

HIGH OR LOW, DEEP OR SHALLOW, WIDE OR NARROW? ESTIMATION BY YOUNG LEARNERS

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*That Christ may dwell in your hearts through faith:
that you, being rooted and grounded in love,
May be able to comprehend with all the saints
what is the width and length and depth and height
(The Epistle of Paul the Apostle the Ephesians,
Chapter 3, 17-18)*

ABSTRACT: *In this presentation we compare everyday and scientific concepts in the use of adjectives belonging to length in a research into the development of length measurement. It was examined how much children are able to interpret and make sentences using these adjectives. Are they able to use them properly to designate dimensions? To what extent are they aware of their meaning in mathematics and everyday life? Children have estimated things close to themselves and in the neighbourhood. We examined to what extent they were realistic and in what ways measurement practice has contributed to estimation and spatial ability.*

INTRODUCTION

We are concerned with the levels of estimation of the measurements of length of various objects and things and the ways they can be improved. Children's ability to estimate can be developed by continuous, lengthy and varied practice.

A lot of experience in measurements is required to estimate the dimensions of objects properly. Children need practical experience of the units of measurements and the relations between them. They have to be aware of the words describing length and their various interpretations.

In the estimations the everyday and abstract concepts are intertwined, as not only the names of the measurement units and their sizes are required but also the designation of various dimensions.

"Many mathematical concepts are announced by adjectives. Adjectives belonging to length are: „long, short”, but also „broad, tight”, „thick, thin”, „high, low”, „deep, shallow”, „far, near”, „wide, narrow”, and finally „tall, sturdy, diminutive, insignificant”. Of course the ability to distinguish such properties precedes the ability to express them linguistically. For the adult it is – at least unconsciously – clear how these expressions are related to the same magnitude, length, and he often presupposes children to be well acquainted with this relation. Researchers in this field are often not aware of this difficulty. It is not farfetched to ask oneself how the child manages to develop knowledge of these connections. A disturbing factor is the overarching of this complex of adjectives by “big and little”, which can serve so many aims (up to “big boy” and “little girl”).” (Freudenthal 1983)

It is not only in mathematics classes that measuring length takes place, but other subjects can have an important part, e.g. in P.E classes in long jump or throwing the ball.

„...as it has been demonstrated by research, children's mental development is an integral process, it is not broken into the system of subjects. What happens is actually is contrary to the idea that certain abilities are developed by arithmetic in isolation and apart from others, while other abilities are developed by written speech.”(Vigotsky, chapter 6)

QUESTIONS OF THE RESEARCH

At which level are children able to apply the synonyms of length for the definition the dimensions of objects and things and to estimate the sizes of the objects and things in various dimensions.

HYPOTHESIS

Talking about and interpreting words related to the dimension of length improve children’s thinking abilities and the links among subjects and also contribute to the designation of and the recording dimensions of objects and things.

THE BACKGROUNK OF THE RESEARCH

The experiment took place in the third class of Bocskai Primary School in Debrecen. Although the school has a swimming pool, the equipment of classes and the standard of teaching are not really up-to-date. Teachers do not make use of demonstration and the method of learning by doing and perhaps teachers do not rely on the knowledge children have already acquired. The pupils can be described as a mixed ability group and their attitude to mathematics is also varied.

METHODS

The research consists of three parts: preliminary test, experiment, post and delayed test.

At first we intended to find out how much children were able to use words related to estimation and length. In the preliminary test children carried out estimations gradually getting away from their immediate environment to the neighbourhood of school, and their level of using words related to length was also measured. They were asked to estimate the length, width and height of various objects. The use of the words ‘narrow’ and ‘thin’ was tested in a way that children were asked to write phrases and create sentences making use of these words. We also wondered if they were able to complete sentences with words and phrases designating length. We also studied if they were able to paraphrase problem situations in a way that they applied the words designating length.

According to the preliminary study we intended to hold ten afternoon activities. The experiment took place in the afternoon day care lessons. The activities were recorded.

After the estimations carried out in classrooms or school-yard, we always measured the size of that particular object, and we also discussed the difference between the measured and the estimated data. At the beginning children were bothered when they made a ‘big mistake’, but later on it was particularly this fact that motivated them to go on working and they were more and more interested in measuring and made a point of competing in finding out whose estimation was more proper. They also invented tasks, e.g. the measured the line of seats, the width of windows, they wanted to find out the height the TV set was placed.

While doing these activities children have become more open-minded and expressed their opinions. They have turned into equal partners during the experiment.

Another important aim of the experiment was to improve the use of adjectives related to length in mathematics and everyday life.

The use of the opposites deep and shallow, as well as high and low was also linked to their knowledge in science beside mathematics and their everyday usage.

Experiments in science were carried out using watering cans and communicating vessels in order that they could observe the change in water level in these objects. Colouring of depth and height on maps was shown the children who were also interested in the determination of the real distance between two towns.

In this presentation we’ll focus on the part of the experiment, which are mainly concerned with the interpretation and the use of words related to length in everyday life and mathematics. Although all word pairs

were used during the sessions, here we are going to deal with only two word pairs, whose English and Hungarian equivalents are well defined.

Children filled in two tests, one right after the completion of the experiment and the other one two months later to check the results of the experiment .During the period of time between the two tests the children did not deal with these topics. What we wondered was if the children’s ability to estimate and their use of the words related to length improved or not. Which words have become part of their active vocabulary, i.e. are they able to make sentences making use of the given words. Are they able to apply transitivity and at which level? The tasks of the two tests were similar and we have also taken onto consideration that the children’s general knowledge have also improved

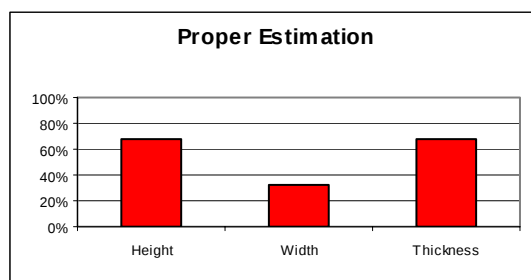
PRELIMINARY TEST EVALUATION

The height of the classroom 78 percent of the pupils came up with proper estimations and no one said something too big or too small. Only 44 percent of the pupils came up with proper estimations for height of the greater objects.(e.g. school or water tower)

They had more difficulties when they estimated width, some children mixed up width and length.

When estimating thickness more than seventy percent of the children came up with a properly estimation of the thickness of course books and desks, but in case of the thickness of the wall, they probably did not listen to instructions as to which wall they should think of, so they relied only on their memories. As it has turned out they have quite often heard that the walls are so thin that the slightest noise the neighbours make can be heard. This is the reason why the estimation of only thirty three percent of the children was correct. When estimating the thickness of the page of their exercise books all the children used the smallest unit of measurement or parts of what they have learned.

Results are shown in the chart below.

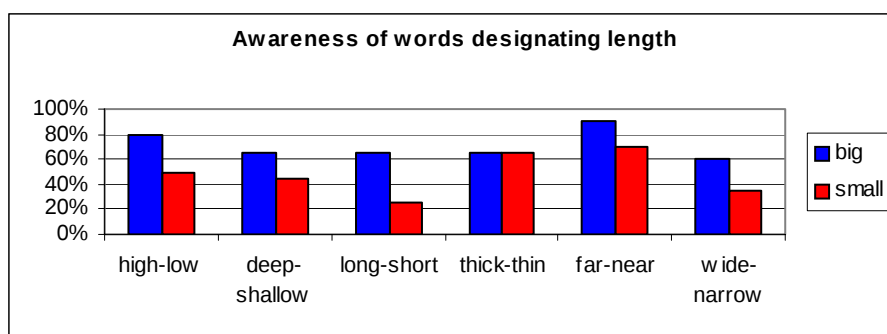


We have also noticed that children were quite good at using words designating length whereas they were not so good at using other words. The use of the word 'narrow' was quite good, but the word 'thin' was used mostly in its everyday meaning, but not really consciously.

In case of the word 'narrow', seventy-eight per cent of the children wrote words related to length. Several of them were used as the synonyms of thin and narrow.

The word 'thin' was used to express a dimension only by thirty three percent of the children they mostly used it as a synonym for slim or for small round objects, e.g. A thin child, thin thread, thin tree etc.

In the other part of the test the children were asked to complete sentences with words designating length. The words to be chosen were provided and the children were asked to complete the sentences with the proper word. E.g. the road isenough for several cars. We wanted to find out how they were able to use the opposites.



In this chart it can be seen which words are to be focused on during the experiment. The use of the words such as low, shallow, narrow and short was not really convincing, most of the children replaced them with the word 'small'.

Later on children had to respond to situations so that their response contains words designating length. Perhaps this was the most difficult thing for the children to grasp, 65 percent of them responded to at least one of the problems and 33 percent of the answers was right.

E.g. the double bed can't be got through the door.

Some of the children's responses:

Ági: Because it is too long and too wide.

Friderika: The double bed is too thick and won't go through the room, but the armchair is thinner and it got in.

Máté: Because the door is narrow and the bed is wide.

Stella: Because it is too huge.

Gergő: It has to be cut

EXPERIMENT EVALUATION

Word pairs such as long and short, wide and narrow were dealt with respectively. We discussed their use in phrases, in everyday life and in science. It was rather interesting to observe how children interpret these phrases. The conversations were recorded and parts of the transcript of the conversation in which children explained two word pairs can be read below.

The use of adjectives high or low to designate length in mathematics and everyday life.

Tamás: High water means too much hot water consumption.

Teacher: It is actually water consumption.

Barnus: The water level is very high in a lake.

Máté: The river, whose water level is high, can flow over.

Pisti: Ideals of low level mean that person has not even reached that level.

Gergő: Low chair is a small chair.

Eszter: Low-born, I think means that it is not really noble.

Stella: I think high jump means that someone goes up somewhere and they jump from there.

The use of adjectives deep or shallow to designate length in mathematics and everyday life.

Teacher: Where do you use the word shallow?

Lora: The Ocean is shallow.

Tamás: The Ocean is a lot deeper than fifty meters. About four thousand meters.

Tamás: Deep secret means a big secret.

Csaba: Deep breath means that your lungs will be full of air.

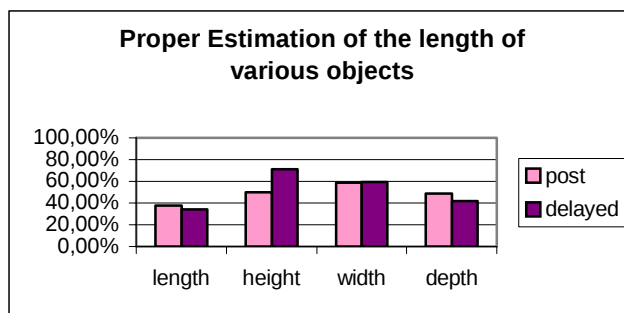
Judit: The hole is two metres deep. It means that it is under the ground.

Eszter: The house is in the depth of the wood, I could describe that it is in the middle.

POST AND DELAYED TEST EVALUATION

In the chart below it can be seen to what extent the responses to estimate length, height, width and depth were right. Defining these dimensions was a lot easier for them in their immediate environment than further. In the post test children estimated one dimension of various objects, whereas in the delayed test they estimated three dimensions of a particular object. The summary of the results can be seen in the chart below.

In the post test the results of the estimation of height was rather poor, because most of the children were



emotionally motivated when they estimated how tall their teachers were. Actually they believed their teachers were a lot taller than in reality.

However, after comparing the definition of heights and widths with the preliminary test, it can be seen that the children's ability to estimate definitely improved.

In the post test children made sentences using the words near and far, low and short, while in the delayed test narrow and deep were tested to find out if these words became part of their active vocabulary.

Eighty percent of the children wrote minimum two correct sentences using the words near and far, and ten per cent of the children wrote sentences not related to length.

All of them were able to use the word low related to length. Only fifteen percent of them wrote other interpretation. At the beginning the word short was used by most of the children to describe time, but as a result of the discussions with them, in the test eighty percent of them got it right.

Using the word deep 89 percent of the children created two phrases or sentences, and 72 per cent of them also came up with sentences not related to measuring length. E.g. 67 percent of children mentioned 'deep knowledge'.

89 per cent of the children used the word shallow in the proper sense, but only 55 per cent of them created more than one sentence. They believed e.g. that if we can say deep knowledge, we can also say shallow knowledge. In this sense we would rather say poor knowledge, but note that in Hungarian the difference between *sekély* and *csekély* is only one letter.

Comparing these results with that of the preliminary test, it can be stated that children are aware of these words, and they have become part of their active vocabulary.

We also wanted to know whether the children would notice the transitivity of the order of size if the function words were changed in the relationship of the opposites. Task a) comes from the post test and b) from the delayed test.

a) *If Kati is taller than Zsuzsi, and Csilla is shorter than Zsuzsi, than is it true that Kati is shorter than Csilla. Give reasons.*

Eighty- five percent of them gave a right answer to the question and sixty percent of the reasons they gave were correct.

The childrens' answers:

- Csilla is shorter than Kati. As Kati is the tallest of the three girls.
- Not because if we remove Zsuzsi from the text, then you can easily notice what the point is.
- No, because the sentence was started with 'Kati is taller than Zsuzsi'

b) *Munkácsy street is shorter than Víztorony street. Munkácsy street is longer than Arad street. Thus, Arad street is not shorter than Víztorony street. Is this statement correct Justify your choice.*

56 per cent came up with the correct answer, but only 28 per cent of them gave proper reasons. But this regression can be illusory, which may be due to the fact that children were in a way puzzled as their school is surrounded by these three streets. Thus they were not so much concerned with connecting the sentences and transitivity, but they tried to remember their real life experience. Their justifications can actually support the above idea.

E.g. Munkácsy street is the longest, then come the Víztorony street, and the shortest is Arad street.

I think yes, I know these streets, excepts for the Arad street.

It's not true, because Arad street is the shortest of all of them.

CONCLUSIONS

- Their ability to estimate has not improved much, but improved. According to the study it cannot be decided whether improvement of a larger scale can be expected in this age or not. I turned out that their estimation of the height, length and depths of large objects was rather inaccurate compared to dimensions described in other words.
- Children's vocabulary increased tremendously, they used more and more proper words to describe a problem, and several children justified their solutions and came up with detailed texts.
- While the estimations were carried out, we also realised that children were not always able to recognise the words referring to length, as mentioned above. This demonstrates the fact that the level of everyday concepts seems to be lagging behind that of abstract objects.

„The way children's spontaneous and scientific concepts develop can be simply schematically outlined by two lines of opposite directions. ...children's spontaneous concepts develop from the bottom to the top, from the basic, lower characteristics to the higher level, whereas scientific concepts develop from top to bottom, from the complicated and higher characteristics to the basic and lower level.” (Vigotsky, Thought and Language, chapter 6)



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