Towards a Practical Framework of the Remediation of Cognitive Skills at Primary Level

Outi Kyrö-Ämmälä

Faculty of Education, University of Lapland

P.O. Box 122, 96101 Rovaniemi, Finland

Tel: +358-40-484-4120   E-mail: outi.kyro-Ammala@ulapland.fi

Kaarina Määttä (Corresponding author)

Faculty of Education, University of Lapland

P.O. Box 122, 96101 Rovaniemi, Finland

Tel: +358-400-696-480   E-mail: kaarina.maatta@ulapland.fi

Abstract

In this article, the remediation of pupils' cognitive skills is studied and a practical framework for educational and remedial work at primary level is introduced. This article is based on a doctorate research that studied by means of action research the development and enhancement of the most low-grade school entrants' reasoning and cognitive skills. Those first grade students (N=43) who performed the worst in the cognitive skill measures comprised the test and control groups. The pupils in the test group were trained with the methods described in this article for 27 teaching moments during two school years. The results showed that the poor cognitive skills can be rehabilitated. Based on the results, a practical framework is constructed for educational and remedial work at the primary education. In this framework, the nature of cognitive skills and various different factors affecting educational situation are presented. With the help of these factors, the development of cognitive skills can be supported. The development of pupils' cognitive skills is individualistic, which should be noticed also in teaching. The principles and references are presented, which can help the teachers with their own actions to repair the defective cognitive processes and, at the same time, support the pupils' learning and working skills.

Keywords: Cognitive skills, Remediated teaching style, Cognitive modifiability, School entrants

1. Introduction

The base of a child's development and learning of cognitive skills is created at the primary level. How well a pupil can follow the teaching in the class depends on the cognitive skills. A pupil's challenging task is to pick up, receive, process and produce information from his/her learning surroundings independently, accurately and in a target-oriented manner. For some of the pupils this challenge is too demanding: approximately 5 % of the first-grade students require certain support for their learning and their behavior is disruptive (Hautamäki et al., 2001).

Even the pupils aged between six and seven differ in their learning needs and talents as well as how they process information (Adey & Shayer, 2002; Hautamäki, 1995; Kyrö-Ämmälä, 2007; Sahlberg, 1996). The child's unique features like the planning of his own action and guidance, his cognitive skills and his control of basic skills as well as the child's social skills and all the factors with relations to motivation have the biggest effects on the learning ability (Wang, Haertel, & Walberg, 1994). In addition, the classroom as an interactional study environment is significant (Ahonen et al., 1995; Ahonen & Aro, 1999).

Some of the children learn the most of their cognitive skills by perceiving the direct environmental stimuli and they do not need any guidance. But for a part of the children, the chances to learn directly are lesser because of the frailties of intelligence or, for example, sensory function, when they need guidance especially from an adult or someone more capable than themselves. The quality, amount, intensiveness, repetitiousness and duration of the guidance vary based on the learners' individual differences. (Haywood et al., 1992.)

The child's cognitive-motivational methods and school learning form either a positive or a negative development path:

On the other hand, enthusiasm and attention to the task will forward the progress and, on the other hand, anxiety and avoiding challenging tasks will increase the problems in learning (Nurmi, Aunola, & Onatsu-Arviloimi, 2001). Not only can the learning strategies be affected by the developing cognitive skills, but also the pupils' image of themselves as learners. (Wilson, 2000.)

From this starting point, we began to create a practical framework for educational and remedial work to support the development of the children's cognitive skills. In our framework, we have taken into consideration a vast amount of previous researches and interventions pursuing to improve a child's cognitive processes. These particular teaching programs are inter alia "Children's Philosophy" program established by Fisher and Lipman (Fisher, 1990); De Bono's "Cognitive Research Trust (CoRT)" program (de Bono, 1991); "Cognitive Acceleration through Science Education (CASE)" and "Cognitive Acceleration in Mathematics (CAME)" programs (see Adhami, Johnson, & Shayer, 1998; Adley, Shayer, & Yates, 1995); "Cognet" program create by Greenberg (Feuerstein, 2006); Das's "PREP (PASS Reading Enhancement Program)" program (Das, Naglieri, & Kirby, 1994); "Bright Start (BS)" program (Haywood, Brooks, & Burn, 1992); and "Instrumental Enrichment (IE)" practice program (Feuerstein, Rand, Hoffman, & Miller, 1980).

The elaboration of our framework grounded on Das's (1989) and his working group's (Das, Naglieri, & Kirby, 1994) neuro-cognitive PASS-theory of intelligence, which was named after the four essential cognitive actions: planning, attention, simultaneous and successive information processing (see also Äystö & Das, 1995). Additionally, we lean on Jean Piaget's theory the development phases (1972, 1977, 1985, 1988) as well as on Vygotsky's (1978, 1981, 1982; see also Berger, 2001; Wilhelm, Baker, & Dube, 2001), Feuerstein's (1980, 1988) and Haywood's (1992, 2000) opinions about learning. Piaget saw the cognitive actions to develop through four-phased steps: the parts of the previous step unite with the parts of the last step and together they form a new step. In his studies on the cognitive development, Vygosky emphasized the meaning of social interaction and zoning. According to him, teaching is to be directed to the pupil's zone of proximal development and the well-timed support for learning (scaffolding) is essential. Feuerstein, on the other hand, accentuated a learner's structural cognitive modifiability and the meaning of a learning experience in the learning. Haywood's noted that these guided learning experiences can be created with the help of the teacher's teaching style.

When forming the framework, we leaned especially on Reuven Feuerstein's thoughts about the learner's structural cognitive modifiability. Feuerstein was Piaget's student in the 1940's and he also completed Vygotsky's theory. Feuerstein emphasized the importance of the inspection of cognitive development to see the cognitive process as a dynamic quality that occurs in the interaction process between two people: a learner and a teacher. A learner is protean and the structural cognitive modifiability is possible (Feuerstein et al., 1980; Haywood, Brooks, & Burns, 1992; Tzuriel, 2001).

The constructive conception of learning, which declares that a learner is an active creature, who processes information in many ways and who selects the learning material and interprets it, encourages to teach cognitive skills. We see the remediation of cognitive skills in the light of optimistic learning conception, which is in line with Feuerstein's et al. (1988) idea of a human's intellectual achievement level never reaching its top. Consequently, a learner's skills can – and must be – evolved and remediated. The learning problems are seen to result from defective and insufficient cognitive processes, which are repairable and developable. Therefore, not only is this article acquaint with the previous, well-known theoretic elaboration, but also it founds on the authors' practical experiences about developing and examining their teaching (Kyrö-Ämmälä, 2007).

The aim of this article is to describe the principles and references which can help the teachers with their own actions to repair the defective cognitive processes and, at the same time, support the pupils' learning and working skills. The remediation of pupils' cognitive skills is studied and a practical framework for educational and remedial work at primary level will be introduced as a result.

2. What are the cognitive skills?

Cognitive skills are needed when processing the information surrounding us. They affect how a human being receives, internalizes and understands the information from his/her surroundings and how he/she utilizes his/her previous experiences when adjusting to a new situation. Cognitive skills also have an influence on how a human being controls himself /herself and on how he/she uses the information. It can be used for adapting and creating new information and for planning and analyzing behavior in order to attain certain information. (Cf. Das, 1989; Das, Kirby, & Jarman, 1979; Feuerstein et al., 1980; Lidz, 1987.)

The information processing is a multidimensional function and a process that form a cohesive entity. Attentiveness and the guidance of actions have an essential influence on the process of receiving information. Attentiveness is a human being's ability to direct his/her own observation to those features of the surroundings that are fundamental to that

situation or task and, then, to choose the suitable ways to act (Ahonen et al., 1995; Vygotski, 1982). Attentiveness is one of the core skills of a pupil's cognitive prerequisites (Hautamäki et al., 2001; Lyytinen, 1999). Attentiveness is combined with one's own guidance of action, which consists of the planning of an action, selecting a conduct, as well as of the ability to maintain and to change the way of acting and seeking and of fluency and the control of impulses. (Feuerstein et al., 1988; Korkman, 1997.) The alertness of a right kind creates the prerequisites for attentiveness, which for one's part enables the other cognitive actions (Das, Niegri, & Kirby, 1994).

A human being processes the collected information. This information processing is connected with thinking and memory. Mentally a representation or a belief is formed while thinking in order to work out new representations or beliefs to reach the goal (Hautamäki, 1995).

The production of information, which is bound to the generating and adapting new information, as well as to the self-expression, language, communication and the interaction with others, is also a part of the information processing (Lyytinen, 1995; Munter, 1995).

3. The Remediation and Teaching of a Child's Cognitive Basic Skills

A mediated learning experience is important in the remediation of a child's cognitive basic skills (Feuerstein et al., 1980). The concept is based on the assumption that a humane development can neither be understood only as the product of a neuro-physiologic maturation, nor can it be regarded as a simple product of what an individual confronts by chance or of what kind of stimuli he/she is exposed to. In addition to these factors, the cognitive functions develop within the information flow, which the instructions itself produces and which is transmitted to an individual in the guidance process.

Two kinds of interactions can occur between a learner and the surroundings: direct and indirect interaction, but both of them can result in learning (Feuerstein et al., 1980). Direct learning occurs from the direct surrounding stimuli. Vygotsky (1978) already pointed out that there must be some factors to mediate between the surrounding stimuli and learning, but it was Feuerstein et al. (1988) who emphasized that this factor must be an humane teacher. Then, the learning is guided or indirect; a teacher helps the learner to function more efficiently with the learning materials, interprets the learners' reactions to the stimuli and, when needed, directs the reactions to enhance a learner's understanding. The teacher's influence should not be too strong because the direct connections between a learner and the surroundings should not be prevented. On the other hand, the influence should not be too weak when the learner's guidance would be insufficient and his/her development hindered. The teacher moulds the information by influencing the order, intensity, occurrence density and the content of stimuli and, in this way, forms timely, spatial and causal relations together with a child (Feuerstein et al., 1979; Jensen & Feuerstein, 1987).

A child's cognitive system can be influenced for example by choosing stimuli, by organizing the timing and the order of functions, by regulating the intensity of the stimuli and by copying and repeating the certain stimuli. A teacher can provoke structured learning experiences aka create artificial situations, which help to detect and learn the relations between things. (Feuerstein et al., 1980) The majority of the interaction between a child and an adult can be structured learning experiences (Haywood et al., 1992). The essential components for the emergence of a learning experience are purposefulness, reciprocity and its meaning content (Feuerstein et al., 1980; Feuerstein et al., 1991; Tzuriel, 2001).

A learning situation must be purposeful and reciprocal where both, a teacher and learner, are committed to the task. A teacher must be aware of where the learning situations are aiming at: what is the lesson's point now and in the future. A learning situation must include factors that both produce feedback "here and now" and refer to the skills and the qualities that a learner needs in the future (transcendence). A learner is not necessarily aware of these distant learning goals or the advantages of learning. A learner has to be informed of these matters by a teacher.

The reciprocity relates to the conversation had during a learning situation: a teacher's challenge is to get the learner follow the available information attentively. It is also a teacher's job to prepare an interaction situation so that a learner becomes aware of the peoples' difference in learning, thinking, feeling and behaving and that the situation itself controls a learner's own behavior. A learning situation does not include competition or factors connected with the order of superiority; on the contrary, preferably it includes the principle of sharing. A teacher works in the situation as a model and as a filter between a learner and the world of stimuli. A teacher knows and feels a learner's skills and needs and reforms the learning situation suitable for the learner by his/her choices. It is essential that the tasks support a learner's opinion on his/her own skills to absorb new information and that they enhance a learner's sense of competency; that is, the feeling that a learner is good exactly as himself/herself.

The idea of a teacher as a filter is also connected with the fact that a teacher explains and opens the conceptions used in the teaching so that their meanings are transmitted to a learner as was hoped to. Then the conceptions share the cohesive

meaning contents. By a guiding teaching style, a teacher guides the learner to study in a goal-oriented way and to search for something new; this way, the challenges are working as the motivational factors. Then, a learner attains an understanding about his/her own possibilities to transform and an optimistic idea of his/her own learning possibilities.

4. The Empirical Execution of the Research

After the theoretical familiarization, we started to plan an intervention program in order to support the school entrants' cognitive skills. The children (N=43) who started their first grade in Rovaniemi in 2004 were selected by the help of Outi Kyrö-Ämmälä's work as a teacher as the research subjects. The parents gave permission for carrying out the tasks that measured the children's cognitive skills. Based on the preparatory measuring, those who performed the worst in the tests (N=12) were divided into a test and a control group to each of which six children belonged. The preparatory measuring consisted of two Finnish tests of school readiness: "Kouluvalmiuden ryhmätutkimus" [The assessment of the school readiness in group] (Elomäki et. 1999) and "Ensiaskeleet – Oppimisen edellytykset [The first steps – qualifications of learning] (Hautamäki et al. 2001). The test group children's cognitive skills were trained in 27 teaching moments during two school years. After the teaching moments, the test group and control group's performances were compared. The teaching moments were analyzed and interpreted by the action research approach and by a theory-bound content analysis. A research diary was in use as well. In addition to the preparatory measure, intermediate and final measures were made for the students. With these measures we carried out the mixed-method research, whom aim was to discover regularities in the development of a pupil's cognitive skills and the central features of the teaching arrangement supporting it. The research results and the methodology are widely introduced in Outi Kyrö-Ämmälä's doctoral thesis (2007).

The research results showed the heterogeneous in the cognitive skills of the pupils from the same age group already at the phase of starting school. The diversity of the learning prerequisites challenges to make the teaching arrangement in a flexible way. The action research confirmed the thought of aiming the teaching at a student's zone proximal development by the relevant and timely support with carefully defined running time. When the students receive suitable tasks as well as the operational and concrete guidance their motivation and sense of capacity increase and, thus, the learning process progresses.

The results showed that the poor cognitive skills can be remediated. The changes in the scores varied a little between the test group and control group pupils both in the analyses between the preparatory and intermediate measures and between the preparatory and final measures. The test group pupils benefitted in different ways from the various tasks. Therefore, it is important to understand how the versatility of the remedial intervention would be beneficial for the pupils with different prerequisites.

5. Towards the Practical Framework

5.1The pedagogical general prerequisites of the cognitive remediation

Every child must learn the basic cognitive functions in order to be able to think logically even without guidance, to see the world systematically and sensibly in an organized way and to know how to learn to adapt his/her intelligence to new situations. However, the children' starting points and chances are the most different. Despite the differences between the pupils, some factors form the basic conditions for the children's chances to improve the learning of cognitive skills. These factors form the pedagogical general prerequisites of the cognitive remediation.

< Figure 1 about here>

5.1.1 A pupil's own will to learn

The significance of a learner's intrinsic motivation in the effective learning is emphasized in the development of cognitive skills (Swizky & Haywood, 1984; Tzuriel, 1991). It is essential that a child wants to learn without any external sanction or reward. A teacher's challenge is to get a low-grade learner's intrinsic motivation directed to the task. A teacher's own attitude towards the tasks and the subjects influences greatly the emergence of the intrinsic motivation. When a teacher is excited about the task and the subject that he/she is teaching, at least a part of that enthusiasm is transmitted to the pupils. Therefore, it is important that a teacher explains the meaning of the tasks and exercises with enthusiasm already at the beginning of a lesson. On the other hand, the challenging tasks increase the intrinsic motivation: The assignments should not be too easy, but not too hard either. The need for guidance is not a sign of a task being too hard.

Using external rewards, such as the stickers, in teaching is fairly common at the primary level, but the pupils may become increasingly addicted to them (Haywood et al., 1992). Then a pupil is not interested in studying without an exterior reward; even though learning itself and finishing a task are sorts of rewards for a pupil. Instead of the external

rewards, a teacher can use the task-related rewards: for example, he/she could give a new and more challenging task or even a more demanding text book. One of the pleasant rewards for a pupil is also to give him/her more responsibility along with the development in learning or to let him/her work as an auxiliary teacher. Being a model or working in a teacher's role increases a pupil's sense of competency, which for its part strengthens the pupil's self-esteem (cf. Prashnig, 1997).

5.1.2 Playing

Playing clearly belongs to the children's world of ideas at the primary level and they want to spend time by playing. Too often the transition from the daycare to the school world means the end of playing although even the father of experiential learning John Dewey (1859-1952) himself emphasized the child-centeredness in his opinion on learning. According to Dewey, the school's biggest problem is the conformity with the subjects and the goals. It means that the material to be learned is already set up as outputs and achievements that all the children have to attain within a certain, preset time limit. Then the focus is by no means on the children themselves or on their actions, but on other, extrinsic things. (Dewey, 1957/1899; Väkevä, 2004).

Also Vygotsky (1981) emphasized the significance of play in learning. In compliance with his thoughts, learning and development take place when a child is in social interaction with his/her surroundings. Play is the most important prerequisite for the development of a child's thoughts, will and feelings and these three areas cannot be separated in a play. New abilities and skills that are important for further development evolve during the play activities and a child develops a new kind of relationship with the surroundings. While playing, a child constantly acts on the area of the zone of proximal development. With the help of a play, a child handles and analyzes the new information – in relation to his/her own experiences –and assimilates it with the previously learned. A child is not yet ready to survive independently, but will succeed with the help of others. Vygotsky has felicitously stated that "a playing child towers over a child not playing" (Vygotsky, 1981).

Playing is the core of the teaching in the day-care and still in the preschool education and learning through playing is essential. Unfortunately, the schools' facilities do not often offer much opportunity for a versatile play. The schools are focused on teaching and education and its surroundings are built to support that (Korhonen, 2005; Lindqvist, 1998). The school's view on the learning structure with its book-orientated features leans on a decades-old tradition and the classroom and desks are considered as the prerequisite for learning. Understanding a play as a factor that contributes to a child's development and as an action that supports a child comprehensively, would give new opportunities also for the primary education. A motivational basis is built for the learning through playing, because then a child does not have to be persuaded to practice his developing skills. Through play, a child learns almost by himself/herself new things, because a catching play makes a child surpass himself/herself and his/her skills (Miettinen, 1990; Pietilä, 2005; Pulkkinen, 1999).

5.1.3 Use of different senses in teaching

It is important, that the teacher utilizes different senses in teaching (Prashnig, 1997; Wagele, 1997). Too often the teaching is carried out only based on hearing and sight, even though the pupils' capacity to use information that comes from different sense channels differs greatly: the pupils' working, learning and thinking styles vary. The pupils get their information from the outside world by using their senses – by observing – which usually is connected to thinking, memorizing and information processing (Dunn & Dunn, 1993). The sense channels mean different to different people: One learns primarily by seeing (a visual learner), the other by hearing (an auditory learner), the third by doing (a kinesthetic learner) and the fourth by using one's sense of feeling (a tactile learner) (cf. Sahi, 2006). Not all the children represent that clearly or strongly a specific learning type: they rather use various channels. Thus, a teacher has to consciously take care that he/she uses different sense channels in teaching. (Huisman & Nissinen, 2005).

A human-being's various sense-based information processing centers develop at different pace. At the beginning, a little child learns the best by experiencing with his/her whole body (a kinesthetic modality) and after that a tactile modality aka sense preference develops and learning happens by experimenting and interacting with other objects and people. During the primary education, the children absorb information by observing and watching their surroundings and then the sight becomes an important learning tool (a visual modality). About at the age of 11, a child's auditory modality starts to develop and a child learns easily by listening. According to Prashnig (1997), with most of the school aged children the kinesthetic and tactile modalities remain at the center stage through the primary level. This fact is usually ignored by the teachers: instead, they lean on the sight and hearing in their teaching.

5.1.4 Learning from mistakes

It is essential in the education situation that there is a sense of trust and collaboration between a teacher and the pupils

and a mutual understanding about how to act at school especially in order to increase learning and understanding. The teaching method is interactive. It must contain a dialogue between a teacher and the pupils and the pupils have to be able to work independently in a confidential atmosphere.

By developing a teaching group's togetherness, also the mistakes can openly be discussed without a fear for a single pupil who made a mistake would be made fun of (Näätäinen, 2001). A teacher guides the lesson carefully and watches closely every pupil's development all the time. A teacher highlights the mistakes and discusses the alternative solution methods or the common misunderstandings. The discussion about the common mistakes is necessary before too many pupils make them. Also the mistakes of a single pupil are dissected in the lesson with the whole class: everyone can learn from every single mistake.

5.1.5 Individual guiding: Various pupils need different amount of time for learning

The pupils' skills to accomplish tasks and exercises of a different kind vary. The one-to-one guidance is needed. In these kinds of differentiating situations, a teacher has to deliberate whether a pupil finds the extra teaching as a sanction or as a positive thing. If a pupil wants, for example, desperately take a break when a teacher asks him/her to stay for a private teaching, it is likely that the pupil experiences the situation negatively. On the other hand, if a pupil is committed to the task and intrinsically motivated to learning, he is motivated exactly by the completion of the task. In this case, having the private teaching to succeed in the task is considered as a price. In this context, the duration of the lesson can also be discussed: Is the standard duration used in Finland (45 minutes) an optimal time to learn new things for a learner, whose learning is slow and requires concretizing?

The problems of individualistic teaching are also connected with the fact that the pupils' teaching is combined with the learning progressing in age groups and that every pupil proceeds to an upper grade at the same pace. It is assumed that all the pupils of the same age reach the goals of the curriculum that are defined by the age groups and that they can proceed or can be transferred to the next grade at the same time. Especially in the primary education and at the phase of proceeding forward, offering educational extra-time as a form of class repetition could notably increase some pupils' control of cognitive skills. At the primary level, the classlessness could be a functional solution. When a pupil is repeating the grade, the attention should be paid especially on the pupil's control of cognitive skills, which are already mentioned in the operative curriculum but which in practice may be ignored as the emphasis is on the subject-specific goals.

The successful learning, meaningful teaching and the contact and communication between a pupil and a teacher are regulated by the group size: the smaller the group, the better and more individually a teacher is able to observe the pupils (Schipper, Riksen-Walraven, & Geurts, 2006). A small group size is of great importance not only to the teaching arrangements but also to the evaluation situations. The low-grade pupils perform the best when working in a small group.

5.2 The core functions for the remediation of the cognitive skills

The previously showed prerequisites for the remediation of cognitive skills are necessary and useful to the pupil's learning of cognitive skills, but at the same time they are insufficient as they are only the surface (see Figure 1). The special educational procedures, which form the core of the remediation of the cognitive skills, are needed as well.

It is important to use images when teaching the cognitive skills. These pictures can help a pupil to practice the accurate information search, but first and foremost they can help him/her to verbalize: that means how a pupil's own actions can be guided with the help of language (Adey & Shayer, 1994). All the pupils do not spontaneously verbalize their actions; in other words, they do not automatically guide their actions in a verbal way and thus the experimentations and the trial and error method are emphasized as the way of action. It is essential to encourage the pupils to describe the images aloud as in detail as possible.

Verbalizing the concepts and problem solving helps learning. When the children are talking about and explaining their conceptions, they also have to consider others' opinions as well as to negotiate and compromise. Through this process, a pupil's own opinions may change, which actually means that a pupil is reconstructing his/her own information structure (cf. Piaget, 1988). A teacher's significant role as a guide, a motivator and a creator of the practice situation for verbalizing or describing aloud the conceptions is the most decisive (cf. Silvén, 1990).

As a cognitive strategy, verbalizing helps the pupil to analyze the learning material and to maintain self-control. It refers to a learner's personal speech that he/she uses to direct his/her actions. Gradually, this personal speech turns into an inner speech that is silent talk to oneself, in other words, thinking.

Practicing cognitive processes is based strictly on carefully designed cognitive teaching moments, in which the attention

is focused on the development of children's understanding and thinking skills. Our next examination leans especially on the Bright Start (BS) teaching program (Haywood, Brooks, & Burns, 1992) and on the Instrumental Enrichment (IE) practice program (Feuerstein, Rand, Hoffman, & Miller, 1980).

There are five essential pedagogical actions to improve a child's cognitive development. They form the core functions of the cognitive remediation.

< Figure 2 about here>

1) With the help of the process questions, a teacher guides the learners' thinking process forwards, helps them pay attention to the thinking processes and to discuss it with themselves. The process questions are questions, which help the pupils to understand the process. The questions include the interrogatives such as 'like how', 'why', 'how else', 'how do you know': "How do you know this?", "What do you have to do first?", "How can you find out what to do next?"

2) One of the core elements of teaching is bridging. It means that the cognitive functions as the teaching subjects are connected to surroundings that are familiar to a learner. Then it is discussed how the cognitive principles and strategies can be adapted to the various connections and contents when acting for example at school, at home, or in a friend group. A child learns explicitly by bridging and less by memorizing. The intention in learning is not to bridge the contents of the teaching, but the precisely to learn to bridge the cognitive functions that are the target of teaching. For example, when rehearsing comparisons, the aim is not that a child learns to compare certain qualities but to use comparison operations also in other situations. The bridging has to happen carefully and in a learner-centered way. Then, a learner figures out the bridging by himself/herself. A teacher's responsible and challenging job is to help the learner to make up situations where the practiced operations are needed.

In addition, a teacher's task is to "build the bridge" by providing to the pupils with the needed mechanisms for constructing and understanding the concepts and connections. A teacher can directly point out common principles behind certain skills and information or encourage the pupils to come up with the examples of bridging in the everyday situations where they use a certain cognitive action. The bridging examples should be as simple as possible and logically straightforward, so that a learner himself/herself also realizes the connection between the cognitive action and example.

3) To challenge or to demand arguments is the third element of the guiding teaching style. A teacher demands reasons for both the right and wrong answers from the pupils and encourages them to explain their trains of thought: "Yes, that could be the case, but could you observe it from a different angle?" or "You are right. How did you come up with this solution?" A teacher uses cognitive questions, where simply "no" or "yes" as an answer is not enough, but it must contain accurate and precise reasoning. According to Haywood et al. (1992), the cognitive questions are, in fact, questions that require thinking and are concentrated on observing, memorizing and on the action strategies. With the help of these questions, a teacher guides a pupil to deliberate his/her answers instead of answering the questions fast and immediately. By his/her own parlance and by presenting models how to ask, answer and use language properly, a teacher can support the pupil's transformation towards more accurate and precise language.

4) Teaching the rule formation is also a part of guiding teaching. A pupil should understand the necessity of rules and how all the rules can be generalized. A teacher encourages the pupils to form common rules from learning material. Then the learners know what to do in a similar situation in the future. In guiding teaching style, it is important not only to form the rules, but to consider the usability of these rules in the different situations (Tribus, 2006).

5) The guiding teacher's attitude should include a world view, in which a teacher emphasizes predictability, consecution and strategies. Teaching the common principle of methodicalness is also essential in guiding teaching. A pupil learns to understand that the events, people and objects can be arrayed in groups. In addition, a pupil will learn to realize the meaning of regularity in predictability and that an effective problem solving is really about finding the effective strategy. According to Haywood et al. (1992), these five elements are part of a good teaching style, but in addition, a teacher has to pay attention to the pupils' feedback and develop his/her own teaching style and strategies based on it.

6. Discussion

When pursuing to create the practical framework of remediating cognitive skills, we leaned on the theoretic discussion and previous studies on the subject matter. We used Reuven Feuerstein's thoughts about a learner's structural cognitive modifiability and its evaluation and intervention as our foundation. Also, this article was built on other previous, well-known theories (Das, 1989; Das, Naglieri, & Kirby, 1994; Feuerstein et al., 1980, 1988; Haywood et al., 1992; Piaget, 1972, 1985, 1988; Vygotsky, 1978, 1982). Besides the strong base from other previous programs supporting the cognitive remediation (especially Bright Star and Instrumental Enrichment interventions), our practical experiences have encouraged us to develop and study our own teaching work.

When getting acquainted with the previous programs made to support the cognitive development, we were convinced that by arranging opportunities for the pupils to rehearse controlling themselves and by guiding them to become conscious of all the facts concerning the control over their actions, the pupil's skills to learn and to handle information would improve (Kyrö-Ämmälä, 2007).   The pupils should be taught to create connections, to bridge the information, the abstract rules and principles, from their experiences. A teacher's role as the guide of the learning process is essential: a teacher helps a pupil to find the connections between a learning subject and the reality. Only controlling the functional cognitive skills will make it possible for a pupil to learn all the basic information and skills taught at school.

Practically, the control of cognitive skills means the vocal guiding of the pupil's actions. A teacher's way of interacting with the pupil and his surroundings is in the centre; so it is merely about how a teacher proceeds and less about what the lesson contains. The guiding teaching style requires numerous things of a teacher. He/she should know the learners well enough and believe in the development of cognitive skills. Additionally, a teacher has to have sensibility to see the relevant stimuli that support a pupil's learning (cf. Oksanen, 2001). The guiding teaching enables providing a guided learning experience for a pupil. The point is to make sure that a pupil performs as well as it is possible within the limits of his/her skill structure. A teacher's responsible job is to find every pupil's limits of learning. Furthermore, it is essential to work at the zone of proximal development defined by Vygotsky (1978).

In the international PISA-research of OECD's member countries, the pupils at Finnish comprehensive school have performed in an excellent way when compared with the pupils from other countries. PISA-results (2000) claim that the Finnish youth' literacy is the best in the OECD-countries. Also, the Finnish youth graduating from the comprehensive school share the highest level in mathematic skills with the Korean, Netherlandic and Japanese youth. The Finnish youth are the second best in problem solving skills in the OECD-countries (The National Board of Education, 2006). At the same time with these excellent results, the people have also started to discuss the state of those children and youth, who do not reach the average expertise in Finland.

In Finland, a concept of "the thinking school" has been brought up when wanting to emphasize that it is, first and foremost, the school's job to teach how to think and know. The goal is that a pupil controls his/her thinking functions and trusts in his/her thoughts, knows that his/her thinking is working and that he/she is able to adapt his/her knowledge and skills to the different situations. This is the place to discuss also the learning and thinking skills.

The discussion, whether the teaching of cognitive skills should be separated from the content of the subjects and be included in the curricula as an individual subject, has been dominant in Finland as well as all over the world (cf. Kivi, 1995; McGuinness, 1999). The program we have created offers only one framework for the teaching work. This framework has also been empirically verified (Kyrö-Ämmälä, 2007). Still, there are plenty of alternative frameworks. For example, 42 European projects to develop the pupils' thinking skills are presented in the book called "Thinking Teaching in Europe" (Kuusela, 2000). It is essential to pay enough attention to the pupils' cognitive skills in the school work, because controlling them not only improves the learning of the school subjects and skills taught at school, but also the succeeding in life much more extensively.

References

Adey, P., & Shayer, M. (1994). *Really rising standards. Cognitive intervention and academic achievement.* London: Routledge.

Adey, P., & Shayer, M. (2002). Cognitive acceleration comes of ages. In M. Shayer, & P. Adey (Eds.). *Learning intelligence: Cognitive acceleration across the curriculum from 5 to 15 years* (pp.1-17). Philadelphia: Open University Press.

Adey, P., Shayer, M., & Yates, C. (1995). *Thinking science: The curriculum materials of the cognitive acceleration through science evaluation (CASE) project.* (2nd ed.). London: Nelson.

Adhami, M., Johnson, D., & Shayer, M. (1998). *Thinking maths: The programme for accelerated learning in mathematics.* Oxford: Heinemann.

Ahonen, T., & Aro, T. (1999). Neurokognitiivisen tiedon soveltaminen kehityksen tukemiseen.[The application of neuro-cognitive information in supporting development]. In T. Ahonen, & T. Aro (Eds.). *Oppimisvaikeudet. Kuntoutus ja opetus yksilöllisen kehityksen tukena. [The learning difficulties: Rehabilitation and teaching as a support of individual development]* (pp. 14−23). Jyväskylä, Finland: Atena-publication−WSOY.

Ahonen, T., Lamminmäki, T., Närhi, V., & Räsänen, P. (1995). Koulun aloittaminen ja varhaiset oppimisvaikeudet [Starting the school going and early learning difficulties]. In P. Lyytinen, M. Korkiakangas, & H. Lyytinen (Eds.).

Näkökulmia kehityspsykologiaan. Kehitys kontekstissaan. [The perspectives to the developmental psychology: the development in its context] (pp. 168-187). Porvoo, Finland: WSOY.

Berger, K. S. (2001). *The developing person through the Life Span.* New York: Worth Publishers.

De Bono, E. (1991). *Teaching thinking.* London: Penguin Books.

Das, J. P. (1989). A system of cognitive assessment and its advantage over IQ. In D. Vickers, & P. L. Smith (Eds.). *Human information processing: Measures, mechanisms and models* (pp. 535-546). North-Holland: Elsevier Science Publishers B.V.

Das, J. P., Kirby, J., & Jarman, R. F. (1979). *Simultaneous and successive cognitive processes.* New York, San Francisco, London: Academic Press.

Das, J. P., Naglieri, J. A., & Kirby, J. R. (1994). *Assessment of cognitive processes. The PASS theory of intelligence.* Des Moines, Ill. Boston: Allyn & Bacon.

Dewey, J. (1957). *Koulu ja yhteiskunta [School and Society]*. Helsinki, Finland: Otava.

Dunn, R., & Dunn, K. (1993). *Teaching secondary student through their individual learning styles: Practical approaches for grades 7–12.* Boston: Allyn and Bacon.

Elomäki, T., Huolila, R., Poskiparta, E., & Saranpää, P. (1999). *Kouluvalmiuden arviointi ryhmässä [The assessment of the school readiness in group*]. Turku: The publication of Turku´s social center 2A.

Feuerstein, R. (2006), Teaching and learning intelligence: Creating the future, Teaching and Learning Strategies. [Online] Available: http://www.newhorizons.org/strategies/ie/feuerstein.htm (July 7, 2006)

Feuerstein, R., Klein, P., & Tannenbaum, A. (1991). *Mediated learning experience (MLE): Theoretical, psychosocial and learning implications.* London: Freund Publishing House.

Feuerstein, R., Rand, Y., Hoffman, M. B., & Miller, R. (1979). Cognitive Modiafibility in Retarded Adolescents: Effects of Instrumental Enrichment. *American Journal of Mental Deficiency.* 83, 539-550.

Feuerstein, R., Rand, Y., Hoffman, M. B., & Miller, R. (1980). *Instrumental enrichment: An intervention program for cognitive modifiability.* Baltimore: University Park Press.

Feuerstein, R., Rand, Y., & Ryndess, J. E. (1988). *Don't accept me as I am*. New York: Plenum Press.

Fisher, R. (1990). *Teaching children to think.* London: Blackwell.

Hautamäki, J. (1995). Älyllinen kehitys ja koulutus [The mental development and education]. In P. Lyytinen, M. Korkiakangas, & H. Lyytinen (Eds.). *Näkökulmia kehityspsykologiaan: kehitys kontekstissaan. [The perspectives to the developmental psychology: the development in its context]* (pp. 219-247). Porvoo, Finland: WSOY.

Hautamäki, J., Arinen, P., Hautamäki, A., Lehto, J., Lindblom, B., Kupiainen, S., Outinen K., Pekuri, M., Reuhkala, M., & Scheinin, P. (2001). *Ensiaskeleet - oppimisen edellytykset. Luokanopettajille tarkoitetun seulan toimivuus Helsinki-aineiston perusteella. [The first steps – qualifications of learning].* The Reports of Educational Helsinki A17. Helsinki, Finland: The School Authority of City of Helsinki.

Haywood, H. C., Brooks P., & Burns, S. (1992). *Bright start. Cognitive curriculum for young children.* Watertown, Massachussets: Charlesbridge publishers.

Haywood, H. C. (2000). Bright start: Cognitive curriculum for young children. The conference lecture L'éducation cognitive Conférence 25.10.2000. Université Charles-de-Gaulle. Villeneuve d'Ascq Cedex. [Online] Available: http://www.univ-lille3.fr/ufr/psycho/master/psychoenfance/educogn/haywoodoriginal.htm (August 6, 2006)

Huisman, T., & Nissinen, A. (2005). Oppiminen, oppimistyylit ja liikunta. [Learning, learning styles and exercise]. In P. Rintala, T. Ahonen, M. Cantell, & A. Nissinen (Eds.). *Liiku ja opi: Liikunnasta apua oppimisvaikeuksiin [Exercise and learn. Physical exercise as a help to the learning difficulties]* (pp. 25-46). Keuruu, Finland: PS-publication.

Jensen, M. R., & Feuerstein, R. (1987). The learning potential assessment device: From philosophy to practice. In C. S. Lidz (Ed.). *Dynamic assessment: An interactional approach to evaluating learning potential* (pp. 379-402). New York: Guilford.

Kivi, T. (1995). Pääkirjoitus [Leading article]. *Tiedonpuu ry -lehti [Tiedonpuu journal]*. 1 (1), 3.

Korhonen, R. (2005). *Pedagoginen draamaleikki kuusivuotiaiden esiopetuksessa. Opettajien kokemuksia draamaleikistä lasten oppimis- ja opetustilanteissa [Pedagogical drama play in the six-year-old kids' preschool education: Teacher's experiences about drama play at the children's learning and teaching situation]*. Annales Universitatis

Turkuensis C 224. Turku, Finland: University of Turku.

Korkman, M. (1997). Lurian menetelmän soveltaminen lapsiin: NEPSY-testistön kehittäminen. [The application of Luria's method to children: the development of NEPSY-test]. In T. Ahonen, T. Korhonen, T. Riita, M. Korkman, & H. Lyytinen (Eds.). *Aivot ja oppiminen. Kliinistä lasten neuropsykologiaa [Brain and learning. Children's clinical neuropsychology]* (pp. 52-72). Juva, Finland: WSOY.

Kuusela, J. (2000). *Tieteellisen paradigman mukaisen ajattelun kehittyminen peruskoulussa: kahden interventiomenetelmän vertaileva tutkimus peruskoulun kuudesluokkalaisilla [The development of thinking towards a scientific paradigm in the comprehensive school].* Helsinki, Finland: Department of Teacher Education, University of Helsinki.

Kyrö-Ämmälä, O. (2007). *Opettaja tiedonkäsittelytaitojen kuntouttajana alkuopetuksessa. Mixed methods -tutkimus oppimista tukevista harjoitteista ja opetusjärjestelyistä [The role of the teacher in improving cognitive skills at primary level. A mixed-methods study of exercises and teaching arrangements to support learning].* Acta Universitatis Lapponiensis 113. Rovaniemi, Finland: University of Lapland.

Lidz, C. S. (1987). Cognitive deficiencies revisited. In C. S. Lidz (Ed.). *Dynamic assessment: an interactional approach to evaluating learning potential* (pp. 444-475). New York: Guilford.

Lindqvist, G. (1998). Leikin mahdollisuudet. Luovaa leikkipedagogiikkaa päiväkotiin ja kouluun [The possibilities of play. Creative play pedagogy to nursery school and school]. Jyväskylä, Finland: Finnish Institute for Educational Research.

Lyytinen, H. (1999). Esipuhe. [Forewords]. *NMI-Bulletin.* 9 (1), 1.

Lyytinen, P. (1995). Lapsen kielen ja kommunikointitaitojen kehitys [The development of a child's language and communication skills]. In P. Lyytinen, M. Korkiakangas, & H. Lyytinen (Eds.). *Näkökulmia kehityspsykologiaan: Kehitys kontekstissaan. [The perspectives to the developmental psychology: the development in its context]* (pp. 105-121). Porvoo, Finland: WSOY.

McGuinness, C. (1999). From Thinking Skills to Thinking Classrooms. Research Brief No 115. Department for Education and Employment. [Online] Available: www.dfes.gov.uk/research/data/uploadfiles/RB115.doc (August 2, 2006)

Miettinen, R. (1990). *Koulun muuttamisen mahdollisuudesta [About the possibility of changing school].* Helsinki, Finland: Gaudeamus.

Munter, H. (1995). Minä muiden kanssa: minuuden sosiaalinen synty. [I with the others: the emergence of identity] In P. Lyytinen, M. Korkiakangas, & H. Lyytinen (Eds.). *Näkökulmia kehityspsykologiaan. Kehitys kontekstissaan [The perspectives to the developmental psychology: the development in his context]* (pp. 240-247). Porvoo, Finland: WSOY.

Nurmi, J.-E., Aunola, K., & Onatsu-Arvilommi, T. (2001). Työskentelytavat oppimisvaikeuksien selittäjinä [The working methods as interpreters of learning difficulties]. *Psykologia [Psychology]*, 36 (1-2), 68-73.

Näätänen, M. (2001). Unkarilaisesta matematiikan opetuksesta Suomessa ja Englannissa [About Hungarian math teaching in Finland and England]. *Matematiikka lehti Solmu [Math journal Knot].* 6 (2), 14-19.

Oksanen, E. (2001). Tarkkaavaiseksi oppijaksi ohjaavalla opetustyylillä [To become attentive learner by using mediated teaching style]. In *EriKa - Erityisopetuksen tutkimus- ja menetelmätieto 3 [Research and method of special needs education 3]* (pp. 25-26). Jyväskylä, Finland: University of Jyväskylä, Center for In-service Education.

Piaget, J. (1972). Development and learning. In C. Lavatelli, & F. Stendler (Eds.). *Readings on child behaviour and development* (3rd ed.) (pp. 38–46). New York: Harcourt Brace Jovanovich.

Piaget, J. (1977). *The development of thought. Equilibration of cognitive structures.* Oxford: Basil Blackwell.

Piaget, J. (1985). *The equilibrium of cognitive structures: the central problem of intellectual development.* Chicago: University of Chicago Press.

Piaget, J. (1988). *Lapsi maailmansa rakentajana [A child as a constructor of his own world].* Porvoo, Finland: WSOY.

Pietilä, M. (2005). Leikki psykomotorisessa ryhmäkuntoutuksessa [Play at the psychomotoric group rehabilitation]. In P. Rintala, T. Ahonen, M. Cantell, & A. Nissinen (Eds.). *Liiku ja opi: Liikunnasta apua oppimisvaikeuksiin [Exercise and learn: Physical exercise as a help to the learning difficulties]* (pp.   93-105). Keuruu, Finland: PS-publication.

Prashnig, B. (1997). *Eläköön erilaisuus. Oppimisen vallankumous käytännössä [Long live diversity: the revolution of*

learning in practice]. Jyväskylä, Finland: Atena-publication.

Pulkkinen, L. (1999). Unohdettu keskilapsuus? [Forgotten Middle Childhood?]. *NMI-Bulletin*. 9 (1), 3-8.

Sahi, S. (2006). *Neuro Linguistic Program oppimisen ja opettamisen menetelmänä. Fenomenografinen analyysi kuusamolaisten nuorten "mielen kielellinen ohjaaminen" -sovellukselle antamista merkityksistä tupakkavalistuksessa. [Neuro linguistic Programming -a method for the teacher and the educator].* Acta Universitatis Lapponiensis 99. Rovaniemi, Finland: University of Lapland.

Sahlberg, P. (1996). *Kuka auttaisi opettajaa-post-moderni näkökulma opetuksen muutokseen yhden kehittämisprojektin valossa [Who would help the teacher – the post modern perspective to the change of teaching in the certain development project].* Jyväskylä Studies in Education, Psychology and Social Research, 119. Jyväskylä, Finland: University of Jyväskylä.

Schipper, E. J., Riksen-Walraven, J. M., & Geurts, S. A. E. (2006). Effects of child-caregiver ratio on the interactions between caregivers and children in child-care centers: An experimental study. *Child Development*. 77 (4), 861–874. doi:10.1111/j.1467-8624.2006.00907.x, http://dx.doi.org/10.1111/j.1467-8624.2006.00907.x.

Silvén, M. (1990). *Miten hyödynnän metakognitioita lukemisen opetuksessa? Ymmärtämis- ja oppimistaidon kehittämisohjelma. [How do I exploit meta cognition in teaching of reading? A program for developing reasoning and learning skills].* Psychological Research 87. Turku, Finland: University of Turku.

Swizky, H. N., & Haywood, H. C. (1984). A biosocial ecological perspective on mental retardation. In N. S. Endler, & J. McV. Hunt (Eds.). *Personality and the behavioral disorders* (pp. 858–869). New York: Wiley.

The National Board of Education. (2006). Suomen koulutusjärjestelmä: Perusopetus [The Finnish education system: comprehensive school]. [Online] Available: http://www.oph.fi/page.asp?path=1,438,4171,4198 (July 25, 2006)

Tribus, M. (2006). Bridging in both directions. [Online] Available: http://www.icelp.org/files/research/Bridging.pdf (August 6, 2006)

Tzuriel, D. (1991). Cognitive modifiability, mediated learning experience and affective-motivational processes: A transactional approach. In R. Feuerstein, P. Klein, & A. Tannenbaum (Eds.). *Mediated learning experience (MLE): Theoretical, psychosocial and learning implications* (pp. 95–120). London: Freund Publishing House.

Tzuriel, D. (2001). *Dynamic assessment of young children.* USA: Springer.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1981). The genesis of higher mental functions. In J. V. Wertsch (Ed.). *The concept of activity in soviet psychology* (pp. 144-188). New York: Sharpe.

Vygotski, L. S. (1982). *Ajattelu ja kieli [Thought and language].* Espoo, Finland: Weilin & Göös.

Väkevä, L. (2004). *Kasvatuksen taide ja taidekasvatus: Estetiikan ja taidekasvatuksen merkitys John Deweyn naturalistisessa pragmatismissa [Educational art and art education: The significance of aesthetics and art education in the naturalistic pragmatism of John Dewey].* Acta Universitatis Ouluensis Scientiae Rerum Socialium E 68. Oulu, Finland: University of Oulu.

Wagele, E. (1997). *Yhdeksän erilaista oppijaa. Enneagrammi kasvattajan ja opettajan oppaana [The 9 types of children and how to raise them successfully].* Jyväskylä, Finland: Atena-publication.

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1999). What Helps Students Learn? *Educational Leadership*. 51(4), 74-79.

Wilhelm, J. D., Baker, T. N., & Dube, J. (2001). *Strategic reading: Guiding students to lifelong literacy.* New Hampshire, USA: Heinemann.

Wilson, V. (2000). Can thinking skills be taught? A paper for discussion. [Online] Available: http://www.scre.ac.uk/scot-research/thinking/#Anchor-33869 (July 1, 2006)

Äystö, S., & Das, J. P. (1995). *Älykkyyden PASS-teoria: Kuntouttavan harjaannuttamisen periaatteet [PASS-theory of intelligence: The principles of rehabilitation training].* Helsinki, Finland: The Finnish Association on Intellectual and Developmental Disabilities (FAIDD).
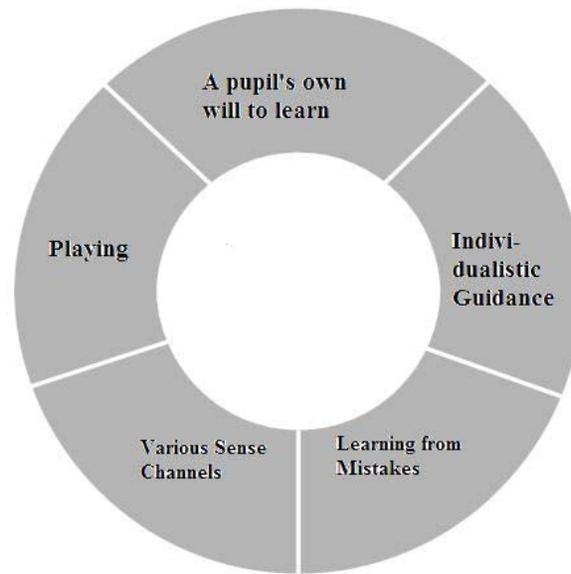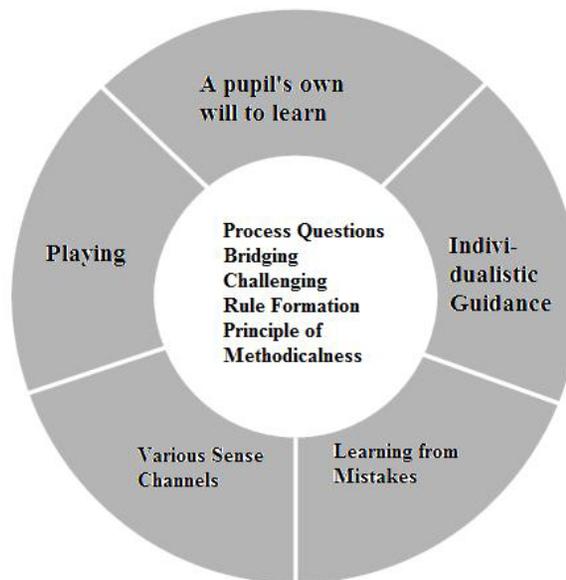
Figure 1. The Pedagogical Basic Prerequisites of the Cognitive Remediation

Figure 2. The Core Functions of the Cognitive Remediation