more students in relation to the object of learning.



In the next step the findings from the pre-test are used as a starting point for the design of the research lesson which is then tried out and revised. In this article we will confine our descriptions to the results of the pre-tests. Although research lessons were carried out and revised in all three cases, we will not include data concerning that element. The reason is that we want to explore the opportunities of using the results from the pre-tests as a way to describe some aspects of the intended learning object – aspects that can be used when designing lessons and assessing student knowing.

While the first generation of Learning Studies (Marton & Pang, 2006) were designed to test the value of the Variation Theory of Learning, later generations of Learning Studies are more focused on the development of teaching-learning units designed to accomplish the learning of specific objects of learning with the help of Variation Theory (Lo & Marton, 2012). The results are presented in terms of critical aspects of the learning object, i.e. aspects that must be discerned in order to grasp the object, together with design principles based on Variation Theory (Carlgren, 2012; Kullberg, 2010).

However, the way we use the Learning Study here differs somewhat from how it is most often used. Since our research object is to describe the meaning of knowing the objects of learning, we are not focusing so much on the results of the research lessons

in terms of students' learning or on the design of the lessons. Rather we are using data from the Learning Study as a way to describe and analyse the object of learning as such.

The object of learning

The object of learning in a Learning Study is what the students are expected to grasp. It cannot, however, be defined externally to the teaching and learning situation. Rather it is constituted as a transactional process (Dewey & Bentley, 1949)² between a specific known and the students' knowings of this known. There is no knowing without something known and no something known without someone knowing it (Dewey, & Bentley, p. 115). This transaction in relation to specific groups of knowers (i.e. the students) is at the heart of teachers' work (Carlgren, 2011b). The triad knower-knowing-known frames the object of learning which is a dynamic and open object that is transformed according to the specific groups of students being taught. The subject-specific capabilities which teachers are asked to promote evolve out of a transactional process where specific groups of knowers (students) develop their knowing of specific knowns. In this transactional process there is constant change in the knower as well as the knowing and the known – each in relation to the others.

Studying knowing and knowns

A point of departure for us is that knowing cannot be restricted to cognitive understanding. It is, in Ryle's words, a disposition to act (Ryle, 1949, p. 22). Since it is only expressed when acting it cannot be studied directly. The meaning of such a disposition should not be confused with thinking or some mental capacity only, it does not involve separating the mental act (of thinking) from the doing (as an execution of the mental act). Different ways of knowing imply different ways of seeing, as well as of doing and being.

Michael Polanyi (1967) considered knowing to be an art, including theoretical as well as practical knowledge. The "art of knowing" is expressed in connoisseurship. In theoretical school subjects the theoretical aspects may be well articulated in

terms of concepts and conceptual relations.³ In practical school subjects the theoretical aspects of the knowing are often implicit – embedded in the actions (knowing-in-action as Donald Schön would say). According to Schön (1983) the knowing is implicit as long as things work well, but when some problem arises, a process of reflection-in-action may result in formulations of some theoretical aspects of the knowing.

The knowing expresses the relationship between the knower and the known. For example people who know a lot of biology relate to nature in special ways – an expert biologist discerns (and therefore can *see*) a more differentiated fauna and flora as well as traces of biological processes as compared to a non-biologist. The ability to discern has several layers. On one level there is the recognising and knowing the names of different species. On another level the ability to determine the species includes elements such as an acquaintance with the different parts of plants such as e.g. leaves or stalks. The biologist must also discern different groups or families of plants which, in turn, are ordered in relation to each other into a huge system of classification. Biological knowledge implies dispositions (such as giving things names, analyse, categorise, etc.) and thereby attitudes as well as a direction in people's lives – a bearing. One important part of this is the ability to do things, perform certain acts. So, apart from the ways of seeing, as was the focus in the technology study, the ways of *doing* can be studied and analysed as well, which is what is implemented in our second case (about movement capability). In our third case (about the capability to act) the focus is, however, on knowing as it is expressed in how the students are able to *be* in an (acting) situation. There is, e.g. a difference between *showing* and *telling* (Frost & Yarrow, 1990/2007). If, e.g. acting includes passing through a door, you can *tell* this by grabbing the handle and clearly *making* the movements of passing through the door. The audience will understand what you are doing but they will not believe it as convincing. In order to be convincing it is also required that you as an actor *experience* the situation yourself to be credible. You *are* in the situation and you *show* that.

We assume that by studying different expressions of ways of seeing, doing and being in relation to something that is known and by analysing these expressions, it is possible to discern different aspects of the knowing. Since part of the knowing is tacit we

also have to pay attention to non-linguistic expressions and actions. We therefore need an approach that includes analytical tools that can deal with tacit and implicit aspects of the knowing, in addition to what is spelled out in linguistic form. In the Learning Study, a theoretical framework of Phenomenography and Variation Theory of learning is often used and result in descriptions of critical aspects which are necessary for the specific group of knowers to discern in order to grasp the learning object (Pang & Lo, 2011).

Phenomenography⁴

In phenomenography, qualitatively different ways of experiencing a phenomenon are analysed and the result of this analysis forms categories of description (Marton, 1981, 1994). By comparing the differences between expressions concerning a certain phenomenon (such as talking about a technical solution, performing a specific movement or acting in specific ways) qualitatively different ways of experiencing the phenomenon can be discerned. These ways of experiencing are described in metaphorical terms as qualitatively different categories of descriptions.

The unit of analysis is “way of experiencing” which covers linguistic as well as non-linguistic aspects. By analysing differences between ways of expressions of the knowings these can be reconstructed, described and related to each other. In phenomenography, a distinction between the referential and structural aspects of these descriptions is made. While the referential aspect refers to the meaning of the phenomenon, the structural aspects refer to which aspects of the phenomenon are discerned (Marton & Booth, 1997).

We will here consider ways of experiencing as correlating with ways of knowing. Thereby we can, through phenomenographic analysis, describe different ways of knowing both in terms of meaning, and in terms of the aspects of the known that must be discerned in order to know what is expected to be known.

There are thus two kinds of results of phenomenographic analyses. Firstly, the different ways of experiencing are described as different ways of giving meaning to the phenomenon and, secondly, the different ways of experiencing are related to the discernment of different aspects of the phenomenon

(or learning object). These two types of results are illustrated in the following example:

In a study of how upper level compulsory school students (13 to 16 years old) conceptualise matter, the phenomenographic analysis of students' conceptions/experiences of matter resulted in six distinctly different categories of description. Matter was understood to be (a) a homogeneous substance, (b) substance units, (c) substance units with "small atoms", (d) an aggregate of particles, (e) particle units, and (f) systems of particles (Renström, Andersson & Marton, 1990, p. 555).

Within each way of experiencing matter there were differences related to which aspect of the phenomenon the subject focused on. The six categories form a hierarchy. They can be ordered in terms of their defining features, which awards them increasingly greater explanatory power and which represents additional components of a more full-fledged understanding of matter:

- A. The substance is not delimited from other substances and it lacks substance attributes;
- B. The substance is delimited from other substances and it exists in more than one form (which creates the potential for thinking of phase transition);
- C. Small particles are introduced. They may be different from the substance in which they are embedded (which creates the potential for thinking of atoms, which are components of the substance but do not have macroproperties);
- D. The substance consists of infinitely divisible particles, which might not consist of the substance;
- E. The substance consists of particles that are not divisible into other particles and that have certain attributes (such as form and structure) that may explain the macroproperties of the substance;
- F. The substance consists of systems of particles. Different macroproperties of the substance can be accounted for in terms of properties of particles and particle systems (Renström, Andersson & Marton, 1990, p. 566).

With each conception, new aspects of matter can be discerned and reasoned about. Phenomenographic categories are thus describing different ways of knowing as well as different aspects of the known.

Variation Theory

The Variation Theory of learning (and teaching) has evolved out of the phenomenographic tradition. Basically it can be described as understanding learning as a process of discerning new aspects of learning objects in new ways. In order for something to be discerned there must be some kind of perceived variation. More powerful ways of knowing are characterised by the simultaneously discernments of more and more differentiated aspects of a phenomenon (Marton & Lo, 2007; Lo, 2012).

Variation Theory has been shown to be a powerful tool for teachers when analysing the learning object, as well as when planning the research lessons (Pang & Lo, 2011). Thereby what is termed *critical aspects* for specific groups of learners (i.e. aspects that the learners must discern in order to grasp the object of learning) can be identified. These critical aspects must be considered in the design of the lesson in order to create preconditions for the learners to discern them.

In accordance with Variation Theory we consider the object of learning as being comprised of different aspects to be discerned in specific ways. These aspects emerge when analysing the differences between the different ways of knowing/experiencing in terms of structural aspects. However, the ways of knowing also include tacit aspects, which to a large extent give meaning to the knowing.

Our primary results are the different ways of experiencing the objects of learning among the students based on the phenomenographic analysis which, in turn, form the basis for the analysis of the different aspects of the learning object. The phenomenographic analyses are carried out on the transcribed pre-tests.

We will now present the findings from the three studies and then discuss the three studies together.

The meaning of knowing how to evaluate technical solutions' fitness for purpose

The study was conducted in collaboration with four teachers in primary school and two classes in grade 1 and 2 (49 students aged 7-8 years). The pre-test was carried out in the form of interviews with students in pairs focusing on some everyday objects representing a variation of technical solutions for

opening/closing, such as zippers of different sizes and models, juice bottles with screw caps, a match box, hinges of different types and sizes, and a tube for storing aspirin. During the interviews the objects were placed on the table in front of the students, and they were encouraged to investigate the different opening and closing devices focusing on the evaluation of the objects' opening and closing function in terms of fitness for purpose. The interview questions included, but were not restricted to:

Why do we open and close things in these ways?

Is there anything not so good about this way of opening and closing?

What things could be opened and closed with this device? Why? Are there any things that this device should not be used on?

How does the opening/closing device function?

Data was generated by audio and video recordings separately. In the transcribed material, in addition to verbal communication, bodily expressions were also documented. The interview material was analysed using phenomenographic analysis, which focused on pupils' ways of experiencing or understanding the phenomenon "the fitness for purpose of technical solutions". The analysis resulted in some qualitatively different categories each describing a particular way of knowing the fitness for purpose of technical solutions. These categories were then analysed in terms of structural aspects, focusing on the aspects of the phenomenon that were brought to the forefront of attention. The discerned aspects of the phenomenon were seen as corresponding to a particular way of knowing the phenomenon, but also as indicating differences between ways of knowing. The differences between the structural aspects discerned were understood in as of critical aspects and dimensions of variation (cf. Pang, 2003), i.e. these aspects are critical for students to discern in order to develop a more complex understanding.

Findings

The meaning of knowing how to evaluate technical solutions' fitness for purpose is, in this study, expressed as aspects to discern and experience simultaneously.

Through the phenomenographic analysis of the pre-test, four qualitatively different categories emerged, describing students' ways of experiencing technical solutions' fitness for purpose. The categories are logically related to each other in that the less complex ways of knowings are included in the more complex, of which category (A) is the level describing the least complex way. In the following section we will describe each category and illustrate it with an example from the interview material.

Effectiveness for me

In this category, focus is on the student's own use of different technical solutions. A technical solution that fulfils a particular desired function well is appropriate. The appropriateness is usually linked to different functions that make everyday life easier. In addition to the main function opening-closing, other functions such as handling, storage and aesthetic aspects are considered.

Interviewer: Is there anything not so good about opening the matchbox in that way?

Eric: Not really/ . . . /it is great, it is very easy to open.

Anna: And very easy to close.

In focusing on your own use, the technical solution is taken for granted. The students do not reflect on any aspects of the object's construction. This type of understanding was very common in the group of students studied.

Effectiveness for others

In this category, students distinguish a technical solution's purpose that is more extensive and complex. The purpose could, for example, be related to different categories of users who have specific needs such as young children, the elderly, those who are ill or weak.

Interviewer: Is it a good or a bad way to open and close it like that?

Agnes: It's actually quite bad for some. Some people may not be very strong so they can't manage to remove it [the lid]/.../and it will be pretty tough for them.

Construction dependency

The fitness for purpose is based on one or several aspects of the object’s construction, such as material, form and components, and how they help to realise the function. For example, an opening and closing device for a liquid has to prevent leakage, which poses special constructional requirements.

Sam: If you pour water into this (holding the matchbox), then this would be wet. If you had a box made of plastic it would still escape in tiny, tiny amounts.

David: It would even escape here (pointing to the gap between drawer and the box).

Interviewer: Why would it escape from that?

David: Because of the type of material.

Sam: It is so easy to press out (pushes the drawer out of the box).

David: It is not tight. It is made of a material that is not waterproof.

Sam: Which is cardboard.

In the extract above David first discerns the functions opening/closing and prevention of leakage. Sam then describes how the form contributes to fulfilling the function of preventing leakage and relates to different materials. When talking about plastic and cardboard they also relate to the functional properties of the different materials.

Technical efficiency

In this category, different common technical solutions are identified and compared in terms of how efficiently they realise specific functions.

Interviewer: The opening device of the bottle, is there anything that is not good?

Josephine: Mm, sometimes it’s a bit hard to open.

Robert: Yes, when it’s new./I think you can have just as a lid and open like this (shows with hands) it would be a bit easier.

Interviewer: Are there any such bottles?

Robert: No I don’t think so actually.

Josephine: But there are water bottles that have a small lid. Robert: Yes I think there are, and then you just lift it (lifts the screw cap) and then you drink.

In this excerpt Josephine first identifies the problem of opening bottles, and Robert suggests a different solution than the screw cap, a hinged lid. Common technical solutions such as screws and hinges are thus identified in different types of bottles.

The four categories were analysed in terms of the structural aspects discerned, reflecting functional and constructional characteristics of technical solutions and the relationship between these (table 1).

The categories below were mainly based on interactive interviews with the aim of analysing students’ ways of *seeing*, in this case, technical solu-

Table 1. Different ways of knowing technical solutions’ fitness for purpose and the structural aspects discerned

Ways of knowing technical solutions’ fitness for purpose as	Description of category	Structural aspects discerned
<i>A/ effectiveness for me</i>	Fitness for purpose is about how well functions related to your own needs and situation are fulfilled.	Own needs and related functions
<i>B/ effectiveness for others</i>	Fitness for purpose is about fulfilling functions based on others’ needs and situations.	Specific needs or situations of others and related functions
<i>C/ construction dependency</i>	Fitness for purpose is based on how efficiently aspects of the construction help to realise the function.	Material, form or components linked to functional requirements
<i>D/ technical efficiency</i>	Fitness for purpose is based on how efficiently commonly-agreed technical solutions realise the function.	Common technical solutions and the interaction between key components of the construction linked to functional requirements

tions and their fitness for purpose. Below, we will present an analysis of how students' ways of *doing*, in this case, moving, are regarded as different ways of knowing.

The meaning of knowing house hop

Despite the fact that physical education is regarded as a "practical subject", practical forms of knowing such as, for example, bodily awareness and movement capability (e.g. jumping, running or dancing) does not seem to be a main issue of learning (Tinning, 2010; Redelius *et al.*, 2009). Instead, the content in terms of moving and movements is taken for granted and therefore there is a need for elaborating and explicating the meaning of knowing in movement (Nyberg & Larsson, 2012).

The object of learning

In this study the object of learning was the capability of carrying out a specific movement called "house-hop". Describing the house-hop as performed by the teacher who composed it, will here serve as a description of one possible, and in this context, powerful way to experience, or grasp the movement. It will in this case be regarded as Marton (1981) puts it: "the authorized conception" which can be "considered as one of the several possible forms of understanding the concept or principle in question" (p. 185). However, a description of the house hop could be made in different ways and whatever way is used to describe it, this will not be extensive enough to cover all features of it as Polanyi (1969) and Janik (1996) point out when discussing practical

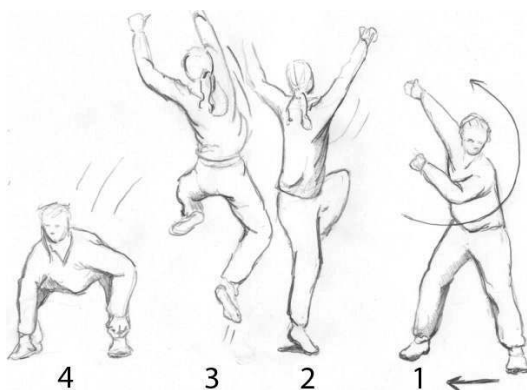
knowledge. The main reason for describing house-hop as follows is to facilitate the understanding of the phenomenographic analysis.

Standing with knees slightly bent and feet wider than shoulder-width apart. Move your arms in the direction of your right side. This is the start position (1), then move your arms quickly to the left, slightly upwards while simultaneously bending your knees, in order to create speed and power. At the same time, your upper body and your head twist so your chest and eyes point in the direction of the ceiling. Your arms will follow, moving through 270 degrees of movement. At the moment when your left elbow points to the left (2) your knees and ankles extend, in order to create additional speed and power. Now you have initiated a 360 degree rotation to be completed in the air. The meaning of all movements so far has been to initiate the rotation in the air, creating sufficient speed, power and direction for the airborne rotation. Your knees, chest and eyes are pointing towards the ceiling when reaching the highest point (3). You will land, after having fulfilled 360 degrees of rotation, steady with bent knees, slightly to the right of the point of where you started (4).

Important to note here is, that the above description was not given to the students. What the students met in the pre-test was the teacher's way of moving without any verbal instructions.

The pre-test

The pre-test was conducted with twenty 18-year old students in upper secondary school. They were asked to replicate a sequence of movements (of which house-hop was the fourth of seven movements) as similarly as possible to the teacher's way of moving. The procedure was conducted as follows: first, all students observed the teacher carrying out all the movements in the sequence without any verbal instruction at all. Then the students were divided into five smaller groups. Four groups were asked to wait in another room while one group was video-recorded whilst imitating the teacher almost simultaneously when she repeated the movements. The following groups then conducted the pre-test in line with this procedure. In this way, the students received equal opportunities to observe the teacher.



Analysis

The phenomenographic analysis of the pre-test was based on video recording of students' movements when replicating the teacher's moves. Hence, they were not interviewed as was the case in the technology study.


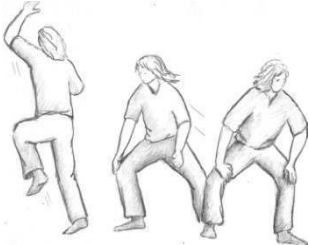


The analysis began by describing each student's movement on the video when replicating house-hop during the pre-test. Common features of differences in ways of moving were then analysed, based on verbal descriptions as well as the students' ways of moving as displayed on the video. These differences proved to concern, for example, the direction of the rotation, the tenseness of movement or whether the students were leaving the ground or not. The outcome of the phenomenographic analysis were based mainly on differences in these areas. Some students rotated for example clockwise and some counter clockwise while at the same time moving firmly or loose. Also, some students rotated on the ground of which some took a lot of room in the space and some less. The differences in ways of moving laid the foundation for categories of qualitatively different ways of grasping house-hop. The different categories emerging from the analysis are not related to individuals. Rather, the categories display the features of the different ways of experiencing the object of learning in the group as a whole (Marton and Booth, 2000, 57). For example, one category was described as "jumping up as high as possible while at the same time being as extended as possible". Several students showed this feature of movement while also showing other features such as, for example, different directions of rotation. The building of the categories was based on how many aspects seemed to be discerned simultaneously. The hierarchical construction is however not straight forward since some categories comprise the same number of structural aspects although different kinds of aspects. The categories provided by the phenomenographic analysis were further studied in order to identify the structural aspects of house hop discerned within each category, as presented below.




Findings

The outcome of the analysis shows seven different ways of knowing house-hop. Knowing a movement as something, for example, "as a high jump in a

tube", "as a house-hop with a trailer" or "as a house-hop in a small cell" can serve as metaphorical articulations which in turn also could be seen as creating a certain meaning of a movement. The illustrations below are drawings of students whose way of moving were regarded as exemplifying a certain way of experiencing house-hopping "as something" (for example "as a high jump in a tube") and thus answering the question: how do students, considered to belong to this category, seem to experience this movement?

Additionally, the analysis show what aspects there are to discern in order to grasp the movement in a powerful manner.

Category of experiencing house hop	Description	Structural aspects discerned
<p>A. House hop as a counter-clockwise rotation on the ground</p> 	<p>House hopping is about walking to a spot to the right and at the same time rotating 360 degrees. The initiating phase is related to the direction of the rotation.</p>	<p>Direction of rotation Simultaneous transportation to the side Degree of tenseness</p>
<p>B. House hop as a rotation clockwise</p> 	<p>House hopping is about jumping up in the air while rotating in any direction. Arms and legs take a lot of room in space.</p>	<p>Flight phase Simultaneous transportation to the side Participation of legs through the movement Range of motion Degree of tenseness</p>
<p>C. House hop as “high jump in a tube”</p> 	<p>House hopping is about jumping up as high as possible while at the same time being as extended as possible. The initiating phase is related to the direction of the rotation and the landing takes place basically at the same spot as where the jump started.</p>	<p>Direction of rotation Flight phase Initiating phase Range of motion Degree of tenseness</p>
<p>D. House hop as a “loose style motion”</p> 	<p>House hopping is about being relaxed and “cool”. The initiating phase is related to the direction of the rotation and the flight phase. Arms and legs take a lot of room in space.</p>	<p>Direction of rotation Flight phase Simultaneous transportation to the side Initiating phase Participation of legs through the movement Range of motion Direction of legs/knees</p>

<p>E. House hop in a small cell</p> 	<p>House hopping is about initiating it “a little bit”, jumping “a little bit” and keeping a “tight” position throughout the movement. The initiating phase is related to the direction of the rotation and the flight phase.</p>	<p>Direction of rotation Flight phase Simultaneous transportation to the side Initiating phase Participation of legs through the movement Degree of tenseness Direction of legs/knees</p>
<p>F. House hop with a trailer</p> 	<p>House hopping is about moving your upper body while the legs are hanging along like a trailer. The initiating phase is related to the direction of the rotation and the flight phase.</p>	<p>Direction of rotation Flight phase Simultaneous transportation to the side Initiating phase Range of motion Degree of tenseness</p>
<p>G. House hop as an explosive, air-borne rotation, “embracing the sky”</p> 	<p>House hopping is about powerfully initiating a counter clockwise rotation high up in the air almost lying and embracing the air at the highest point. The initiating phase is related to the direction of the rotation and the flight phase. Your body takes up a lot of room in space and the landing is firm and “deep”, taking place some distance to the right of the start.</p>	<p>Direction of rotation Flight phase Simultaneous transportation to the side Initiating phase Participation of legs through the movement Rate of motion Direction of legs/knees Degree of tenseness</p>

The categories above were mainly based on ways of *doing* with the aim of analysing ways of knowing, in this case, a movement called house-hop. Below we will present an analysis of how bodily expressions, including gestures, gaze, speech and movements, constituting ways of *being*, are regarded as different ways of knowing how to act with presence.

The meaning of knowing how to act with presence

For the past twenty years Swedish students have been able to select theatre as their main subject at

upper secondary school level, as part of the national aesthetics programme. This study examines the acting capability and if the students are able to communicate with presence. The study was carried out in an upper secondary school where students had chosen theatre as their main subject. The eight students were in their second year, aged between sixteen and seventeen years old. Four teachers were involved in selecting the learning object, designing common research lessons and analysing the filmed material.

The object of learning

The learning object of this study is the *capability to express presence, when in an indoor swimming pool*, which acts as an example of being able to act with presence. Presence was found suitable, as it was something that the teachers had experienced difficulties with in teaching and instructing. Presence is a core quality in acting and it is one of the criteria teachers agree on as being of importance when assessing a student.

Pre-test

A pre-test was conducted in order to investigate how much previous knowledge the students had about the idea of presence. The exercise used as the pre-test is called “The swimming pool” and the students were asked to “be themselves except that they were not acquainted with each other”. The purpose of this was that they should neither take on playing a role nor become too personal with each other, even if they, of course, were allowed to make contact. The purpose was to try to “be like you would be” in a similar “real” situation. The teachers wanted the students to focus on and examine *experiencing* being in a swimming pool environment. The choice for the exercise was selected as a way to make the students experience an imaginary situation. Either you *are* in a situation, which requires presence, or you *pretend* you are in a situation, which is often less convincing.

Before the students started the exercise, the teacher together with the students, decided where the different settings in the swimming pool environment were placed. “Here is the swimming pool, here is the sauna, the stairs up to the cafeteria” and so on. The exercise/pre-test took around 20 minutes.

The pre-test was analysed using phenomenographic analyses where **bodily expression**, which includes gestures, gaze, speech and movements, constituted the material for constructing the categories.⁵ The analysis process considers and takes into account how the expressions tell us something of the *being* in the swimming pool area. How do the expressions express “the *being*”? By placing “the *being*” in focus, the *capability of expressing presence* is considered, which is the learning object.

Findings

Through the phenomenographic analysis of the pre-test, four qualitatively different categories emerged describing students’ ways of *expressing presence in a specific situation (in this case a swimming pool area)*. The categories are logically related to each other so that the less complex ways of knowing are included in the more complex, of which category (A) is the level describing the least complex way. In the following section we will describe each category and illustrate it with an example from the filmed material.

Expressing presence as imitation

One figure is in the swimming pool cafeteria. He is eating an ice cream, suddenly he puts his hand in an imaginary pocket and the ice cream seems to have disappeared. But then suddenly the hand is out of the pocket again and he continues eating the ice cream.

The expressions in this category have the character of imitating, or pretending similar situations experienced in real life, now put in an imaginary situation. In the example above we see how the student interrupts the act of eating an ice cream. Oddly enough this rupture exposes the students ability to imitate as the act of imitating becomes apparent.

Expressing presence as interaction

Two figures meet in the sauna. They make up/improvise, a story where they eventually start fighting and throw ice cream at each other. The focus is on the dialogue and the fighting.

The expressions in this category have the character of interacting with others. Speaking and making up new stories “take over” which means, the focus is on what happens between the figures, specially the verbal interaction.

Expressing presence as illustration

One figure is sitting in the Jacuzzi and moving his hands as if playing with the water. The movements are mechanical, there is no “real” experiencing of the water. It has the character of producing signs of

Table 3. Different ways of knowing/expressing presence, when in a swimming pool facility

Category of expressing presence	Description of category	Structural aspects discerned
A. Expressing <i>presence</i> as imitation	Concerns imitating being in a similar situation and/or handling a similar object.	Focus is on <i>maintaining concentration and illusion</i> .
B. Expressing <i>presence</i> as interaction.	Concerns interacting with other students, where improvisational talk or creating new situations are significant.	Focus is on <i>physically reacting in the situation</i> .
C. Expressing <i>presence</i> as illustration.	Concerns communicating the situation or the relationship to the others as significant.	Focus is on <i>giving signs or using gestures to communicate</i> .
D. Expressing <i>presence</i> as incorporation.	Concerns experiencing a situation where expressions have the character/quality of being immersed in the situation.	Focus is on <i>being in a perceived situation</i> .

being in a Jacuzzi but not experiencing it. Another example is three girls sitting in the sauna fanning their faces with their hands implying that it is hot.

The expressions in this category have the character of exaggerated or symbolic gestures, e.g. gesticulating and fanning their hands to imply heat. Occasionally concentrated on the situation happening right now, resulting in a routine expression, but still being aware of trying to communicate these expressions.

Expressing presence as incorporation

One figure walks in into the swimming pool cafeteria. In theatre terms he is coming from one situation and going to another. The result of this is that the movements become dynamic, there is a change in tempo, including small stops, which are not planned or rehearsed but come out of being “in” and experiencing the situation through the body.

The expressions in this category have the character of a relaxed body and breathing where the movements are rhythmical and dynamic, but not planned. A concentrated and focused body, i.e.

attentive to what is happening in the situation and reacting in a credible manner.

The results will be presented in the form of an outcome space together with the structural aspects of the specific learning object. Four qualitatively different ways of expressing *presence* in a (imaginary) swimming pool facility were found. The four categories were analysed in terms of structural aspects discerned.

Discussion

Our purpose was to show some examples of how subject-specific ways of knowing can be studied and described and thereby contribute to the development of teachers’ professional language. In these three cases, the primary results were produced through a phenomenographic analysis within the framework of a Learning Study. Qualitatively different categories of descriptions concerning the meaning of evaluating technical solutions, performing a house hop and being able to act with presence were presented together with descriptions of certain aspects of the specific knowns that must be discerned in order to know the intended object of learning.

The three studies differ in how the phenomenographic analysis has been carried out. While the findings in the first study are based on interviews (or rather conversations in relation to physical artefacts), the second study focuses on the students' ways of moving, i.e. what the students actually did. In contrast to this, the third study did not primarily focus on what the students were saying or doing, but rather on whether what they were saying and doing expressed presence. The first study emphasised *ways of seeing*, the second emphasised *ways of doing* and the third *ways of being*. The phenomenographic analysis thus concerned different kinds of expressions of the knowings – to a large extent depending on the “nature” of the object of learning (making an evaluation of technical solutions, performing a house hop and being present when acting in an imaginary swimming pool).

However, they all result in descriptions of what must be discerned in order to develop some subject-specific capability – as well as descriptions of different ways of knowing the specific known (the different categories of description).

We believe that the qualitatively different categories can be used by teachers when discussing the level of knowing among different groups of students in relation to the specific objects of learning. The different aspects that must be discerned are important for the design of lessons and student tasks as well as for assessments. More research is, however, necessary in order to find out if and how these kinds of results may be useful for teachers. But even without such studies a few remarks can be made. Concerning the teaching of technology in primary school (with a lack of teaching traditions) the results may be used in order to select and design the content of technology teaching, while in theatre education the results may contribute to a common professional language within the framework of existing traditions. Concerning physical education, the content of performing a house hop is not prescribed in the syllabus, so the results may be used as an example of how movement capability (which is prescribed in the syllabus) can be articulated, discussed and analysed in relation to a specific movement.

Although the phenomenographic analyses of pre-tests were the main source of results in the three cases presented here, the Learning Study also produces other data which can be analysed in different ways. In the collaborative selection and

formulation of the object of learning, teachers' tacit knowing interacts with formulations in the syllabus when trying to describe and analyse specific learning or teaching difficulties within a subject area, as well as in the construction of the pre-test. Also, when analysing teacher-student interactions during the lessons (which are video-documented) new dimensions of learning difficulties or of the object of learning will appear through the cycles. All these different kinds of data are materials that can be used to generate knowledge concerning the meaning of different subject-specific ways of knowing – through the continuous specification of the meaning of the object of learning.

We consider this change in the understanding of the learning object as one of the most important results of a Learning Study. Normally, the results from a Learning Study are presented in terms of how a certain lesson design is related to student learning as differences between pre- and post-tests. However, in the studies presented here the differences between pre and post-tests are used to revise the research lessons but are not considered to be a result of the studies.

In our study the focus was not foremost on the learning of the students but on the meaning of the object of learning as well as the subject-specific capability that the students were expected to develop.

Our research object was the meaning of the subject-specific ways of knowing. Knowing is not a free floating entity, but related to specific knowings as well as specific knowers. Our results were of two kinds; on the one hand the phenomenographic categories of descriptions of ways of knowing and, on the other, different aspects that must be discerned in order to grasp what is expected to be known. While the phenomenographic categories of description also comprise the tacit features of the students' knowings, the discerned aspects form dimensions of what may be called the focal knowledge (Polanyi, 1967) concerning the object of learning.

The results in terms of aspects to be discerned as well as the categories of description form a way of articulating the meaning of the objects of learning and thereby become a contribution to theorising the meaning of knowing these objects of learning. The Learning Study can, in this manner, be used as theory-building case study research (Stiles, 2009).

NOTES

1. These capabilities are not considered to be a general kind of competencies (Vollmer, 2007) but rather subject specific ways of seeing, doing and being.
2. Dewey and Bentley describe the relationship between the known and the knowing as *transactional*, meaning that they must be dealt with together and as mutually defining each other.
3. However, as Wittgenstein points out, in order to grasp the meaning of the concepts they must be used in a praxis/practice and this use is, in itself, tacit. The capability of using the concept in adequate ways must be moulded in classroom discourse/interaction (Wittgenstein 1953/2001).
4. It is important to note here that phenomenography is not to be confused with phenomenology although there are some similarities. Phenomenography developed as an empirically-oriented approach in the 1970s (Marton, 1981) in contrast to phenomenology which in essence, is a philosophical method although there are also empirical phenomenologically approaches. Phenomenography aims at exploring the qualitatively different ways of experiencing a phenomenon among a group of people (Marton and Booth, 2000, 152 ff). Phenomenography is used with an intention of analysing differences in the way people experience a phenomenon (often something to be learned in the context of education) and results in qualitative descriptions of these differences.
5. It is important to stress that we are not analysing individuals but expressions. One individual can (bodily) communicate several expressions.

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