

VARIATION THEORY: A TOOL TO ANALYSE AND DEVELOP LEARNING AT SCHOOL

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Abstract

This chapter argues that the decisive factor in the learning process is the object focused upon in the learning situation and not, as is commonly believed, the teaching method. We demonstrate how teaching and learning can be facilitated with the aid of a theory. The theory chosen is variation theory, which allows one to explain what it takes to learn a certain learning object. Both pupils' and teachers' learning are focused upon, as learning takes place in the interaction between the two. It is in the meeting of pupils' and teachers' knowledge that understanding of a specific learning object takes place. The three integral components of variation theory – discernment, simultaneity and variation – are described. By studying a specific learning object in three different classroom situations we demonstrate how it is possible to illuminate the different ways in which a learning object can be presented. These ways are described and analysed in terms of their implications for pupils' learning. Our paper elucidates how variation theory can be employed to describe, plan and analyse the learning process. In a research project, it is the selection of what is to be focused upon which is the most critical factor, as it determines both the choice of theoretical perspective and method. Both theory and method are important tools for providing answers to research questions. It is only when the lesson content is specified and the pupils' knowledge before and after a lesson is both ascertained and related to how the specific learning object has been presented in the classroom that one can determine what pupils have learned, and why they have learned it. Variation theory is an ideal theoretical perspective for such a study.

Key words: *variation theory, phenomenography, learning, instruction.*

Introduction

School as a phenomenon is based on a vision of what constitutes teaching and learning. This vision incorporates the assumption that learning at school is a direct result of teaching. Nuthall (2005) argues that this assumption is in fact a myth. Irrespective of whether it is the teacher or pupils who express themselves in the teaching situation, there is a generally accepted belief that such communication automatically leads to learning (a.a.). Nuthall argues that whoever (teacher or pupil) is responsible for making the learning object visible (i.e. the selected phenomenon or the skill to be developed) in a teaching situation, it is *what* is made visible and *not* by *whom* or *how* that are the crucial factors. What is critical at school is thus not if teaching is teacher-steered, i.e. in the form of formal lectures, or if learning is the result of co-operation between pupils and teacher as part of a socio-cultural process; rather, the decisive factor in learning is *what* is focused upon in the teaching situation and not the method. Nuthall's (2005) research demonstrates that the assumption that

pupils learn and achieve excellent results as a consequence of working diligently in the classroom can be misleading. His study showed, for example, that the pupil who achieved the best results had not actually learned anything new. Unbeknown to the teacher, all the necessary knowledge had been acquired earlier. This did not become obvious until the focus was moved from the teaching method to what was to be taught. This problem has also been discussed by Carlgren and Marton (2000), who argue that teachers place far too little emphasis on the content of what is to be taught; instead, they tend to focus on the work method, in the belief that it is this which determines what pupils learn. It is, however, what aspects of the learning object are made discernible that determines what can be learned in a given teaching situation.

This chapter presents a content-related perspective on learning at school. It is based on the variation theory, which is used as a tool for analysing and developing learning in the classroom. Variation theory is a theory of learning which has developed from phenomenographic research (Martin & Booth, 1997; Runesson, 1999; Holmqvist, 2004; 2006; Holmqvist, Gustavsson & Wernberg, 2007; 2008). The theory is based on the principle that learning is made possible by distinguishing the critical aspects of a phenomenon. These aspects are seen against a background of variations that enable the pupil to discern aspects of the learning object which have not previously been obvious. The purpose of this chapter is to illuminate the advantages and disadvantages of adopting a theoretical perspective on a teaching situation. At the same time, the positive effects of adopting the variation theory will be demonstrated.

Theoretical Assumptions

Numerous studies based on a phenomenographic approach have been conducted on how people perceive phenomena (Marton, Dalhgren, Svensson & Säljö, 1977; Marton & Booth, 1997). A phenomenographic approach allows one to map different perceptions of a particular phenomenon. It is important to have knowledge of different ways of understanding a phenomenon when, for example, planning a specific teaching situation; this is because the teacher has a greater chance of achieving good results if s/he understands the pupils' individual perspectives. A phenomenographic research approach is limited to describing various interpretations; variation theory, on the other hand, goes one step further and plots the way in which learning develops. Phenomenographic research has highlighted how a phenomenon may be understood in various ways by different individuals. This prompts the question: 'what is required to teach a particular phenomenon or learning object?' This question has given rise to variation theory, the goal of which is to explain how learning takes place; in other words, variation theory makes it possible to understand how different experiences can be converted into a common understanding of a learning object. Variation theory assumes that knowledge of how different students understand a phenomenon enables teachers to develop personal teaching strategies which are tailored to the specific needs of their pupils.

We have chosen to adopt a variation theory perspective since our primary aim is to study in what ways intentional learning at school may be furthered with the aid of a specific theory of learning. Our interest is thus not in learning in general or in establishing the efficacy of a particular method. Rather, our concern is with how pupils learn selected facts about a specific learning object. Variation theory is non-dualistic; we study pupils' learning about the learning object as well as teachers' knowledge about how pupils learn a similar learning object, focusing on the interaction between both perspectives. It is in the meeting of pupils' and teachers' knowledge that understanding of a specific learning object takes place in a teaching situation. It is not possible to differentiate between the pupil and the teacher in the classroom, as learning is the result of the ways in which the critical aspects of a learning object have been made discernible by all the actors in the learning situation. The one presupposes the other and reflects each individual's understanding of the phenomenon. The teacher's understanding of what is required to teach his/her pupils is intertwined with the pupils' opportunity to understand the learning object. Variation theory focuses upon the content of what is to be taught rather than on other structures or artefacts that influence learning, e.g. socioeconomic preconditions, linguistic factors, gender, work routines etc. This is not to say that such factors are insignificant. It is our belief, however, that it is the way in which the learning object is presented in the classroom that *determines* the limits of what a pupil can learn and how learning can be developed.

Variation theory has three integral components. The first is *discernment*. Learning implies that one allows different aspects or features to change position: what was once background may take a more prominent position, and what was initially focused upon retreats into the background. If it is not possible to discern what is to be learned, it is pretty obvious that learning cannot take place. One of our studies investigated how nine- to ten-year-old pupils learn the infinitive verb 'to be'. The majority of pupils (31/61) used only one word for the Swedish word 'är' (to be) when writing in English as they had not understood that 'är' in Swedish can be translated in three different ways in English, as 'am', 'are' and 'is'. Although language lessons at school and various forms of out-of-school contact with the English language, e.g. on television and radio had presented pupils with the opportunity to differentiate between the three forms, the majority had not observed these differences as they had not developed the ability to discern them. One possible explanation is that in the mother tongue there is no variation in the use of 'är'. Polanyi's (Carlgren, 1999) research in gestalt psychology bears some similarities to the discernment aspect of variation theory. Gestalt psychologists are especially concerned with the focal and background knowledge necessary to focus upon a particular phenomenon. In the above example of 'är', the focus is upon the target language. The pupils identify the word 'are', which they use indiscriminately since their mother tongue is Swedish. They assume that one word is sufficient to translate the Swedish word 'är'. They do not look for alternatives as their mother tongue has only one word for 'är'; as a result, they fail to discern 'is' and 'am'.

The second feature of variation theory is *simultaneity*. Part of something can at the same time constitute a complete unit in itself, and a complete unit can be part of something larger. In the example of 'är' in English, it is necessary for pupils to discern three different words at the same time; such simultaneity is essential if one is to put the correct word in the right place. In order to establish if the word 'is' is the correct word in a particular context, it is also necessary to understand why it is wrong to use 'am' or 'are'. An example from mathematics, i.e. percentage, is illustrative of the importance of simultaneity in understanding a particular phenomenon. In figure 1 below, there are two identical copies of the same picture depicting a circle which is missing a piece the equivalent of 25% of the entire circle. In one of the pictures the caption explains that the figure is 75%. It could, for example, be a representation of a cake after a piece has been removed. In the other picture, which is absolutely identical, the caption reads that the figure is 100%. In order to understand that both captions are in fact correct, it is necessary for the observer to see the part and the whole simultaneously. In the first picture, a complete figure (a circle) is 100%; in the second picture, only the figure which is depicted in the picture is 100%. The figure might be a representation of a perambulator. In which case, no part is missing. The figure should not be interpreted as a complete circle.

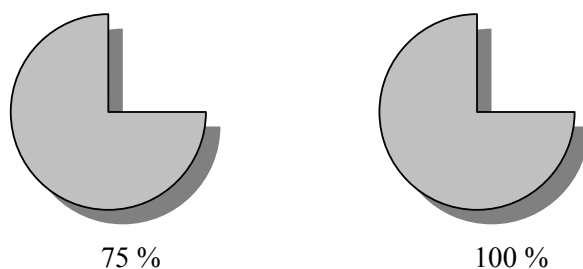


Figure 1. Representations of how percentage can be explained using variation.

The third feature of variation theory is *variation*, i.e. opposites and deviations. Understanding a phenomenon is the result of observing how it deviates from the normal pattern. In order to understand what 'cold' is, one must have experienced heat. It is not possible to experience joy without experiencing its opposite, sorrow. Pupils can apply a strategy which can be fruitful even if it is 'wrong' or incomplete. It is when one encounters an example which deviates from other examples or phenomena, and where the strategy proves to be erroneous, that new learning can result. This is exemplified by studying the behaviour of people from war-torn nations. Different ways of acting are

based on socio-cultural learning (Säljö, 2000). Consider the following situation: you are sitting in a classroom and the door suddenly swings open. Previous experience will determine if you suddenly throw yourself to the floor or remain sitting in your seat. We build up a picture of the world that makes it difficult for us to discover that which is considered normal. We do not question ways of acting if the acts are seen as 'normal', but as soon as they differ from what we define as 'normal' we discern them; at the same time, we will become aware of what we consider 'normal'. Discernment, simultaneity and variation are intertwined. They are necessary components of all learning situations if pupils are to become aware of new phenomena or develop new abilities.

Methodology of Research

The aim of the present chapter is to describe the advantages and disadvantages of variation theory in understanding and developing learning at school. By studying a specific learning object in three different classroom situations it is possible to illuminate the *different* ways in which a given phenomenon can be presented. Following our discussion of these different ways is an analysis of their implications for learning. In this way, we elucidate how variation theory can be employed to describe, plan and analyse the learning process.

The starting point of this study is the pupil's perspective. It is assumed that people learn in different ways even when they participate in the same learning situation. The focus is on intentional learning at school. An individual perspective is adopted. We investigate how the individual's perspective, i.e. the individual pupil's understanding of a given phenomenon, influences more general developments in the learning situation. The insights or abilities which a pupil develops in relation to a particular item of knowledge or task are seen to depend on how the teacher chooses to present the learning object in the classroom (Marton & Booth, 1997; Marton & Morris, 2002; Marton & Tsui, 2004).

As the object of our study is learning situations in which the teacher aims to develop a specific ability or impart a particular piece of knowledge, we chose a method that allowed us to study a number of lessons with the same learning object. The method selected was the 'learning study' (Marton, 2004; Holmqvist ed., 2006). The latter is characterised by co-operation between researchers, a group of teachers and their pupils. The object is to elucidate how a learning object is understood. Phenomenographic analyses as well as more traditional tests and interviews have been used to collect data which describe the pupils' previous knowledge (see the following chapter in the present book – Holmqvist, Lindgren, Mattisson & Svarvell, 2008). The starting point of a learning study is always the different teachers' questions about what and how pupils learn (Marton & Tsui, 2004). The learning study was implemented in the spring 2003 and was one of 18 learning study cycles carried out in the research project "The Pedagogy of learning" (Holmqvist, 2002). Six groups of teachers were involved. There was one study per term and subject (spring and autumn 2003, and spring 2004); the three subjects involved were Mathematics, English and Swedish. The same teachers participated, taking it in turns to teach; the pupils, on the other hand, took part in only one lesson per learning study cycle (this included three lessons per cycle).

Results of Research

One important result of our research is that the teachers involved were able to develop a more successful teaching strategy having been given the opportunity to analyse and discuss their work from the perspective of variation theory. Following is an example of one of our studies, which illustrates the advantages of variation theory in understanding and developing learning at school. The aim of the chosen learning study was to teach pupils how to use the infinitive verb 'to be'. The teachers started the learning study cycle by discussing the problems that they had encountered earlier while teaching the verb 'to be'.

The groups presented in the table below contain all the pupils included in the study cycle. As there were no significant differences between the results of the boys and girls, these are not presented separately.

Table 1. (%) = pre-test; % post-test; +/- change in percentage points.

Item	Pupils group A	Pupils group B	Pupils group C
I am	(15%) 45% +30	(13%) 61% +48	(12%) 85% +73
You are	(28%) 50% +22	(50%) 74% +24	(52%) 43% - 9
She is	(35%) 75% +40	(39%) 61% +22	(38%) 81% +43
Mary is	(45%) 65% +20	(43%) 78% +35	(38%) 86% +48
He is	(38%) 55% +17	(39%) 61% +22	(33%) 86% +53
Sam is	(35%) 90% +55	(43%) 70% +27	(33%) 91% +58
My dog	(25%) 40% +15	(35%) 57% +22	(33%) 91% +58
We are	(15%) 35% +20	(39%) 57% +28	(48%) 71% +23
Sam and Mary are	(15%) 40% +25	(28%) 35% + 7	(43%) 86% +43
My parents are	(10%) 32% +22	(28%) 26% - 2	(50%) 62% +12
Sam and I are	(15%) 28% +13	(30%) 43% +13	(48%) 43% - 5

Prior to the first lesson, the teachers assumed that the following critical aspects are needed to develop understanding: 1) the pupils must discern three different words (am, are, is); 2) they must replace the personal pronouns which correspond with the correct form of 'är' with other words (e.g. he, my brother, my father, a boy, Tom etc.) and 3) they must discern the difference between singular and plural, which invalidates agreement with the personal pronoun. The first lesson showed that the pupils found it difficult to discern the structure of the target language. As a result, a table was introduced in lesson two which shows the pattern pertaining to the learning object. In certain tasks (see table 1) the pupils developed a greater understanding of the pattern and could answer questions correctly. This enabled them to answer more questions correctly in the post-test (given after the lesson) than in the pre-test, which was given before it. It was demonstrated, however, that even better results in terms of learning outcome could be achieved, particularly with regard to the plural form. The focus in the third lesson shifted to *what determines* the form of the verb (am, are, is) as opposed to the relationship between personal pronouns and the form of the verb. The plural form was *not* divided up into the sub-groups 'we are', 'you are' and 'they are'. The pupils were informed that when there is more than one, the verb form should always be 'are'. Instead, the pupils concentrated on the construction of the singular form, in which they made such sub-divisions as 'I am', 'you are', 'he is' and so on.

The best results in terms of knowledge acquisition were found in lesson three. One explanation is that the teachers' insight into what is required to teach the chosen learning object had increased. They were better able to identify the critical aspects in their teaching group, as well as what is required to learn the selected learning object. By observing in groups one and two that the pupils did not understand what determines the verb form, the teachers understood that the focus in group three must be upon this specific aspect. At the same time, irrelevant information was removed, e.g. pupils were not asked to sub-divide plural forms since 'are' is always used when there is more than one. As a result, it was possible to adapt the teaching to the pupils' needs since their ability to learn the required learning object had improved. There is a positive correlation between teachers' increased understanding of what pupils need to know in order to learn the required learning object (understanding gained by systematic investigation of the pupils' incomplete answers) and identifying critical aspects. Once the aspects which prevent pupils' understanding of the learning object are identified they can be presented in a new way in the classroom. The knowledge developed in a learning study gives other pupils new opportunities to discern critical aspects. This has been verified by the analysis carried out after each research lesson. The teachers' ability to identify the critical aspects of the learning object and to use these to elucidate the latter improved, with the result that learning in new

groups of pupils increased, as demonstrated by the test results after the lesson. It is reasonable to assume that the ability to identify critical aspects is useful in all teaching situations. It appears that in some of the learning study cycles we carried out, the process of identifying critical aspects and adapting the way the critical aspects of the learning object were presented became faster for every cycle. During the second and third terms, the teachers appeared to be able to identify the critical aspects as early as research lesson one or two.

As demonstrated above, variation theory provides a tool with which teachers can develop their ability to distinguish critical aspects of a learning object and offer these to their own particular group of pupils. The teachers developed a new perspective on learning, how to speak about learning, and how to develop learning. This has been clearly illustrated in a questionnaire distributed to the teachers. It was further confirmed at a meeting of the teachers after learning study cycle three was completed (all six teacher groups met; three groups were affiliated to Kristianstad University and three to Gothenburg University) (Gustavsson, in press). The focus of the present chapter has been on learning related to a specific learning object. Other forms of learning have not been taken into consideration as they cannot be elucidated by the learning study cycle data collected as part of our study. They are, in other words, 'in the shadow' identified in figure 2.

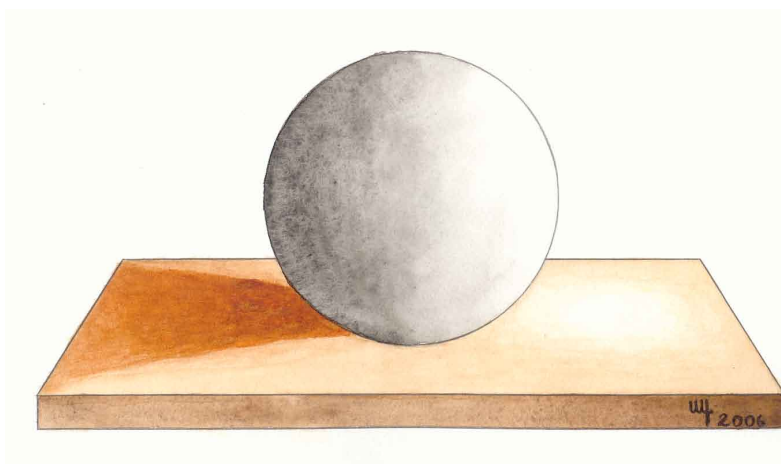


Figure 2. Researchers' reflections on phenomena are always limited by what is focused upon. The aspects described are those which are focused upon, leaving the unfocused aspects in the shadow of the phenomenon itself.

Conclusions and Discussion

The present study demonstrates how a theoretical perspective on learning - in this case, variation theory - can help develop learning at school. The lessons described here were planned in accordance with the principles of variation theory. We have focused on intentional learning for a restricted period of time and in a particular place, that is to say, learning at school. Our results demonstrate that learning requires that the pupil be exposed to and be given the opportunity to discern the critical aspects, i.e. the distinguishing qualities of the selected learning object. This can be achieved in different ways: a teacher or a pupil can elucidate a new critical aspect and contrast this with earlier identified aspects; alternatively, new aspects can be focused upon simultaneously. Had we chosen to study learning from any other theoretical perspective, the results in terms of pupils' learning would have been different, reflecting the kind of restriction imposed by the chosen theoretical perspective. Our chosen method was the learning study cycle, as this enabled us to revise the lessons discussed above on the basis of results from the previous lessons. In this way, we were able to compare lessons with identical content but with different groups of pupils.

We have demonstrated that the ability of the teachers to discern critical aspects and elucidate these in a learning situation improved. At the same time, the test results demonstrated that the pu-

pils' learning also increased. It would be a little naive to suggest that one theoretical perspective is sufficient to cover all events at school. Rather, different theoretical perspectives complement one another; they do not provide conflicting pictures of the same situation. Choosing a perspective that will provide an answer to the chosen research question is not a matter of finding one 'right' perspective that covers a multitude of situations. Our study demonstrates that variation theory is a powerful tool in studies where the focus is on what is to be learned.

The illustration (figure 2) demonstrates how potential aspects of a chosen research area can be elucidated or obscured. The research field is the circle. The highlighted area of the circle is the focus of research. The results are displayed on a table top in the form of a shadow from the illuminated section of the circle. The shaded area is not accessible. The shaded part exists irrespective of whether we choose to elucidate it or not. Another theory must be chosen, but it is clear that it is impossible to cover all the aspects of a natural situation and elucidate these in a scientific manner with the aid of one theoretical perspective alone. In choosing one research area, one rejects other possible aspects. When a new research project is being planned, the selection of what is to be focused upon is the most critical factor, as it determines both the choice of theoretical perspective and method. Both theory and method are important tools for finding answers to research questions. The ability to select and restrict an area for elucidation can be developed in different ways. It is less fruitful to select one part of the circle to study and choose a method which yields results that would be better placed on the shaded side of the globe. To return to Nuthall (2005), a study of how pupils work with particular assignments in a classroom situation, and the ensuing discussion, does not show what the pupils have learned. It is only when the lesson content is specified and the pupils' knowledge before and after a lesson is both ascertained and related to how the specific learning object has been presented in class, that one can determine what pupils have learned, and why they have learned it. Variation theory is an ideal theoretical point of departure for such a study.

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