

# CONTRASTING CASES AND THEIR IMPACT ON LEARNING: A REPLICATION OF A LEARNING STUDY CONFIRMING THE IMPACT OF CONTRASTS

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## **Abstract**

*The present article describes how Swedish pupils in class 4 (nine to eleven years old) learn English as a second language. The study replicates a learning study carried out within the framework of a more extensive project known as “The Pedagogy of Learning”. The present study is aiming to find out if the results from one original learning study can be generalised to other teachers and pupils. The pupils participating in the presented study learn how to use “to have”. The original Learning Study Cycle (LSC) consisted of three lessons per cycle, each lesson carried out in different groups of pupils. The teachers focused on the critical aspects, i.e. the features which must be distinguished in order to understand a phenomenon. This process entailed investigating the contrasts between the specified learning outcome(s), i.e. the ability or knowledge targeted. The lessons were planned from a variation theory perspective. The LSC demonstrated that the use of contrast – applied in only one of the three lessons – between “to be” and “to have” had a positive effect on pupils’ generative learning, i.e. continued learning outside the classroom. In order to establish if the results of the present study are coincidental or repeatable the LSC was replicated. The first replicated study was conducted by a group of teachers with a good knowledge of variation theory. These teachers had previously applied the theory in mathematics lessons. A second replication was initiated by a group of teachers with no knowledge of variation theory. The results demonstrated that contrast is important for generative learning provided that teachers are able to focus on critical aspects and thereby elucidate contrast. In the group familiar with variation theory the results were similar to those of the original study, i.e. generative learning was promoted, while contrast had little effect on the pupils generative learning in the group of teachers who had no knowledge of variation theory. The study demonstrates that generative learning is dependent on teachers’ knowledge of how the critical aspects of the target knowledge should be presented to pupils. Such knowledge enables teachers to apply contrast as a means of developing pupils’ ability to distinguish qualitative differences. In this way, pupils continue to develop their knowledge beyond the classroom.*

**Key words:** *variation theory, phenomenography, learning study, contrast, generative learning.*

## **Introduction**

We experience things in different ways. To experience means to be able to discern something in a given context and relate it to a specific context. It also means discerning elements of our experience and relating these to other experiences or to the phenomenon as a whole (Carlgren & Marton, 2002). Vygotskij (1999) claims it is possible to learn concepts only if the pupil can both discern aspects which are similar to as well as those which differ from other phenomena. To demonstrate how this kind of learning develops he refers to Sacharov’s experiment with four groups of objects – geometrical

figures of different colours, sizes and thicknesses. It was necessary for the pupils to comprehend that neither the colour nor the geometrical shape was critical. To define a group of connecting objects the pupils must understand that it is the size and thickness which are critical. The variation theory relies on the same kind of observations regarding how learning develops. Our study assumes that contrasts, as well as associations, are important for developing learning. This is an assumption we share with Vygotskij. “[...] it seems as if the associations of sameness have been replaced by associations of contrasts” (Vygotskij, 1999, p 198, authors’ translation). In order to discern something, we focus on certain aspects and not on others. If we are to focus on specific aspects these must be distinguishable from an invariant background, i.e. variation is necessary for discerning, discerning is necessary for experiencing. The contrasts between what varies, and what does not, result in a discernible pattern. As Thorndike (1914) indicates, “/.../man is originally attentive to *sudden change and sharp contrasts*...” (p. 14). Bransford and Schwartz (1999) found that “[d]ata strongly supported the assumption that contrasting cases better prepared pupils for future learning” (p. 77).

Research shows that what we remember is either familiar or divergent. We recognise the appearance of those who are close to us irrespective of circumstance or situation. However, if one is to recall an unfamiliar face it must stand out in some way for it to be noticed and remembered (Stenberg, 2006). The same principle applies to the teaching situation. The teacher creates a “picture” of what is to be learned by including what is already familiar to the pupil, but s/he must also include unfamiliar parts. If the latter is to learn something new, it must diverge from the already familiar. Only then can it be discerned and remembered. The new information can be used in new situations which ultimately become familiar. In this way, the environment is perceived in a new way. Learning is promoted as a broadening of experience which enables the pupil to continue learning outside the classroom. Studies based on variation theory and the principle of contrast demonstrate that long-term learning is promoted if the teacher associates the unfamiliar with the familiar by applying different levels and forms of contrast (Al-Murani, 2006).

Schwartz and Bransford (1998) have demonstrated that “analysing [...] contrasting cases provided pupils with the differentiated knowledge structures necessary to understand a subsequent explanation at a deep level” (p. 504). They also showed that describing features was not as effective as helping pupils to discover these for themselves when using contrasting cases; the pupils learned to discern critical aspects, so-called “significant features”, to use Schwatz & Bransford’s term. Deep understanding, they suggest, requires differential knowledge of empirical phenomena or theories as well as an understanding of their significance.

When the learner can distinguish aspects of a learning object which he has not been able to discern previously, and at the same time focus on new aspects, his/her understanding develops. This is reminiscent of a connoisseur of wine whose ability to distinguish between different kinds of wine increases as s/he identifies new properties. The contrast may initially be great, such as that between red and white wine. The level of sophistication gradually increases as one’s power of differentiation improves. Schwartz and Bransford (1998) found that contrasting cases could serve as guides to discernment and differentiation.

The “discovery as discernment” position is that individuals learn well when they have generatively discerned features and structures that differentiate relevant aspects of the world [...] general knowledge did not help the pupils notice specific features embedded in the hypothetical study – features that could cue their concept knowledge. This is why analysing the contrasting cases yielded an advantage on the prediction task; it helped the pupils discover the characteristic features in the prediction task, and the features could serve as a set of cues that reminded the pupils of the target concepts (p. 493).

If the teacher is to enable pupils to focus on the critical features of an object of learning, s/he must first learn how to define these aspects. One feature must be presented as “basic” while others should be focused on from a variation perspective in order for the learner to distinguish the critical aspects. The foundation of learning is the knowledge shared by both teacher and pupils. In other words, promoting learning entails opening up the dimension of variation (Marton & Tsui, 2004). This dimension relates to phenomena. Parts of a phenomenon can, however, be separated into new

dimensions as a kind of differentiation or enrichment as the learner gains a deeper understanding. Colours are a good example. If the learner recognizes four different colours (red, green, blue and yellow) these become part of the dimension of “colour.” But if the learner has discovered different types of green, the colour green may constitute a dimension of variation. In this dimension, it is the different types of green that make up the varying constituents. Schwartz and Bransford (1998) found that

[i]n domains in which pupils have less prior experience, less complex contrasting cases may be more appropriate lest pupils get lost in the little contrasts [...] The contrasts between the tools are less “cluttered” compared to the contrasting cases of these studies. This makes it so pupils with limited algebra knowledge can still locate the important contrasts. (p. 507)

To return to the example of the wine connoisseur, for the beginner, contrasts must be simpler and more obvious than for the expert. The connection between the pupils’ experience of the object of learning and the complexity of the critical aspects in the contrasted cases of the enacted learning outcome indicates where learning may be expected to occur. If the pupil has limited knowledge about the learning object, the differentiation in and complexity of the critical aspects considered by the teacher must be less than in situations where the pupil has greater knowledge. The complexity of the contrasted cases must be considered otherwise they will not have any impact on the pupils’ learning outcomes. The study presented in this article describes how contrasts used by the teacher in learning situations influence pupil learning outcomes both in the short- and long-term perspective; they also demonstrate the importance of the teacher’s ability to distinguish the critical aspects to be contrasted.

### **Preparation for future learning (PFL) as a perspective on assessing transfer**

Like Bransford and Schwartz (1999), we link transfer to future learning. Bransford and Schwartz (1999) argue “/.../ that prevailing theories and methods of measuring transfer are limited in scope; we propose an alternative that complements and extends current approaches; and we sketch this alternative’s implications for education” (p. 61). The PFL perspective is one such alternative as it takes into consideration the ability of the pupil to learn from new experiences.

Our study has shown that some pupils have gained an ability to continue learning about the learning outcome even when the research lesson is finished and irrespective of the kind of situations in which they subsequently participate. This ability is shown in the results of the delayed post-tests. In accordance with PFL, which focuses on “extended learning instead of one-shot task performances” (Bransford & Schwartz, 1999, p. 77), we have conducted delayed post-tests to ascertain if pupils’ learning outcomes change over time. “The PFL perspective draws attention to differences between short-term and long-term efficiency” (ibid. p. 78). We have also tried to establish if there are any links between learning outcomes and what happens in the classroom in terms of variation, i.e. contrasting critical aspects of the dimensions of the learning object. As Bransford and Schwarz argue, the “PFL perspective focuses on evidence for useful learning trajectories” (ibid., p. 92). If the teacher plans a lesson based upon the variation theory and embeds contrasting cases to create the variation necessary for discernment, pupils are not only given the opportunity to learn about the object of learning itself, they also learn how to develop methods for discerning minor differences between phenomena. These methods appear to impact on pupils’ future learning activities.

### **Methodology of Research**

The method used in the present study is a replication of a learning study cycle. A learning study is a fusion of lesson study (Lewis, 2002; Lewis & Tsuchida, 1998; Stiegler & Hiebert, 1999) and design experiments (Brown, 1992; Kelly & Lesh, 2000). The different steps in a learning study are presented in Holmqvist, Gustavsson and Wernberg (2008). In a lesson study, teachers discuss, plan and observe lessons with a very specific content. The purpose is to promote teaching and learning

in an educational setting. A group of teachers choose an object of learning, usually something experience has identified as problematic. They prepare a lesson together after investigating the pupils' previous knowledge of the subject. The next phase is to teach the lesson. One or more of the teachers teaches the class. The lesson itself is regarded as a team project. It is recorded on video as well as documented and analysed. The analysis leads to a revision of the lesson; the revised lesson is then taught to a new group of pupils. A lesson study can involve several evaluations and revised lessons (Lewis, 2002; Stiegler & Hiebert, 1999).

The aim of a design experiment, as with the lesson study, is to study learning in a normal school environment. A design experiment is based on a particular theory, and its results are systematically evaluated. It develops knowledge about how the teaching environment influences pupils' learning opportunities and is integrally related to efforts to improve practice (Brown, 1992; Kelly & Lesh, 2002).

An LSC is carried out in the same way as a lesson study but, as with a design experiment, it is theory-based. Teachers often collaborate with researchers, with whom they study the lesson itself, different theories of learning and subject-related research in the field of the learning outcome. In our learning studies we rely on the theory of variation and research approaches adopted in our chosen field. A learning study can be designed with parallel lessons or, as in the present case, a cycle. In a cycle, the lesson is revised once or several times. The group of teachers working with the cycle remains the same, while the pupils change from lesson to lesson (Holmqvist ed, 2006; Holmqvist, Gustavsson & Wernberg, 2008; Holmqvist & Mattisson, 2008).

### *The object of learning - "to have"*

To identify different areas in need of special attention the pupils in our study were instructed to reply to a letter from Holmqvist. 61 replies were analysed phenomenographically. Three problems were identified: the constructions "to have", "to be" and possessive pronouns. The present study focuses on the construction "to have". The learning study cycle was carried out in three-week periods; and the original learning study was the second which took place in the spring term 2003. We found that the teachers' assumptions about the pupils' problems in learning how to use "have" and "has" correctly were verified in the pupils' test results. As in the above-described study, the new study was subject-based, and the researcher played a part in clarifying both the critical aspects of the learning object and how the variation theory could be used in planning the coming lesson. The teachers in the replications also had the opportunity to study the original lessons and tried to copy them as much as possible according to which critical features to present. In Swedish, the word "har" is used for both "have" and "has." In English, it is possible to use "has" with "he," "she" or "it," but the Swedish word "har" is not associated with the personal pronoun, i.e. it is used in all cases. Swedish pupils learning English are not concerned about which personal pronoun to use as they are not used to making such a distinction in their own language.

### *Participants*

The original LSC incorporated 48 pupils and five teachers from one school in the south part of Sweden. Two teams of four teachers were used when replicating the original learning study in autumn 2006. The teacher in the first replication had previously taught mathematics according to the principles of variation theory; this time, however, there was a new group of pupils (N=26). The second group of teachers were administered by an assistant who had knowledge of the theory; the teachers themselves, however, had no such knowledge. Their group comprised 21 pupils.

The replicated study involved the original team of teachers and 47 new pupils. The pupils in the original learning cycles were randomly placed in three groups and were also selected from three different research "classes", divided on the basis of the screening results. Previous knowledge of the pupils and their understanding of the object of learning enabled the teachers to place them in three heterogenous groups. In other words, the groups contained equal numbers of pupils with inadequate or adequate knowledge of the target construction. The groups were divided as illustrated in Holmqvist, Lindgren, Mattisson & Svarvell (2008). In the replicated cycle, a different model was chosen: two

groups of pupils (26 and 21 pupils) at two different schools. The classes were divided into three groups, on the same premises as in the original study, and the original lessons KE3.1, KE3.2 and KE3.3 were replicated in one group each.

### *Test-material*

- A test was constructed in the original study and was also used in the replication. The test, as in the previous screening process, included 15 sentences of varying degrees of difficulty:
- A Knowledge that there are two English equivalents of the Swedish word “har.”
- B Knowledge of how to use the two different words (“have”/“has”) with different personal pronouns.
- C Knowledge of how to use “have” and “has” when words other than personal pronouns are identified in the sentences, including the difference between singular and plural.

The test included different degrees of difficulty, as presented below (from Holmqvist, Gustavsson & Wernberg, 2007):

1. *I **have** a bike.*
2. *You **have** blue eyes.*

In these sentences, the personal pronouns are singular, while the nouns are plural, which could confuse pupils who do not understand the meaning of the sentence.
3. ***Have** you got a dog?*

The change of word order in sentence 3 can be more problematic since the sentence includes both “you” and “a dog (it).”
4. ***Has** he blue jeans?*

In sentence 4, both “he” and “jeans” could refer to “has.” It cannot thus be determined if the pupil made a mistake in agreement or not.
5. *My father **has** a green car.*

“Has” could apply to both “my father” and “green car.” Sentence 6 was so constructed to ensure that the pupil knows which word determines the use of “have” or “has.” The pupil must know that “[m]y father” should be followed by “has,” but “two children” by “have.”
6. *My father **has** two children.*
7. *She **has** breakfast at eight.*
8. *The dog is nine years old, and it **has** a big nose.*

Sentence 8 is less difficult than 9 since it includes “it.”
9. *The flower **has** beautiful colours.*
10. *We **have** one house.*
11. *Sarah and I **have** dinner at five.*

Here it is possible to connect “Sarah” with “has,” which could be confusing as the relationship between “I” and “have” is not usually a problem for the pupils. If the latter do not know the rules governing singular and plural forms, it is difficult to pick the right word. Sentence 15 was included to ascertain if the pupils had a clear picture of the difference between the forms.
12. *There are 67 pupils in your class. All of **you** have got pencils.*
13. ***They** have two cars.*
14. ***They** have an umbrella.*

In sentences 13 and 14, “they” is plural while “an umbrella” is singular. A pupil must know what to look at in the sentence in order to pick the correct word.

**15. Sam and Tom** have got a cat.

As already mentioned, in this sentence the pupils could be confused by “Sam has” and “Tom has” but “Sam and Tom have” if they are not familiar with the difference between singular and plural forms and their implications. If they do not understand the meaning of the sentence, they could also be confused by “a cat.”

The results of the pre-test (Table 1) showed abilities which had not yet been developed, especially in areas B (knowledge of how to use the two different words - “have”/“has” - with different personal pronouns) and C (knowledge of how to use “have” and “has” when words other than personal pronouns are identified in the sentences, including the difference between singular and plural).

**Table 1. Table of the lived object of learning in percentage correct answers from the three research lessons in the original learning study cycle (Holmqvist, Gustavsson, Wernberg, 2008, p 123).**

Item	correct answers gr. 1ABC			correct answers gr. 2ABC			correct answers gr. 3ABC		
	Pre (%)	Post (%)	Change	Pre (%)	Post (%)	Change	Pre (%)	Post (%)	Change
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
TOTAL	25	50	+25	35	57	+22	39	75	+36

When analysing the results, we identified a significant difference between lesson 1 and the other two lessons with respect to the delayed post-test 4 weeks after the research lesson (table 2). We found that in research lesson 1, where the teacher had contrasted two different systems (“to be”/“to have”), the pupils continued to learn even after the lesson was over. Instead of a decline in knowledge after 4 weeks, this group showed an increase.

**Table 2. Results of the original study.**

Original study	KE3.1 (1) 15	KE3.2 (1) 17	KE3.3 (1) 16
A. Pre-test	7.87	7.00	7.31
B. Post-test	9.13	9.24	9.81
Diff B-A	+1.96	+2.24	+2.50
C. Delayed post-test	9.93	8.06	8.50
Diff C-A	+2.06	+1.06	+1.19
Diff C-B	+0.80	-1.18	-1.31

Opportunities to compare and contrast the different systems seem to have enabled the pupils to continue to learn from new situations. This confirms the findings of Bransford and Schwartz (1999), who claim that being forced to make well-reasoned changes in one's beliefs and assumptions influences future learning. Our study provides additional evidence to support this claim. Bransford and Schwartz argue that readiness for future learning is affected by how contrasting cases are applied in the learning situation. In the present study, however, it appears that contrasting cases also stimulated new learning outside the learning situation. We call this kind of learning "generative learning". Similar results have been demonstrated by Al-Murani (2006). Research lesson 1 seems to have given the pupils insights that resulted in a "do-not-take-for-granted attitude" and sharpened discernment in such a way that the pupils could learn from situations beyond the learning situation itself. The revised lessons influenced the learning outcome in a positive way. The teachers' reflections were an important tool for change enabling the pupils to discern and recall information from a former lesson and apply this to a new learning situation.

### Results of Research

The above presented LSC was replicated in exactly the same way as the original study but in two new school contexts. The greatest difference between the three research lessons was the teachers' way of contrasting the two examples of "to be" and "to have" in the first of the three lessons included in the original learning study. All three lessons were repeated with new pupils and two new groups of teachers. One group of teachers was familiar with variation theory and had employed it in mathematics lessons. In the latter group, the critical aspects of the learning outcome were identified and contrasted in the classroom, and copied from the video-observations and written plans from the original study. The second group of teachers had *no* previous experience of variation theory.

The results demonstrate that the pupils in the first lessons of the cycle, in which the structures of "to be" and "to have" were contrasted, made greater progress than the other pupils. There is, however, a difference between the teacher group who have had inservice training in variation theory and the group with no prior knowledge of the theory.

**Table 3. Results of the replication carried out by teachers with knowledge of the variation theory.**

Replication VT	KE3.1 (2)	9	KE3.2 (2)	9	KE3.3 (2)	8
A. Pre-test	5.78		6.33		4.62	
B. Post-test	6.67		9.22		8.88	
Diff B-A	+0.89		+2.89		+4.26	
C. Delayed post-test	8.14		9.55		8.71	
Diff C-A	+2.36		+3.22		+4.09	
Diff C-B	+1.47		+0.33		-0.17	

It appears that the contrast alone ensured that the pupils in the first replication made progress both in the short- and long-term perspective. However, in the second replication (table 4), where the teachers had no knowledge about the variation theory, the pupils made progress in the short-time perspective but the effects were not increased in the long-term perspective at the same level as in the first replication (table 3). Even if the result did not increase in a long-term perspective, the results show the largest difference between pre-test and delayed post-test in the first lesson, where the contrasts were used.

**Table 4. Results of the replication carried out by teachers with no prior knowledge of the variation theory**

Replication	KE3.1 (3)	7	KE3.2 (3)	7	KE3.3 (3)	7
A. Pre-test	5.57		6.43		9.57	
B. Post-test	9.71		9.28		10.43	
Diff B-A	+4.14		+2.85		+1.09	
C. Delayed post-test	9.14		9.43		9.14	
Diff C-A	+3.57		+3.00		-0.43	
Diff C-B	-0.57		+0.15		-1.29	

The analysis of the first lesson in both replications demonstrates that teachers with knowledge of variation theory emphasised and presented contrasts more clearly. In the second replication, the teacher is more concerned that the pupils produce the correct answers and fails to emphasise certain important differences between the critical aspects. The ability to discern small qualitative differences was not promoted in the second replication, where the teachers were not familiar with variation theory; this may explain the differences in long-term results.

## Discussion

20 LSCs have so far been carried out within the framework of the “Pedagogy of Learning” project. The results have demonstrated in different ways how a theoretical standpoint during the planning stage can promote pupils’ learning. One hundred learning studies have been carried out in different subjects in Hong Kong. In the earlier studies, we discovered the importance of the relationship between teachers emphasising the critical aspects of a learning outcome and pupils’ results. We have endeavoured to replicate the results of the “Pedagogy of Learning” project to see if they are specific to the group being studied or if they can have a more general application. Bransford & Schwartz have demonstrated that contrasting cases are significant for pupils in terms of experiencing learning outcomes and thus for their ability to acquire knowledge. Our study shows that contrasting cases are important tools for creating the dimensions of variation which are necessary for discerning new aspects of an object of learning. However, it is not only contrasting cases as a *method* which determines whether a child learns or not: we have discovered that the teacher’s ability to discern and present contrasting cases is crucial for whether a child retains knowledge in the long term. This became particularly apparent in the two replications produced by teachers who either had (2) or did not have (3) knowledge of variation theory. Without knowledge of the latter, teachers were more diffuse and general in their presentation of contrasting cases; those with knowledge of variation theory, on the other hand, were focused and precise in their choice of examples. While the groups and tendencies which we describe here are small, the beneficial results for teachers using a theoretical model in their teaching are becoming increasingly clear. At the same time, researchers can develop more general knowledge of how one learns.

## Acknowledgements

This research was sponsored by the Department of Behavioural Sciences, Kristianstad University College and The Swedish Research Council, Committee for Educational Science. We would also like to thank Ph.D students Laila Gustavsson and Anna Wernberg for their assistance in collecting data. We also thank professor Lennart Svensson for advising this article.

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