

The Object of Learning - Before, During and After a Learning Situation

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ABSTRACT

The aim of this study is to describe in what ways the object of learning changes shape during its way from the intended (planned), enacted (offered) and lived (discerned) object of learning. The study is based on variation theory, and learning study is used as a model. A total of three preschool teachers, 39 children aged 4-5 years and three researchers participated in the study. Three interventions were carried out in three different groups of children (A, B and C) by three preschool teachers. The data consist of video-documented meetings with the preschool teachers and researchers, interviews with the children in the form of pre-, post- and delayed post-tests and video-documented interventions (3). The results show (a) how the teachers' focus on aspects concerning the object of learning and aspects not concerning the object of learning affects learning possibilities. The results also show (b) a discrepancy between the children's possibilities to learn and what the preschool teachers intend to offer them to learn. Finally, the results show (c) how the preschool teachers' understanding of children's learning sometime make them use other words than the appropriate ones to make the intervention funnier or more interesting.

Keywords: variation theory, learning study, pre-school.

1. INTRODUCTION

According to variation theory [1] the focus in learning situations should be on the learning of something and not

on how to teach, or what learning is, as the starting point for learning is the relationship between what is going to be learnt and the learner. It is not the conditions of learning that cause learning, as conditions only make it possible for learners to learn certain things [2]. Instead we have to direct our focus on the relationship between the person and the phenomenon. These phenomena are called *objects of learning*,

In every institutional instructional setting abilities or phenomena are intended to be developed or understood by the learners. It is the teachers' or the instructors' responsibility to make it possible for learners to learn. Objects of learning have a direct or specific aspect, that is, the concrete object of learning is to be understood: how to read, the rock cycle, division in mathematics, progressive creativity, and the difference between number and size. But objects also have an indirect or general aspect, that is, what you are able to do when you have developed knowledge about the object of learning. Learners and teachers have a different focus on the object of learning, as teachers should focus on both the direct and indirect aspects, while pupils mostly focus on the direct aspect of the object of learning. The object of learning appears in three ways in a learning situation: the intended (what the teachers plan to offer the pupils to learn), the enacted (in what way it is offered the learners in the learning situation), and the lived (what knowledge the learners have achieved) [2].

Teachers, and their intentions concerning the object of learning, are the crucial part of any lesson. The *intended* object of learning is the teachers' perspective on what is to be learnt — their thoughts and intentions with the learning situation. It is the teacher who delimits the object of learning. By deciding what is possible to discern, and what

is not possible to discern, the pupils are offered different aspects to experience. It is possible to get a view of the intended object of learning by what teachers do and say in accordance with how the object of learning is offered in the classroom. Thus, teachers' statements and actions concerning the object of learning establish the possibilities and limitations for learners to learn in a given situation.

Secondly we have the *enacted* object of learning. This can be said to consist of how the teacher structures the conditions of learning, and how the object of learning is shaped by the teacher and pupils in cooperation. The researcher is able to observe the enacted object of learning. The result is an analytical description of what necessary conditions, and to what extent, an object of learning becomes visible for learners, or what limitations for learning a certain situation have. The enacted object of learning is a relation between the possibilities that are offered by the teacher and the possibilities that are utilized by the learners in a given situation. Accordingly, the intended object of learning could change as the pupils' participation in the classroom discussion might contribute dimensions not planned or offered by the teacher.

Finally, the *lived* object of learning is the knowledge the pupils have developed during a learning situation, i.e. if their abilities or knowledge on the targeted object of learning have developed during the learning session. That is, what the pupils actually have learned. This can be analyzed both on individual and group level.

In this research project we have studied the different shapes of the object of learning during its three phases: the intended, the enacted and the lived, what implications differences in focus between these forms have on the learning outcomes, and hence what teachers learn from a learning study.

The data material obtained in the study consists of: a) video-taped discussions with the teachers before, between and after the lessons, b) video-taped interviews with the children before and after the learning situation (pre-, post- and delayed post-tests) and c) video-taped activities (lessons) in preschool.

This study is a part of a major research project funded by the Swedish Research Council — "The Pedagogy of Learning". All studies carried out in the project are based on variation theory.

2. THEORETICAL ASSUMPTIONS

The theoretical assumptions of this study rest on variation theory, which assumes that variation is needed to discern aspects of an object of learning not previously discerned by learners. By the use of variation and simultaneity between aspects brought up, the pupil can learn to see the object of learning in new ways [2]. Here the theory's corner-concepts of *discernment*, *simultaneity* and *variation* will be discussed.

To be able to discern something you have to discern what features it consists of. If someone tells us about a round, green ball that bounces well, we have no difficulty visualizing it. This is because we already have knowledge of shapes, colours and how balls should function. Thus, to be able to discern something you have to have experienced

variation in a corresponding dimension of the aspect. That is, to be able to discern green, you need to discern other colours. In a more complex setting, you have to discern features and values of things, but also parts of wholes and wholes in different contexts [2]. For instance, to be able to discern a chair you have to be able to discern the various parts of the chair. If you leave out the back of the chair, you have a stool [3]. To be able to see an animal in the forest, you need to be able to discern the difference between the context (branches, leaves and so on) and the animal (legs, fur, face and more). We have to discern the start and the end of many different aspects of the context (what a forest consists of) that belong together to be able to sort out what does not fit in this whole - the animal - as it consists of other things than are represented by the aspects of the forest [1]. This means we can discern the animal as a contrast to the forest and define it as a different phenomenon than the forest. And finally, we must be able not only to see the variation between different aspects belonging to the same phenomenon (for instance colour and size of a cat - parts of the whole), but also be able to discern what the object is *not* (a dog is not a cat - the differences between wholes based on a lack of certain aspects).

Variation theory also claims that aspects must be considered simultaneously. That is, as we see the colour green we simultaneously discern it from all the colours we have experienced through life, our non-visual representations from earlier experiencing. This is called *diachronic* simultaneity, and can be defined as the necessity to recall earlier experiences of a dimension of aspects at the same time [2]. But things also have different features, like the ball's shape, colour and functionality. This makes it necessary to be able to discern different co-existing aspects of the same thing at the same time, so-called *synchronic* simultaneity [2]. That is, we discern shapes, colours and available functions at the same time within the object. The difference between aspects and features is referred to in this article in this way: an aspect is a specified feature of an object, but a feature is a general value that could be an aspect of several objects. If we say this apple is green, it is an aspect of the specified object, but green as such can be a feature in several other objects. Aspect refers to a specified object, but a feature is generic.

Concerning how we learn the particular object of learning - wholes and halves - all the aspects of wholes, parts and contexts are present to us, in several different ways, and we are aware of them in our own individual way. The discernment changes over time and in different situations, and in relation to what other aspects are offered in a situation. This makes it essential for teachers to be aware of how the aspects offered in a learning situation affect the possibilities to learn. Most important is to hold on to the intended object of learning during a learning situation, instead of opening up dimensions of variation not related to the intended object of learning.

The learning situation may thus not be either too difficult or too simplified. If things are simplified too much, children open up their own dimensions of variation and make up their own rather complicated systems and explanations, because they do not discern all the aspects of a phenomenon and fill in gaps with how they think it could be. This can make learning even harder in the future if they

have to reconsider aspects they have assigned to the phenomenon. By that they have to change perspective two times in a learning situation. First by delineating aspects they have incorporated with the phenomenon, and then by incorporate new aspects previously not discerned. In this case they have to replace their own created aspects with those they had not discerned before. If the level of complication is too high, they do not have the capacity to see what is crucial and do not discern the aspects even if they are offered to discern them. It is like when we learn a new language. If we are only offered the words we already know, we cannot talk about such phenomena, or, like a child, produce our own words. On the other hand, if we are offered the new language in a way that native speakers speak it – we do not understand the conversation and lose interest. Teaching is a careful consideration of how and by what means they give opportunities for children to understand in relation both to what they already know and what aspects of an object of learning are offered. Using this theoretically grounded design includes consideration of discernment, simultaneity and variation, concurrently. The theoretical assumption is that variation is needed to discern aspects of an object of learning not previously discerned by the pupil.

3. METHOD

Combining lesson study [4, 5] and variation theory yield learning study. Learning study is a kind of action research, as it intends to develop practice, and it includes different steps where researchers and teachers work together discussing and developing practice while collecting data [6,7].

Learning study [8] is the method used in this article to collect data on an object of learning and how it differs in its three shapes (intended, enacted and lived), and to describe if and how the different dimensions of variation affect the learning outcome. The setting for the study is a preschool with children 4-5 years old. The object of learning is that the children develop knowledge about the difference between the concepts number (many) and size (much). The study also includes discussions about planning and analysing the object of learning before, during and after the learning situation.

The participants in the study were three pre-school teachers who represented different levels of work experience; three researchers, who represented scientific knowledge; and 39 children (Table 1), who were respondents in this learning study.

Table 1. Data about the children in the three groups.

	Group A (n=12)	Group B (n=12)	Group C (n=15)
Mean age (months)	61	59	59
Min – max age (months)	53-67	52-67	47-69
Girls	7	8	7
Boys	5	4	8

The children belonged to three different but comparable groups who were exposed to one learning situation each per group, concerning the same object of learning.

A learning study consists of two or more micro-cycles that form a macro-learning study cycle. In this case there are three micro-cycles. A micro-cycle consists of at least three parts, that is *pre-test*, *intervention* (at school a lesson, at preschool an activity) and *post-test*. It is also possible to include a *screening*, where you scan what could be the difficult parts to understand for children concerning the object of learning. In addition you can end the study with a *delayed post-test*. A delayed post-test's purpose is to enable the research team to see whether the changes in knowledge are a long-term result or only a short-term effect of the lesson. The aim of a learning study is to develop sustainable learning rather than to achieve short-term learning successes, and tests given directly after the lesson are not indicators of long-term change in children's experience. If children's way of looking at the phenomenon has changed, it should sustain or even develop a long time after the learning situation. This is called "generative learning" [7], which is a kind of transfer.

All learning studies start with a discussion where the teachers and the researchers analyze all possible aspects of the intended object of learning, and the experiences the teachers have from previous teaching. These discussions result in the planning of the first activity, as well as in the design of the tests that are used throughout the study. The activity plan is rather detailed, especially concerning what aspects should be made possible to discern. Special attention is paid to the importance of focusing on a specific content when planning instruction, and in what way this has an impact on the children's learning with respect to this particular content [9].

The pupils in group A (the first group of children and the first planned activity) do the pre-test. It consists of different choices of "where they find most items". The children are here exposed to variation concerning the concepts many (number) and much (size), by being showed different objects (Table 2).

Table 2. Test material

Test	Test material
A	Geometric blocks; 2 thick Geometric blocks; 3 thin
B	3 Potatoes 4 Hazelnuts
C	2 Full bottles 3 Empty bottles
D	3 Hot dogs 4 Small frying sausages 5 Meatballs
E	3 Hazelnuts 4 Hazelnuts 5 Hazelnuts
F	3 Bikes 4 Roses 5 Chickens
G	5 Children 10 Trees 20 Fishes

The children have seven different tasks to decide upon where there are most items (greatest number).

After the pre-test the children are exposed to the planned activity. The preschool teacher of group A gives the children the opportunity to discern the differences between the concepts of many (number) and much (size) in two varied parts. The *first part* is composed of a game where the children imagine that they are swimming in the sea and suddenly see sharks in the water, but the children can save themselves by running to large rings that represent islands. Then the teacher asks the children how many they are in each ring, and also in which ring there are the greatest number of children. This part is the same in all three groups (A, B and C). In the *second part* the teacher place items of different sizes (balls, small bean-bags and wooden blocks), and numbers inside the rings, and let the children count the items. The teacher exposes the children to differences in number and size, and offers them to understand that number and size are different phenomena by using fusion and separation. Finally they give the children opportunity to discern the difference between the concepts many and much, as a contrast. In Swedish we differ between most when we address most meaning greatest number (flest) and most meaning greatest size (mest), by the use of different words.

When the activity is completed it is time for the post-test, which is identical to the pre-test. After four weeks the children are given the delayed post-test, which is identical to the pre- and post-test. This ends the first micro-cycle.

The second micro-cycle starts after the first groups' post-test, with discussions between the pre-school teachers and the researchers concerning how the children reacted to the first planned activity, in combination with the results of the children in group A at the pre- and post-test. The discussion focuses on what another design might have given the children for opportunities to discern the object of learning. Could the aspects of the object of learning have been separated or been fusion in another way, or could other contrasts have been used? The pupils in group B do the pre-test, which is exactly the same as for group A. In the second activity (B) the first part is the same, that is, the shark game is played. In the second part of the activity the items placed in the rings are different and consist of one huge teddy-bear, ten small teddy-bears and three dolls. Here the teddy-bears provide opportunities to put one small teddy-bear together with the huge one (variation in size), to be able to count them as two, although one of them is bigger than all the other teddy-bears put together. The teacher informs the children that it is possible to count the items when asked about greatest number (flest), but not when asked about where there is greatest size (mest). The teacher presents the concepts of greatest number and greatest size on a number of occasions. The activity is followed by the post-test, and in a couple of weeks the delayed post-test will be administered, and so the second micro-cycle is complete.

The third micro-cycle follows the same pattern, but now it is group C and their preschool teacher who are involved. The teachers and researchers discuss the first (A) and second (B) interventions, what happened and what could be done in another design. One critical aspect seems to be an emotional aspect, in relation to the dolls and bears.

It seems as the children often refers to what the representations think and feel, instead of the general principle to differ number from size. To avoid such interference, it was decided to select non-emotional representations, which also could be in both different sizes and numbers. After pre-test and the shark game, it is time for the part where items are put in the rings. Now the items are the same, they all consist of cotton wads (invariation of material). These are arranged in one huge, three big and ten small cotton wads. This time it is possible to put the different wads together, or to divide a bigger wad into a number of smaller ones. The teacher elucidates the difference between greatest size and greatest number, and also that, it in the case of number, is possible to count the items. The two concepts are heavily focused by the teacher. And finally group C completes the post-test, and the delayed post-test. These three micro-cycles put together form the macro-cycle on which the results are based.

4. RESULTS

The results are divided into two parts. First, we can notice an increased learning outcome in all three groups (Table 2). It is clear that the children have increased their learning through the intervention, no matter which group, and also that in two cases they have increased their understanding of the concepts of number and size over time, an indicator of generative learning. It is also possible to distinguish that learning seems to increase more from a lower origin, when comparing the results of group A and B with group C. The only initial difference we have found among the three groups is based on how the groups are composed. Groups A and B include children of different ages in their ordinary activities (1.5 – 5 years), but in the study we have only included children 4-5 years old. In group C no children younger than 47 months are included in their ordinary activities.

Table 2. Mean results of pre-, post- and delayed post-test (max 7.0).

Group	A	B	C
Pre test	3.7	3.5	5.3
Post test	4.3	4.8	5.9
Delayed post test	4.7	4.9	5.9

The object of learning in the intended phase was to make it possible for the children to discern the difference between size and number by sorting different items (three representations – balls, pads and fabric bags). The representations varied but the size did not vary as much as should be needed to make the children discern this aspect. The children were offered to discern more, fewer, fewest in the activity with rock rings. They offered to tell the difference between size and number by the use of balls, fabric bags and pads. The enacted object of learning was by that limited by only one varying aspect, which is not enough to discern the critical difference between size and number. This is verified in the lived object of learning, as the interviews show the children still find it hard to discern the difference. The analysis of the results in group A showed that the children's average learning outcome

increased from 3.67 to 4.5 (max 7.0). In the individual interviews with the children we found that they easily understood that five hazelnuts are more than four and three hazelnuts. However, they had difficulty understanding that five meat-balls are more than four small sausages or three hot dogs. They found it hard to believe that five chickens are more than three cycles in the first picture. However, they had no trouble understanding that 20 fishes are more than 10 trees and five children in the second picture. Another task they had difficulties in understanding was that three empty bottles are more than two filled bottles. We also found that children mixed most with best. The critical aspects are still to discern the difference between size and number, but also to distinguish between most (in relation to both size and number) and best.

In group (B) the intended object of learning is planned to be presented with other representations, to make the children discern the difference between size and number simultaneously. This was made by the use of representations in different sizes, small and very big bears and dolls. The enacted object of learning was very close to the intended, although it changed in some parts as emotions as a dimension was used to explain why the teacher moved the items between the rock rings to change positions of where there was highest number of items.

Comparing group B with group A also shows that there is a difference between the dimensions of variation that are presented in the different activities. This difference is based on the contrast between greatest number and greatest size, which was mostly focused upon in design B, and the representations were more similar in design B (different sizes of bears and dolls). The lived object of learning in group B, the outcome of the children's learning, showed differences. They initially found it difficult to understand that five meat-balls are more than four small sausages and three hot dogs (4 of 12 answered correct initially), but after the intervention nine out of 12 children could separate number from size. They understood that five chickens are more than three cycles in picture one (9 of 12 children). But they had some problems to understand that 20 fishes are more than 10 trees and five children. A further indication that they had understood the difference between number and size was that all of them understood that three empty bottles are more than two filled bottles after the intervention.

The intended object of learning in group C differed from intervention B in one way. Combined with the doll and bear-exercise another exercise was included. In this the representations were only cotton-wad, possible to divide into small pieces or keep in a big piece. It did not include the dimension of emotions in the same way as dolls and bears. This means the intended object of learning differed by the invariance of representation compared to the dolls and bears-exercise. The enacted object of learning differed from the intended as the children sometimes found it hard to see the difference between size and number as the representation was the same no matter if it was most concerning size or number. They tried to point out in which ring they thought there were highest number, but as it was possible to divide a big cotton pad to many small pieces, there could be most concerning size and number at the same time, depending which perspective the children had. If they

simultaneously saw the small pieces in the big cotton pad, it was not possible to discern the difference. By that, even if the dimension of emotions could be opened up by the use of bears and dolls, the use of whole entireties might have helped the children to discern in a better way than the cotton pads.

Even though the results at the pre-test are high in group C, the children in group B develop their knowledge further and keep it in a long term perspective. It is possible the learning outcome would have been even higher in group C if they had a weaker initial result, but we can not verify such assumptions in this study. But we have defined the lived object of learning. The highest increases in this group were found in items B and F, in the pre-interviews 10 of 15 children answered three hazelnuts are more than two potatoes, but after the intervention all of them answered correct. In item F, 8 of 15 children answered five chickens are more than three bikes and four roses, and after the intervention 12 children answered correct.

5. DISCUSSION

We have also found results concerning the teachers' learning, which consists of an increased ability to discern the critical features of a learning object in relation to pupils' capability to learn. This is shown through the increased scores by the groups (A, B and C). The use of learning study, based on variation theory, therefore enhance teacher's abilities to predict in what way the object of learning should be offered to children they meet in a learning situation. This result is clarified by the interviews with the preschool teachers. In these we can distinguish a difference between teachers' expectations of the children's learning, compared with what they actually learned in this study. This was shown through the combination of interviews, both before and after the micro-cycles, with the teachers and the results of the tests (interviews) with the children before and after the interventions. The teachers' expectations on individual children's learning were in many cases improper. It was very hard for them to identify what capabilities a child has to learn. They both under- and overestimated the children. When they were confronted with the discrepancies between their assumptions and what the child actually has learned, they tended to seek the reasons in the child rather than in the learning situation. Instead of giving reasons connected to the interventions or the targeted object of learning, they discussed the individual children's personal features (*he might not want to do it ... , I mean a bit uninterested*), language problems (*because she can be a little distracted sometimes, and she has a bit of a language problem*) and that the researchers were unknown persons for the children (*you are new people coming in, it is a new situation*). This means they did not express their understanding of the connection between the learner and the targeted object of learning.

This in turn indicates that there is an obvious risk that teachers' expectations, whether too high or too low, affect children's ability to learn. Even if the teachers have, in fact, developed an ability to find the crucial differences in how to present the critical aspects of the object of learning to the children, the expectations that they are unaware of can

affect the learning outcome. This difference was highlighted by using the learning study model, as the teachers in this model are analysing the learning outcome in relation to what actually was offered the children to discern in the intervention. This discernment seems to be crucial for understanding what it takes to learn.

Teachers' expectations are also shown in the enacted object of learning, as the communication sometimes is childish "play-talk". When this happens, the children focus on aspects not belonging to the object of learning itself, and the object of learning is not discerned during this part of the intervention. When one small teddy-bear was put beside the huge teddy-bear the teacher (B) said: "Now they can be friends". This was problematic as it could direct the children's focus to friendship instead of numbers and size. Thus, it opens up a dimension of variation not intended (for example the feelings of teaching materials, why there have been a conflict and so on). This could have been prevented by using an educational discussion in a playful way, but not in a childish conversation about other aspects of the object of learning than those critical for understanding it. This example also highlights adults' views on children's learning. If teachers diminish the object of learning to a predetermined childish "level" there is a risk for a depreciation of children's learning. Even if the outcome in group B was the highest, it might have been even better without this kind of aspects.

Furthermore, in the discussion concerning the intended object of learning we found some different perspectives between teachers and researchers. The researchers focused on the object of learning and how it is offered the pupils through the activity. The teachers on the other hand were worried, as they perceived different difficulties that the children could experience during the exercises in the intervention — for instance that not every child will find room in the rings during the shark play, and consequently get a feeling of being left behind. Both perspectives are of course useful, but we think we can learn a lot from each other in this kind of action projects. The researchers can find new fields of interest important for learning, and the participating teachers can learn to be more focused on the targeted object of learning.

That teachers and researchers have different expectations therefore indicates two things to be attentive to in action research-projects. It is necessary to discuss the different expectations the included parties have, and how they individually regard the important aspects in the different parts of a study. Even so, this study does not have the intention to focus on differences between teachers' and researchers' experiences, but on how the object of learning changes shape during its three phases (intended, enacted and lived object of learning). However, the results are more general concerning learning as such. The preschool study is only chosen to exemplify what happens when the object of learning is intended, enacted and lived – regardless of the learning situation. The results can help us understand how to design more powerful learning situations in different types of schools and learning environments (face-to-face and virtual).

6. CONCLUSIONS

The object of learning must be exposed to variation for learning to be achieved, which can be accomplished through discernment, simultaneity, and awareness. Learning study as a method has proved to be functional for variation. Learning studies have been carried out in different settings, including different objects of learning and different learning contexts. The aim was to carry through a learning study in a preschool context, and in this paper to describe what implications for learning different focus on the object of learning have in the intended, enacted and lived phases of the learning object. It also meant to study what teachers learned by participation.

We propose that learning study as a model can be used in preschool settings to provide learning, which is confirmed as all three groups of children increased their results (group A 3.7 to 4.7; B 3.5 to 4.9; C 5.3 to 5.9), and two of the groups also increased their results between post-test and delayed post-test (A 4.3 to 4.7; B 4.8 to 4.9) while the third kept their knowledge intact. We also submit that teachers' participation made them aware of the difference between children's abilities and the teachers' own expectations, and the limitations this could cause.

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