

THE WAY TO CHILDREN'S THOUGHTS

Monika Riihelä

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AIKAKORTIT - TIE LASTEN AJATTELUUN

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INTRODUCTION

An adult often finds it difficult to understand the way children think. The world of children with its richness of images does not always coincide with that of reason-based adults. A grown-up often listens to a child in a way that is based on adult terms.

"Once when I was six years old I saw a magnificent picture in a book, called *True Stories from Nature*, about the primeval forest. It was a picture of a boa constrictor in the act of swallowing an animal. Here is a copy of the drawing.

In the book it said: 'Boa constrictors swallow their prey whole, without chewing it. After that they are not able to move, and they sleep through the six months that they need for digestion.'

I pondered deeply, then, over the adventures of the jungle. And after some work with a coloured pencil I succeeded in making my first drawing. My Drawing Number One. I showed my masterpiece to the grown-ups, and asked them whether the drawing frightened them.

But they answered: 'Frighten? Why should anyone be frightened by a hat?'

My drawing was not a picture of a hat. It was a picture of a boa constrictor digesting an elephant. But since the grown-ups were not able to understand it, I made another drawing: I drew the inside of the boa constrictor, so that the grown-ups could see it clearly. They always need to have things explained.

The grown-ups response this time, was to advise me to lay aside my drawings of boa constrictors, whether from the inside or the outside, and devote myself instead to geography, history, arithmetic, and grammar. That is why, at the age of six, I gave up what might have been a magnificent career as a painter. I had been disheartened by the failure of my Drawing Number One and my Drawing Number Two. Grown-ups never understand anything by themselves, and it is tiresome for children to be always and forever explaining things to them"

The Little Prince, De Saint-Exupéry

I find that there is a gap between children and adults and this gap gives rise to many misunderstandings. In order to momentarily comprehend things from the point of view of children, we have to become more sensitive and listen to them without prejudice.

SUMMARY

The interview method emphasises the position of children. Their opinions become central.

The Time Card series was developed as part of the research work - Children's group learning and the concept of time (Riihelä, 1989). It has been used in schools as well as in day care centres. It has also been applied to the group learning research by Karlsson (1990). The Time Card series helps us to gain information from several different angles on the way children think. The series is suitable as a tool for teachers, kindergarten

teachers, special teachers, psychologists, social workers, speech therapists, action therapists, etc. It also provides material for the organisation of innovative teaching and educational methods. The traditional methods that focus on the problems of the individual have often proved insufficient in practice. The complications that affect a community are often forgotten when the difficulties are looked upon simply as the children's problems. Traditional individual methods, tests and tasks designed to evaluate performance, may make the child feel guilty which results in a learning activity that is dominated by the vicious circle:

"I am bad because I can't learn
and since I won't learn I'm bad."

The development work on the Time Cards has shown that children move on several conceptual levels simultaneously. Their thinking is clearly richer and more complex than one might think based on the results of simple question-answer patterns. A combination of experience and theory has been used to develop the Time Cards. The reasons for learning difficulties and promoting learning were some of the aspects that we wanted clarify. The aim was to find angles in the learning of concepts that are important to the children themselves.

The Time Cards are a semi-open interview method. Some of the questions are posed to every child in the same way. The interview consists of a story told by the child, questions asked by the adult and descriptions and explanations by the child. Four pictures depicting different times of the day are part of each series of cards. The children can express their views on how and when changes occur in the different pictures.

The assumptions about learning, thinking and time that have formed the background to the Time Cards are presented in the following chapters. The instructions for the Time Cards can be found at the end of the book.

THE CHILD IN THE ADULT'S WORLD

"In the course of this life I have had a great many encounters with a great many people who have been concerned with matters of consequence. I have lived a great deal among grown-ups. I have seen them intimately, close at hand. And that hasn't much improved my opinion of them.

Whenever I met one of them who seemed to me at all clear-sighted, I tried the experiment of showing him my Drawing Number One, which I have always kept. I would try to find out, so, if this was a person of true understanding. But, whoever it was, he, or she, would always say:

'That is a hat.'

Then I would never talk to that person about boa constrictors, or primeval forests, or stars. I would bring myself down to his level. I would talk to him about bridge, and golf, and politics, and neckties. And the grown-up would be greatly pleased to have met such a sensible man."

The Little Prince

The child has traditionally been considered inferior to the adult. A child has to "grow up"

in order to understand. The adult is the one that knows. It is difficult to break this pattern between children and adults. Education and teaching often ignore the knowledge that children already possess. This becomes a problem for many children to such an extent that they start feeling stupid and ignorant. They feel they will never learn. The fact that the concepts used by children and those used by the educators differ so much leads to misunderstandings that occur daily and cause major problems. This can result in a more or less conscious power struggle about who is right and who is wrong. Children should have the opportunity to use the knowledge they have already acquired in a planned and conscious way in new situations through experimentation and through conveying their experiences to fellow pupils. This kind of learning situation requires that things are problematized.

In problem-centred teaching the child is encouraged to ask "why?". Unsolved questions arouse the desire for knowledge. The desire for knowledge awakens the need to act. Or as Socrates described it, "a state of aporia", a dynamic tension, where everything that is disturbing is important: holes, gaps, the incompatibility between the parts.

A QUESTIONING CHILD

When you grow up
you have to experiment,
whether gulls have wings of steel,
and what kind of wings
ocean salt uses to fly
and whether the raging bull's froth
is plastic foam.

You have to feel, to touch
and look and smell,
press your cheek to the topsoil
and taste the water.
Then you know in what kind of world
you have to live.

But there is no time to see it all,
lots will whiz past
and every moment something is born
that will change the world.

Ilpo Tiihonen, Little Pegasus, Otava, 1981

New challenges of learning

In the report of the Club of Rome, *New Challenges of Learning*, a lot of emphasis is put on the fact that it is by no means irrelevant what kind of learning theories are applied, from the point of view of the survival and evolution of mankind. Communities and individuals have traditionally adopted the starting points of static learning. Static learning is the adoption of accepted visions, methods and rules in order to master known and

repetitive situations. It improves our ability to solve familiar problems. Another form of learning is still more important in order to guarantee survival on a longer time scale. A reformative, innovative form of learning that promotes change and the reformulation of problems, is required.

Reformative learning alone does not solve any problems. It is one way to promote understanding between people and communities when they face new situations. The main aims are survival and human dignity. Static learning has paid too little attention to the ingredients that are necessary for innovation - in particular values, human relationships and ideas. The most important of these are values. A value is a borderline that separates objectivity and subjectivity. When evaluating a fact, it separates what "really is" from what "it should be". Values distinguish science from ethics, exact sciences from humanities, the means from the end and even the rational from the irrational. Values also play a central role in decision-making.

Decision-making is based on the ability to evaluate priorities, compare advantages and disadvantages and weigh up the effects of the decisions. When one's own values are challenged a desire to learn is aroused. Values distinguish static learning from reformative learning. Static learning is important but insufficient. Its base values are safe and well-known. It is primarily analytical and founded on rules. Reformative teaching is formulating problems. It promotes our thinking by rebuilding entities, not by fragmenting reality. The obstacles for reformative learning are deep within the structures of society.

THOUGHT BEGINS WITH WONDERMENT

THOUGHT

A THOUGHT

I am everything

I am nothing

I can have beautiful thoughts or ugly

I can like or dislike.

Sometimes I'm sad and gloomy

then I don't enjoy myself

but sometimes I am jolly and happy.

I can travel

thousands of kilometres

in a second

and I have my own wings.

But I am always alone.

No one can see me

no one can hear

no one can abandon me.

I always tell the truth
but the mouth that tells my thoughts
is sometimes deceitful
Only thought thinks.

Barbro Karlen, 11
Man on Earth, Gummerus, 1968

12-year old Matti: "Thinking is bothering your head, reflecting and wondering. When I was little I thought about many impossible things. Thinking always, or almost always, starts with things you don't understand. Thinking about impossible things is nicest. I wonder about things like what happens when the Earth explodes." 11-year old Mervi: "I think that the good side about thinking is that no one else knows what I'm thinking."

Adults have studied the development of thought from the point of view of logic, developmental psychology and so on. It has also been studied in interactive situations, early education and school learning. The requirement of developing thinking skills has become increasingly more central when defining aims for education and teaching. But what is thought? It is often assumed that a child cannot develop thinking skills alone, but is dependent on the information given by an adult. This could also be seen in such a way that a child's thinking is not inferior to that of an adult, it is simply different, even to the extent that a girl's way of thinking is different from that of a boy. This notion also includes the assumption that children possess all the necessary tools required to develop their thinking. The task left for the adult is thus to make sure that appropriate equipment and situations for play and study are available to the children so that they can develop their thinking skills.

The basic structure of thought is a feature typical to the human species. It is independent of age and background. Children's thinking contains, at a very early age, all the logic that forms part of adults' thinking. The ability to think, however, develops differently in people. Through thought, notions are created, observations and experiences are combined into multifaceted constructions. Thinking is an ability that can be trained and taught. Making observations is an important part of this process. Thought and action are linked with each other. There are numerous programmes to develop thinking among older children and adults. Young children develop their thinking primarily through experiment and play.

Thinking organises the phenomena of the outside world and the psychological and social world that is dependant on human action. Feelings and interactive relationships are conceptualised through thought. This conceptualisation does not always appear guessed in speech, but often takes in other kinds of meanings. A concept is an abstract shape, a notion verified through thought.

Thinking begins

A lot of research has been done on the development of children's thinking. There are, however, few results that are clear and generally accepted. "Thinking begins with something that gives room for thought", eleven-year old

Hanna says. "Thought starts with wonderment, bad moods, good moods or in fact everything", says Kristel of the same age. The inspiration for adopting something new comes from a desire to "make sense" of events, to find reasons and meanings for what is happening. A small child often approaches this with wonderment, making assumptions and trying them out. Children have aims and goals already at a very early age. They want to know. They also want to do. It seems that a child first learns to understand what others do and then uses this understanding to make sense of what others say. The interaction between a baby and the other family members is already full of generalisations. These are, however, expressed through other means than speech. The growing versatility of different forms of expression and language as well as thinking skills is thus closely connected with all other kinds of learning.

Tools for thought

A concept or a generalisation is the basic unit of human thought. The meanings and usages of concepts change when knowledge and experiences accumulate. A concept is a tool for thinking, something which helps one to "get a hold" on reality. Concepts are not fixed definitions of thought that can all be served at once. They intermingle, move from to another and always refer to other concepts. Generalisations are created in the subconscious as well as in the conscious. In order to develop they need flights of imagination, observations through the different senses, interaction and spoken language. Concepts can be divided in two groups; those based on experience (empirical) and those based on theory (abstract).

Experiential Concepts

Empirical concepts emerge when a person makes observations about objects and phenomena, compares their external characteristics, classifies them and gives the class a name. From observations we move to generalisations. These kinds of concepts are descriptive. They do not inform us why objects and phenomena are how they are. Experiential concepts take shape with the help of the senses, the emotions and reasoning. The depiction may be in words, thoughts, colours, form, sound, taste, smell and feelings. Concepts link similar phenomena and distinguish between different.

Theoretical concepts

Theoretical concepts, on the other hand, emerge because humans search for the birth and origin of phenomena, the principles of their primordial cells and core. Thus knowledge is born, which explains at the conceptual level a large number of apparently separate, individual phenomena. We can move from generalisations to observation. Theoretical thought comprises the desire to see the essential features of phenomena and their relationships with each other and from this takes shape a concept system. Different viewpoints can be combined into a fabric, a new concept, which is still further away from the experiential concept. This fabric of theoretical concepts can be constructed by experimenting, reasoning, discussing, collecting more information from different sources, reflecting, studying, analysing, projecting, perceiving, aided by the imagination and

chance, by dreaming and by intuition.
Concepts and thought

The question 'Why does night come?' can be answered in many ways. One's own experiences and observations can form part of the answer and/or they can be combined with theoretical concepts "beyond the visible".

A Theoretical concept
"When I'm asleep, night comes."
One experience is connected to subject.

B Combined concept
"Night comes when I go to sleep."
Combined concept: Two observations are combined.

C Combined concept
"Night comes when it gets dark."
Combined concept: The change in light is connected to the arrival of night.

D Combined concept
"When the sun sets, night comes."
Combined concept: The movement of the sun is connected to the arrival of night.

E Abstract concept
"When time passes, night comes."
Theoretical concept: The arrival of night is explained through one abstract concept. TIME PASSES

F Substantiated theoretical concept
"When time passes and it gets dark, night comes."
Substantiated theoretical concept: TIME PASSES
The explanation is based on a theoretical concept and an observation of change in light.

G Substantiated theoretical concept
"Night comes when I go to bed and the sandman comes and sends me to sleep."

Substantiated theoretical concept:
An imaginary theoretical concept and experiences of one's own actions explain the phenomenon.

Sandman

H Abstract concept
"Night comes because the earth rotates."
Theoretical concept: A large theoretical concept that lies behind the phenomenon rotates

The Earth explains the arrival of night.

I Substantiated theoretical concept
Observation

"Night comes because the earth rotates around the sun. From the earth it looks as if the sun is sinking."

Substantiated theoretical concept:
The arrival of night is explained through the combination of major theoretical concepts with the observations of man.

The Earth
rotates
around the sun

Combining theory and experience

Wide experience alone is not sufficient, any more than good theoretical knowledge. If theory remains detached from experience we can find ourselves in the same situation as Rabbit in Winnie the Pooh:

"Rabbit's clever," said Pooh thoughtfully.

"Yes," said Piglet, "Rabbit's clever."

"And he has Brain."

"Yes," said Piglet, "Rabbit has Brain."

There was a long silence.

"I suppose," said Pooh, "that that's why he never understands anything." (A.A. Milne)

Knowledge based on concepts derived from experience also remains limited. A person can easily become the prisoner of millions of trivial facts. There is, in practice, a strong link between the formulation of theoretical concepts and those based on experience.

Knowledge and skills

Knowledge does not become broader only by the addition of new knowledge, nor do skills improve by practice alone. Knowledge and skills, conceptual and functional, theoretical and practical, all develop through mutual interaction. Knowledge and skills should not be seen as separable but as different sides of the same coin. Knowledge has little meaning without skills and skills always contain knowledge.

Thought develops

"Now that I'm this big I no longer need to keep my eyes shut when I think," says six-year old Pekka. "I have more dreams nowadays than when I was little. I dream about fame and the profession that I would like. I don't think as childishly as I used to. My thinking has become more mature. I think about things that can actually happen. As a child I thought about the most incredible things", says eleven-year old Kristel.

It has traditionally been thought that real theoretical thinking is possible only after puberty. Traces of independent theoretical thinking can, however, be found much earlier. As children learn to speak during their second year, they have already used a vast number of theoretical concepts when learning to construct sentences from words and fitting them into coherent and relevant interaction. But even much earlier, children interpret people's expressions, voice tone and body language and draw their own conclusions. Children learn very early to understand what others want and they apply this knowledge to their own behaviour. Superficially it appears that the child is simply imitating others but nobody could manage to copy everything that comes. Children independently select, from the wide range of alternatives, what they want to apply to their own activities. Concepts based on experience develop "bottom-up" becoming more and more subtle through observation and experience whilst theoretical concepts develop "top-down", from the abstract to the concrete. "Bottom" here means observation of the surrounding world and "top" means generalisations or higher concepts, distinct from practice. Both concept types are dependent on the other for their development. As experiential concepts become more complex the theoretical concepts take on a more concrete shape. Extensive control of theoretical concepts presupposes in the child's experienced-based thought patterns a complex and rich fabric of concepts. Their conscious development begins at the stage when deliberate attentiveness and logical memory develop, at about the age of seven. To encourage children's examination of the relationships between phenomena, we should try to promote a reflective attitude towards things.

WHY DO NIGHT AND DAY CHANGE?

Children get interested in time, space and the origin of the world at an early age. Six to eight-year old children talk about time in the following way:

WHAT DO YOU KNOW ABOUT TIME?

Time exists.

Hours pass in time.

It takes time for the summer to come.

It takes time to do your homework, to feed the dog and for an aeroplane to get going.

Time is clever because there is enough of it for all the clocks.

Time goes quickly.

A watch measures time.

It takes 60 minutes for an hour to pass.

The arms go round and round.

WHAT DO YOU NEED TIME FOR?

To know what time it is.
You can study.
You need time to wake up.
To sleep.
To know when to go to bed.
Not to be late.

WHEN IS TIME THE SAME?

In Finland the time is the same.
When it's night in Finland, it's night in Sweden too.

WHEN IS TIME DIFFERENT?

When it's night here, it's day somewhere else.
In Sweden, time is an hour ahead.
When it's winter in Finland, in Africa it isn't.
In Finland the time is more than somewhere else.

WHAT DO YOU WANT TO KNOW ABOUT TIME?

I want to know what time it is.
How is a watch made?
When will the break come?
How many hours are we at school?
What is time like?
Where does time live?
What does time do?
When was time born and how?
How does time stay where it is?
Why does time not stop?
How does time continue?
Why does time not run out?
How does time move?
How can the first man on earth have been born?
How was the earth born?
Where does space end?
What was born before space?
Where did the ape come from?
How was the sun born?
Are there any other living planets?
When was God born?
What were the names of the first people on earth?
When will the sun die?
How come there is enough time for the whole planet?
How big is time?

"Time is when you have time. Sometimes morning comes at different times. I always have time and I wish that it was always Christmas. One could be without time and never

go to school or to work and never do anything. Night is always the same time and dark".

"Time is like having dinner-time and then playtime and of course bedtime. The real time you have to check on a watch. Soon we'll have snack time. A watch shows when it's night and when it's day, but that you know anyway when it gets dark".

Time

Time is a concept which for humans is both close and distant, concrete and abstract, biological, psychological, historical, physical and philosophical. Time is connected to human activity and exists outside it, independent of man. Our idea of time is formed through concept systems that are based on both experience and theory. The concept of time is obscure even to adults and it reaches new perspectives with age. Even an adult does not have any final answers to the philosophical question: why does night change into day? This is the case, even if science, particularly physics, continuously provides us with new information on how these changes can be explained. This is an advantage in the interview situation since the adult is in a more equal position when listening to the children's thoughts. There is no single correct or final answer to the question. The essential point is not that the child can answer the question in the way that the adult wishes but the point is to try and clarify the perspectives and the conceptual systems that the child uses when observing time.

The concept of time is for many reasons well suited to the research of children's thought. Time as a concept is complicated enough to give plenty of information about the child's individual way of thinking. Children of all ages have experience of time. In their everyday life children come across concepts of time very early. "Come home within an hour" the adult says and forces the child to conform to the family's time schedule. Each family has its own rhythm of activity that the child should learn. The activity periods in day-care centres limit the children's games. The bells at school regulate the rhythm of the day.

The child is taught to organise time in different ways. In early learning, reading a watch is practised as well as the names of days, months and seasons. In the curricula and textbooks of the two first years of school the time concept is dealt with in abundance. Pictures of the movements of the planets, the movement of light, shadows and the changes between night and day as well as of the solar systems are shown. The children are taught to measure time with the help of a watch. While the adults aim at teaching new and useful knowledge to the children, the children's own conceptual thoughts often remain hidden. Whether the concepts of adults and children ever meet in order to create new conceptual systems that the children can use, remains a matter of chance.

Time as experience

The perception of time is part of a larger perception of the world. But how does the time concept develop? The first time concepts that a child learns are perceptual and motor. The baby's first experience of duration is when he or she cries with hunger. The time the child experiences is one of waiting.

It can be presumed that a new-born baby experiences the present in relation to the

future and the past. When adults disappears from sight they cease to be real to the baby. When adults reappear it signifies continuity and a feeling of security to the baby. The adult and the outside world have proved reliable. When things repeat themselves experiences of causes and effects become possible. Broken promises annul the meaning of relationships that the baby has begun to experience.

Our own experience about duration, the passing of time, is not reliable. Our internal clock fails us continuously. We often rely on the physical time shown by our watch or our calendar. Events that we experience as positive seem to have shorter duration than those that arouse negative feelings. When you perform a task quickly, it seems that you have not taken a lot of time over it but later, in your memory, the period will seem colourful and long. A period of passivity will seem long for as long as it lasts but in one's memory it will remain short.

Our impressions of the essential nature of time are manifold. We have endless experiences of time and expressions to describe them. We use, spend, fill, save and invest our time. We may have too much or too little of it. We are aware of the past and the future. Our experiences of time are our common experiences of everyday life, our daily phenomena.

Time as a theoretical concept

The concept of time is vast and problematic. When thinking of small units of time, hours or days, we can be fairly exact and avoid misunderstandings. But the longer the periods we think about the more complicated the concept becomes. At its vastest it encompasses the whole essential nature of humanity. Researchers McGrath and Kelly have identified nearly 300 different ways of theoretically defining the concept of time.

The Earth's movement and the time of man

Ideas about the historical development of the world have changed during the last century and a half. Our perspective of time has grown from six thousand to six billion years. Humankind has had to adapt its old beliefs to suit the new time perspectives.

In early human societies time was defined according to natural events and was tied to natural phenomena. Human activities were grouped according to light and dark, heat and cold. Whether you went to sleep because it was dark or whether it got dark because you went to sleep was of little importance as far as the activities were concerned. These two different perspectives formed part of one single concept. Man was an integral part of nature.

Information about the Earth's relationship with the Universe, important for the definition of time, has changed many times. In ancient Greece, Earth was the centre of everything. For Aristotle it was clear that the Earth was a globe. The centre of that globe was at the same time the centre of the Universe. The Universe of Aristotle had no beginning and no end and it never changed.

Aristarchos, not much younger than Aristotle, already presumed that the Earth not only rotates around the sun but also around its own axis. His views did, however, not gain much success among the other wise men of the time and thus Aristotle's static and Earth-centred views on the Universe remained dominant.

In medieval Europe the earth was still seen as spherical and stationary and other planets were believed to rotate around it. Gradually, views based on the sun being the centre of our solar system and the planets rotating around it, started to gain ground. The more we have learnt to know about outer space, the further we have got from the idea that man, or even our Earth, is the centre of the Universe.

To divide the day into 24 hours was an Egyptian invention. The unit for the measuring of time was derived from the rotation of sunlight. In Babylon the day was divided into twelve equal parts because a mathematical system based on the figure sixty was in use in the country at the time. The division of an hour and a minute into sixty units is derived from this system.

The children's answers to the question "Why does day change into night?" reflect the beliefs of different eras. This is not surprising since our own thinking also often contains bits from different historical development periods. The use of concepts based on experience on one hand, and those based on theory on the other, vary according to the situation. The awareness of the child is saturated with all kinds of conflicting views. Cultural heritage is transferred through everyday expressions, fairy tales and fables. Through these children internalise different views on the essential nature of the world. Fairy tales often embellish nature with mysterious characteristics and also reinforce the view of Man as master of the Universe. There are many stories about the birth of the Universe. One has made the sun appear in the sky to give us pleasure and another has created the Man-in-the-Moon to peep in through our windows. In our everyday language we explain to a child, for example, that "morning comes when mummy goes to work", "the sun rises in the morning" or "now the sun went behind a cloud".

The most typical explanations that emphasise human activity in the change between night and day were: "In the evening when it gets dark we go to sleep, in the daytime when it gets light we go to school and to work." "The night becomes dark and we go to sleep when the sun sets", "That's the kind of habit it has, that sun, it sets". Earth-centred explanations included; "Because the sun rotates around the earth" and "the sun rotates around the earth and when it gets near us, we have day." Sun-centred explanations require knowledge about the relationship between the earth and the sun and are thus more theoretical: "When the earth rotates we are in the sun and then later in the shade", "When the earth rotates and we have shade and night, the other side of the earth has sun and day."

Timeless children

A lot of research has shown that weaknesses related to the conceptualisation of time are often connected to other mental problems. That success at school and a clear sense of time are often connected has been shown through school psychological experience. A weak sense of time adds to a lack of security. You cannot anticipate a situation if you have no idea of what to expect. On the other hand, it is not important to plan in advance if you feel that you cannot possibly influence matters. Things just happen, without cause and effect, unconnected to each other.

The observation of cause-and-effect phenomena requires, among other things, conscious attention, an ability to shut out other things from your consciousness for a moment, to stop time in order to develop your own thinking. Children whose sense of

time is ill-developed cannot or dare not stop. They are in perpetual motion, following surrounding events in a haphazard manner. These children, who find it difficult to concentrate, are the ones who ask at school, year after year: "When are we eating?", "When are we finishing today?" or "What! Do we have a test today?"

The ability to study requires an ability to tolerate conflict. A studying child has to accept the fact that he or she does not know what others already know. Children with learning difficulties are often incapable of looking at present challenges through past experiences. They easily forget what happened an hour earlier or what they just learnt. They find it very hard work to think about future events, tomorrow's homework, next week or next year. Studying tasks seem like a waste of time since they cannot see what possible good it will do to them to learn things. All learning requires the possession of space for needs that are directed towards the future.

Changes in children's concepts of time

To learn times of the day, names of the days of the week or the seasons is not sufficient to support a development of the concept of time. Learning of names may in fact be a hindrance for the development of a broader time orientation. Time may not mean anything other than a watch. In the group learning research by Riihelä (1989) children's impressions of the change from night to day were studied, and how these impressions changed during a period of six months. Children who learnt in small groups through group tasks were compared to children who learnt about the concept of time in a traditional way with a text book under a teacher.

The research showed that the time concept develops very rapidly during the first schoolyear. Many children move from using haphazard concepts to using combined concepts. From this phase the children usually move to the phase of abstraction. The children that studied in the small groups have usually internalised the different sides to time concepts better than those studying under a teacher. Boys use abstraction more than girls, girls on the other hand use more combined concepts that relate to human activity. The girls gain more from group work than boys. In small groups girls get excited and express their views freely.

The girls were usually more ready than the boys to admit that they did not understand a certain series of cards (mostly the space series where movements of planets are described). Boys came up with explanations that were removed from human activity more often than girls. It seemed natural to the girls to understand the world from the perspective of human actions. A challenging question thus remains; how can we create an improved interaction that would enrich both sexes by encouraging both tendencies, the boys' inclination to abstraction and the human-centredness of the girls.

TIME CARDS

Time cards are usually used in individual interviews. The pictures are suitable for ages ranging between five and twelve/thirteen. Time cards can be used to discover a child's logic and thought. Through them an adult can see and understand the many levels in children's conceptualisation. They can also help to provide information about a child's general orientation in relation to time, action and the environment. The cards can also be

used as a basis for teaching by mapping out a child's existing knowledge and skills.

The time concept of the time cards

Physical, historical and biological elements related to time have been connected to mental ones:

Time is the fourth dimension of existence and is transmitted to one's consciousness through three physical phenomena. These are movement, change and rhythm. Movement causes change and regularly repeated changes are experienced as a pulsation at regular intervals. Every creature has its own rhythm of movement and change. Humans interpret the rhythm as units of time.

You cannot observe just any change to be reminded of the passing of time. The subject of observation should be chosen in such a way that one can observe changes that happen in the same phenomenon with a certain regularity. Different factors play a part in the changes: what changes?, how does it change?, causes and effects of the change. etc. In the time card interviews the change question are illustrated with change arrows which are placed between the cards under observation.

The model below describes the connection between time phenomena, observations and time cards.

Time phenomenon:	Observation:	Time cards:
change	same - different	M D E N*
movement	before - after	>>>>>>>
rhythm	regular and repetitive	M D E N

*M=morning, D=day, E=evening, N=night

Something in the cards stays the same, something changes. The change can go in a certain direction, something happens before, something after the change. This gives the feeling of movement. All card series contain the same change and movement, the changes of the parts of the day. Regular changes create the rhythm.

The model is like a question which will help you start thinking. It gives the children new tools for thought, with the help of which they can observe changes in general, think about their causes and effects and pay attention to the rhythms, to the things that are repetitive in changes. The time cards act as the analysers of children's thoughts.

The structure of the interview

It is not easy to study children's concepts. When developing the interview children were asked direct time-related questions without time cards. Many problems occurred in the interaction between child and adult. The children made an effort to guess the adult's aims, to do things correctly, to give the kind of answer they presumed that the adult wanted.

Many children were suspicious of the interview. "Why do you ask me that when

you know it yourself?" The children gave answers based on what they felt about the question and the situation in hand. If a question was designed in such a way that it only had one correct answer, the adults with their facial expressions gives hints to the children about which direction to go in for the correct answer. In these situations the children's answers are more an indication of social sensitivity than the child's own thoughts.

Another important observation when developing the interview was related to the way children deal with concepts. The question "why does night change into day?" was often answered by "because the earth rotates". When children was asked to describe this, it transpired that they did not understand it at all. When children were asked to explain it with the help of a large globe, they pushing it around haphazardly as if the wind was making the earth move here and there. Children often got confused with the globe when asked again why night changed into day even when they had been quite sure about their original answer. Very few seven-year olds were able to explain the relationship between the rotation of the earth and light and shade. "The earth rotates" was more of a sentence learnt by heart than an internalised concept.

The most important thing in interviews is usually the meaningfulness of the situation. If the adult asks the children about things they already know about, the situation loses its meaningfulness from the child's perspective. This is why the children were told: "Everyone has their own way of thinking. I am interested in how you think. Since I am an adult I cannot know anything about that." One child said with a surprised expression: "You mean you are interested in what I'm thinking?"

The aim of the situation was clearly explained to the child. The adult did not evaluate the child's response on a right-wrong perspective, but expected to hear something new, something that this particular child was thinking. Many children, after this instruction, took a thinking pose, scratched their heads and stopped observing the adult. They stared ahead for a while before answering.

Showing the cards does not, however, always make children tell their own thoughts. The interviewers have to be able to convey their sincere interest in the child's individual world of thought. The interviewer starts by asking the child to tell his or her own story. After this, both the interviewer and the interviewee are ready to start thinking about things from the child's perspective.

Equipment

Paper and crayons

Answer forms

Time cards, five sets and a change arrow

- a. Child-sets, red and blue: the change from night to day is described from the point of view of human activity.
- b. Nature-sets, orange and yellow: the change from night to day is described in an earth-centred fashion, according to light and shade.
- c. Space-set, green: the change from night to day are described through the rotation of the Earth around its own axis.

TIMES OF THE DAY IN THE CARD SETS

:card symbols

NIGHT MORNING DAY EVENING

Green: G
Red: R
Blue: B
Yellow: Y
Orange: O

In order to be able to follow the development of the time concept and perform a follow-up interview, two parallel sets of cards have been designed to maintain the child's interest. There are two sets of cards describing children's activities and the rotation of the sun. Only three sets are used in the interviews: the child, the nature and the space sets.

Instructions

1. OWN STORY

There are advantages in making the children tell their own story.

- * Children feel that the adult is interested in what they draw and say.
- * Children feel that the adult does not expect a ready answer but that they have permission to think of one.
- * Children are given time to get used to the interview situation.
- * The adult has time to get acquainted with the child and can thus shape the interview situation to suit each particular child.
- * The drawing and the story provide important additional information about the child.
- * The child sees how spoken language is turned into written language.

" You can tell your own story first and draw a picture to illustrate it. I'll write down your story. Then we'll look at the time cards. Now, you think of a story, whatever you like, and draw a suitable picture. I'll write it down exactly as you tell it."

The adult writes down the story on a separate piece of paper, preferably in printed script so that the child is, as early as possible, able to read the story. It is important to write down the story exactly as the child tells it. It is easier to write down the story of a child that uses standard language than of one using slang or colloquialisms. One has to control one's own desire to change the spoken language and correct mistakes made by the child. The purpose is, however, to make it clear to the child that the interviewer is specifically interested in what the child thinks. The aim is to inspire the child to tell about his or her own world and thoughts. The story can be included in the group's common story file or the children can include it in their personal files. The interviewer can ask the child to give her a copy of the story. It is important to give the feeling that the children have a "copyright" on their work and that it is not only being used for the purposes of the

adult.

Inhibited children sometimes have to be encouraged and given some hints; "What would you prefer to draw?" " Would you make a boy's or a girl's story?" etc. If a child has a totally negative attitude towards telling a story it is usually not useful to perform the time card interview. Bold children sometimes have to be restrained if there does not seem to be an end to the story. The interviewer can estimate how much time there is and what length of story it is possible to write down. One way is to tell the child that one piece of paper is all we have strength for and that the story ends when the sheet is full.

An example of a story:

PETTER'S (9) STORY

The sun shines in the sky.
The birds sing and the crickets play
and it's a nice summer's day.
Flowers are flowering and it's summer at last.
Winter is far behind.
And the grass is green.
The ant has a little nest at the foot of the tree.
Fish swim around in the water.
Gulls fly around in the sky.
The little furry balls are dandelions.
Fish jump now and then.
The little fisherman does not catch any fish whatever he does.
Big fish chase the smaller fish.
The little bird has a nest on the rock.
A little motor boat casts fishing nets.
The magpie has a nest in a green tree.
A little squirrel runs across the green.
Autumn comes again.
Mushrooms begin to grow
and the downpours come.
Gradually rain turns into sleet.
Finally winter comes.
Children play excitedly.
Trees have already dropped their leaves.
Children have to keep going inside.

2. TIME CARDS

Firstly, the children are told the purpose of the interview.

"Here I have some Time Cards. We'll look at them soon. But I would like to know something first. I'm interested in what YOU think about something like why day follows night. Why is it night at one time, and then again day?"

The answer of the child is noted down at the top of the form. If the children do not answer this question they can be prompted to come up with their own thought structure. One can say: "You know what day is. And you also know what night is. Why do you think they keep changing? Why is it not night all the time?" One may call on the child's imagination and ask: "The four-year old boy next door asks you: 'I don't understand why it's day and then again night. Explain it to me, please!' What would you tell him?" The child is thus given a task.

"I have here three sets of cards, cartoon strips, that all describe how night changes into day."

Three sets (the child, nature and space sets) are placed, in any order, in separate piles in front of the child.

"Now you can put these pictures in order in such a way that the story starts here (pointing at the left side of the child) and finishes here (pointing at the right side). Which set do you want to start with?"

A more detailed instruction is given in case the child does not understand. If in spite of this the story is still running from right to left, the order can remain and the matter is noted down. Finished sets of cards are moved to the side to wait for the explanations. The child finishes off all the sets first.

The sets of cards that the child has organised are moved in front of him or her in the order that the child has dealt with them.

1

2

3

THE CHILD

and the following question is asked:

"Which set do you want to use to explain how night changes into day?"

The set that the child wants to begin with is left in front. The symbol of the set is noted down in the bottom square on the left of the reply form. Some children start, on their own accord, to describe the contents of the pictures. If not, they will be asked to tell what each picture contains.

"What can you see in this picture?" "What about this one?" etc.

The descriptions are noted down.

If the child does not say anything about the passage of time he or she will be asked:

"What's the time in this picture?" etc.

The answers are noted down.

A change arrow is placed between the first two pictures of the set in order to point out the direction that the story is taking. The child is told:

"Let's use this change arrow to see how time changes".

When asking questions, the word used by the child to describe time is repeated whenever possible. For example:

"Why does 'morning' in this picture change into 'day' in this one?"

The child's answer is noted down. The child is asked to move the change arrow between the second and the third picture and so on. When the series of pictures is ready it is put away.

"This is now OK. Let's put it away. Which one of these two remaining sets do you want to use now to explain how night changes into day?"

All sets are dealt with in the same way.

If the interviewer is uncertain about the meaning of a certain explanation given by a child, she should try and clarify the child's thought. Little children sometimes start talking about seasons forgetting that the instruction specifies that the pictures depict how night changes into day. The children's answers are, however, noted down as such. The different time concepts that children have probably just relate to each child's own individual kind of logic. It is, after all, exactly to find out more about this logic that this interview has been designed.

The most important thing is to show real interest in what the children think and how they combine the different concepts they use. This is something that only the children themselves know and feel. And it can often be very surprising to an adult.

All additional instructions that fit the situation can be used in order to persuade the children to talk and to describe their own views. It is important that this does not lead to the children giving answers that they think the interviewer expects but instead tell exactly what goes on in their heads when looking at these pictures.

FOLLOW-UP INTERVIEW

The same space card set is used in the follow-up interview. The other card sets will be changed. It is worth waiting for at least five months before the follow-up interview. It is started, as in the initial interview, with the child's own story.

Starting instruction for the follow-up interview:

"Now you are older than when we last met and you have learnt a lot of new things. Here I have some new Time Cards and one set that you already saw last time. But tell your own story first and draw a picture. I'll be your secretary and write everything down."

"Let's look at the Time Cards now. I'm interested in what you are thinking at this moment about why day changes into night."

The answer is noted down. The rest of the instruction is the same as for the initial interview.

Interpretation

The essential part in the interpretation is the knowledge gained about those concept systems that the child uses and that are related to time. The aim is not to give points for the answers and to make a ranking order, but to describe the way the children, at any given moment, use concepts related to the time of day, how they notice changes and make generalisations about the reasons for these changes. This information will give shape to the children's short-term development zone, the next phase in their development.

It has been notable, in the answers given by children, that each group has produced many new and surprising replies, as well as old familiar ones. A final list of answers given by children cannot be made.

A. TIME WORDS

The words children use to describe time can be compared to how well they correspond to words that are generally used to describe parts of the day. The change between night and day is cyclic, thus any part of the day can form the beginning of the description.

Time words used by children:

- a) The child does not use any of the usual words that describe parts of the day.
- b) The child uses his or her own expressions such as 'morning-evening'.
- c) The child uses a lot of concepts derived from activities, e.g., school-time, going-out time.
- d) The child does not master the order of the parts of the day. For example, early morning can come before evening.
- e) The child mixes up the parts of the day, parts of the year and time of the day.
- f) The child uses the same words and in the same order as usual, e.g., morning, day, evening, night or morning, midday, afternoon.

Interpretation of time words

Not mastering the concepts related to the times of the day creates uncertainty. A lot of things will remain confusing to the child. Some children combine words in a surprising

manner: morning-evening comes before evening.

Times of the day and seasons often get confused. Time words are not yet very important in children's lives. The child may also mix things up because these words are often used in other meanings in fairy stories and poems. Morning may signify the beginning of life or spring, day may symbolise maturity and summer. Evening is often used to depict old age and autumn and night again frequently stands for winter and death.

Children need help in the use of exact expressions related to time. In groups the children can be asked to think of as many words as possible that describe time. In order to clarify the children's concepts, expressions such as bedtime and dinner-time can be included too, if the children propose it. These time words can be put one after the other or in a circle. Exact expressions form one level, action-based expressions another and poetic ones a third level.

B. OBSERVATIONS

The children's observations are compared to those features of the picture that are, from an adult point of view, essential. The child sets describe human activity that varies according to the time of day. The essential feature of the nature set is that the sun moves and light and shade change according to the time of day. The space set describes the rotation of the Earth and the position of the Finnish flag in relation to the sun. Descriptions and explanations are combined in order to understand the child's thoughts. In the child sets, for example, a "sleeping card" can be described as a day card through the explanation that the child is taking a nap.

Things that the child observes

- a) The child answers "I don't know".
- b) The child tells what he or she thinks about in a situation where the pictures have not been understood.
- c) The child observes only certain features, others go unnoticed.
- d) The child is aware of his or her lack of knowledge and asks questions.
- e) The child observes the essential features.

Interpretation of the child's observations

Children who demonstrate weak observation skills need tutoring. They require encouragement, exercises and questions which will help them learn to widen their observation skills, to trust in what they see or hear and to gain the courage to talk about their own experiences.

There may many reasons why a children include in their descriptions numerous things that are not in the cards. Imaginative children who like to make up stories can make any picture come to life. They will describe things from outside the picture as well. These children usually do also answer the question.

Other children may also tell a lot but the descriptions include false interpretations. In the "bear set" the ice float may become a "broken lawn" or in the "boat set" the boat may have "gone out to sea". The children have difficulties in structuring the situation

directed by an adult. They carry the risk of being misunderstood.

C. GENERALISATIONS OR CONCEPTS

Children's generalisations can be studied with the help of the answers they have given to the why and how questions. The number of these answers varies between one and ten. The straight question "Why does night change into day?" gives the first answer and the "How does time change?" questions between the pictures, produce the other nine answers.

2	3	4
5	6	7
8	9	10

With the help of the change arrow, the children observe the change and make generalisations, drawing conclusions about the reasons for the changes. The conclusions may be random, even contradictory. Often a child explains the changes in one set of cards by repeating the same answer. Sometimes a child will explain all the changes in the same way ("time passes", "the Earth rotates", "God has said so" etc.). Generalisations are either based on experience or theoretical concepts. There are three kinds of explanations based on experience.

Concepts based on experience

a) Random combinations

The child explains the change by making up a story or by connecting the change to something that has little to do with the phenomenon in question. For instance: An interview performed during the winter produced the answer: "The school day changes into afternoon during the winter".

b) Combined concepts

The child explains the change by combining things that happen simultaneously. For example: "Morning becomes noon when the boy is at school because the teacher says so." "Evening comes when the sun starts to set and night comes when the sun is completely behind a cloud."

c) Concepts from the early phase of theorising

The child explains the change by combining things and simultaneously looking for causes and effects behind different phenomena. For example: "Night comes when time passes." "Was it something like morning comes when the sun goes around the moon or the earth goes around the moon?" "Morning comes when the sun rotates all the time around the earth. The Earth can't possibly rotate around the sun!"

Theoretical concepts

d. Theoretical generalisations.

The child explains the change through a theoretical concept and understands the relationship between the concept and another concept as well as that with the phenomenon itself. For example: "Night comes when the Earth all the time rotates around that sun. Now it's rotating in such a way that night comes soon." The child shows, on the picture, what he or she means and how this movement continues.

Observations link up with theoretical concepts on many different levels in the answers of a reflective child. For example: "When the Earth rotates around its axis and it is daytime here, it is night in China. There they go to sleep when we get up. It looks as if the sun is rising and setting, but it isn't like that for real."

Adults may reflect that shade and light change according to the Earth's rotation around its axis and the relationship of this movement and the sun. The final answer to the question "why does day follow night" cannot be given for the time being, since the fundamental reason for the Earth's rotation is not known.

Interpretation of generalisations

A child that only produces random generalisations needs to be encouraged to find combinations. The most appropriate way to do this is to start from the child's own sphere of experiences. One way is to use the change model. The child draws a snowman in the square on the left and a puddle that the snowman has turned into in the sunshine, in the square on the right.

when.....then

WHAT CHANGES? WHY DOES IT CHANGE? WHAT DOES IT CHANGE INTO?

HEAT FROM THE SUN

Children can be encouraged to make their own daily programme. They write down whatever they do at different times of the day.

in the morning > during the day > in the evening > at night

The child can think about a contradictory situation.

something happened.....followed by

WHAT CHANGES? WHY DOES IT CHANGE? WHAT DOES IT CHANGE INTO?

AN OLD TREE

DRIED

LUMBERJACK

Human activity can be observed from a wider horizon and changing natural phenomena

can be followed up.

A SNAKE SLEEPS
IN WINTERTIME
AND WAKES UP
IN THE SUMMER

WHAT CHANGES? WHY DOES IT CHANGE? WHAT DOES IT CHANGE
INTO?

A CAR MOVES
BECAUSE IT HAS
AN ENGINE.
THE MOUNTAIN
COLLAPSED BECAUSE
A DIGGER WAS DIGGING.

When children find it difficult to think about the reasons that lie behind different phenomena, they can be encouraged to think about generalisations with the help of the arrow in the change model. The children in a group think of something that changes and reflect on the reasons for this change.

It is worthwhile going through concepts based on experience with children who tend to use theoretical concepts only. Theorising children may not pay enough attention to their own observations. They do not relate theoretical concepts to experience and previously acquired knowledge. The concept often remains detached and is pushed aside when another, equally detached, theoretical concept appears. Concepts based on experience and theoretical concepts complement and nourish each other. The richer and more personal the children's experiences are, the easier it is for them to adopt theoretical concepts. The importance of concepts based on experience will never diminish.

Imagination and the world of fairy tales also inspire abstraction. Events are explained by spirits in old mythologies. Witches and fairies are the executors of change in fairy tales. The genie of the bottle is a champion at producing new phenomena. The characters of fairy tales enrich reflection.

In the book "Thought begins with wonderment" there are several tasks that can be used to deepen the concepts used by children. The tasks are designed for small groups but they can be adapted to individual work with one child.

Finally we present a couple of completed reply forms with some typical answers given by children.

TIME CARD FORM

CHILD'S NAME	Girl
SCHOOL/CLASS	Primary, 1st grade
INTERVIEWER	M.R.
DATE	26.10.89
INITIAL INTERVIEW	X

FOLLOW-UP INTERVIEW

WHY DOES NIGHT CHANGE INTO DAY?

So that people and animals could sleep and go to school in the morning

DESCRIPTION	they sleep
TIME ? (a)	night
DESCRIPTION	they go to school in the morning
TIME ? (b)	morning
DESCRIPTION	they are at school
TIME ? (c)	day
DESCRIPTION	they come home and eat there
TIME ? (d)	evening

HOW DOES TIME a CHANGE INTO TIME b?

at night so they could sleep in peace and in the morning wake up bright

HOW DOES TIME b CHANGE INTO TIME c?

so that they could go to school in the morning and work there during the day

HOW DOES TIME c CHANGE INTO TIME d?

day changes into evening so they can eat and go to sleep peacefully

DESCRIPTION	the bear is sleeping
TIME ? (a)	night
DESCRIPTION	it wakes up
TIME ? (b)	morning
DESCRIPTION	it goes for a walk
TIME ? (c)	day
DESCRIPTION	it stumbles back to sleep again
TIME ? (d)	evening

HOW DOES TIME a CHANGE INTO TIME b?

at night the bear sleeps soundly and can peacefully wake up and stretch in the morning

HOW DOES TIME b CHANGE INTO TIME c?

when it's day it can go for walks

HOW DOES TIME c CHANGE INTO TIME d?

it could go to sleep again in the evening

DESCRIPTION	it's night in Finland
TIME ? (a)	night
DESCRIPTION	there's a bit of white

TIME ? (b)	morning
DESCRIPTION	the sun is a bit closer there
TIME ? (c)	day
DESCRIPTION	-
TIME ? (d)	night

HOW DOES TIME a CHANGE INTO TIME b?
so that Finnish flag could go around

HOW DOES TIME b CHANGE INTO TIME c?
so that people could wake up and got to work and school

HOW DOES TIME c CHANGE INTO TIME d?
so that one could start sleeping in peace in the evening

TIME CARD FORM

CHILD'S NAME	Boy
SCHOOL/CLASS	Primary, 1st grade
INTERVIEWER	M.R.
DATE	9.11.89
INITIAL INTERVIEW	X
FOLLOW-UP INTERVIEW	

DESCRIPTION	The Earth rotates, that's Finland
TIME ? (a)	night
DESCRIPTION	Dawn is already beginning
TIME ? (b)	morning
DESCRIPTION	now it's nearly noon
TIME ? (c)	noon
DESCRIPTION	night's coming again, the flag is going away
TIME ? (d)	evening

HOW DOES TIME a CHANGE INTO TIME b?
because the Earth rotates

HOW DOES TIME b CHANGE INTO TIME c?
the Earth has rotated so much

HOW DOES TIME c CHANGE INTO TIME d?
the Earth has rotated one whole round

DESCRIPTION	it's asleep (the bear)
TIME ? (a)	night
DESCRIPTION	it's getting up, the bear
TIME ? (b)	morning
DESCRIPTION	it's leaving its nest

TIME ? (c) day
DESCRIPTION it's going back again
TIME ? (d) evening

HOW DOES TIME a CHANGE INTO TIME b?
the Earth has rotated

HOW DOES TIME b CHANGE INTO TIME c?
the Earth has rotated so much

HOW DOES TIME c CHANGE INTO TIME d?
when the Earth has gone around one whole round

DESCRIPTION sleeps

TIME ? (a) night
DESCRIPTION eats breakfast
TIME ? (b) morning
DESCRIPTION starts to paint
TIME ? (c) day
DESCRIPTION going to bed
TIME ? (d) evening

HOW DOES TIME a CHANGE INTO TIME b?
the Earth has rotated again

HOW DOES TIME b CHANGE INTO TIME c?
the Earth has rotated almost one round

HOW DOES TIME c CHANGE INTO TIME d?
the Earth has rotated completely

TYPICAL TIME CONCEPT ANSWERS

(Concept level a-d in brackets, see p.??)

DQ= answer to direct question

CC= answer related to child card set

NC= answer related to nature card set

SC= answer related to space card set

Maarit, six years

DQ: If you didn't sleep you wouldn't have the strength to be awake. (b)

CC: (Change depends on..) You have to go to school. The child knows it. (b)

NC: The shadows come. When the sun is almost down, night comes all the time. The sun has set on the other side. (b)

SC: The sun goes around the Earth. (c)

FIVE MONTHS LATER

DQ: So that you don't have to stay awake all the time. The Earth goes around all the time. (c)

CC: The sun is right up when the Earth rotates. (Night comes) when the Earth is right in the middle of dusk. (c)

NC: The sun is up. The Earth's gone into the light. (c)

SC: The Earth's gone round to the point where Finland is in the morning. (d)

Mikko, seven years

DQ: I don't know, maybe because the Earth goes round. (c)

CC: (Change depends on...) I don't know, maybe because the sun has set. (Evening has come) when the moon has come to the sky. (b)

NC: (Change depends on...) When the sun has set. (b)

SC: (Change depends on...) When Finland has changed places. When the Earth rotates. Because night comes. (c)

FIVE MONTHS LATER

DQ: I don't know.

CC: Because the sun rises. It can't always be day. (b)

NC: Earth I suppose, because it rotates. The sun is a bit everywhere. (c)

SC: Finland is on the other side and it's night over there, and day on the other side. (d)

Mia, eight years

DQ: It can't always be day and it can't always be night either. In daytime you have to be at school and work and at weekends you have to be in the country and at night you sleep. (b)

CC: You have to be at school during the day, you can't do that in the evening. And you can't be outside because it's dark. (b)

NC: (In the evening) the sun is down a bit. It has to be evening sometimes because the sun can't shine all the time. At night it can't shine at all because it has set. (b)

SC: Day comes when the sun can shine. (b)

DQ: Sometimes it has to be night and day too. (b)

CC: The girl has come away from school because it's afternoon. (b)

NC: (Mixing up A.M. and P.M.). Night comes when the sun has already set. (b)

SC: The sun is a bit on the other side when it's afternoon. The Earth is not quite close to the sun yet. When the Earth is by the sun, the sun starts to shine on Finland. Night is when Finland is left a bit behind and the sun no longer shines there. (c)

Jani, nine years

DQ: When the Earth rotates there is no more light and it's night. (c)

CC: You go to school in the morning because that's what the law says, you have to go. (b)

NC: (Explains with the space card set) The Earth rotates and things like that. (d)

SC: Where there is light has changed. The Earth rotates at a crazy speed in the same direction. (d)

DQ: When the Earth rotates around its own axis. (d)

CC: Time changes in the same way as the Earth rotates. (d)

NC: When Finland is not facing the sun, it (the sun) rises, they say. (Night comes when the Earth) starts again to rotate on top of the sun so that it can't be seen. (d)

SC: The Earth rotates, not quite straight, around its own axis. (d)

REFERENCES