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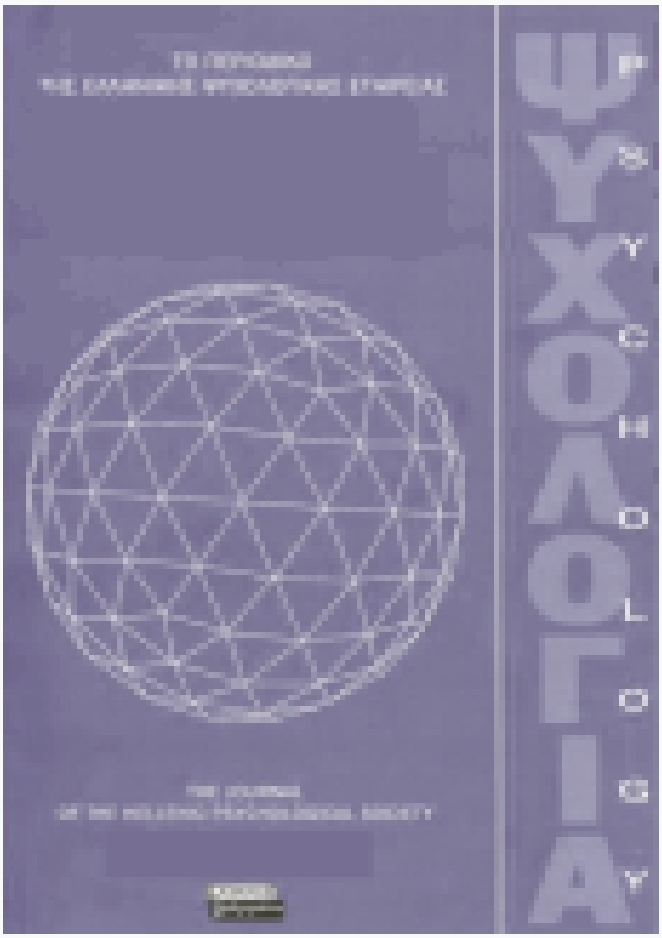

Teaching thinking: Programmes and evaluation

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Teaching thinking: Programmes and evaluation

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ABSTRACT At present, the systematic teaching of thinking skills is considered important. This need is created by the rapid changes taking place in today's society. Knowledge is becoming ever more complex and soon becomes dated. Furthermore, it is almost impossible to take in all new information, to assess, process amd retain it. Children therefore should be equiped with the skills of evaluating and arguing choices, and identifying and solving problems by way of logical reasoning. It means that it is not enough just to have a considerable amount of knowledge at one's disposal, the question of efficient ways of acquiring knowledge and its effective application is also important. Besides, it is claimed that a limited command of thinking skills is one of the reasons for falling behind at school. This means that teaching thinking skills should form an integral part of the school curriculum because stimulation of such skills should have a beneficial influence on school performance. This article presents the results of an inventory of European programmes for teaching thinking. Some relevant trends in teaching thinking in Europe will be discussed and proposals for the classification of programmes into categories will be presented. A tentative evaluation of theoretical and methodological issues will be presented.

Key words: Teaching thinking, teaching thinking programmes, thinking skills.

Introduction

In the history of education there has never been so much interest in the teaching of thinking to children. The need for teaching, stimulating or training of thinking is, according to Resnick (1987), a consequence of the rapid changes taking place in today's society. The amount of knowledge and the quantity of new information has increased enormously. Besides, information gets out of date quickly. Therefore, it is almost impossible to take in all new information effectively, to assess, process and retain it. That is why children should be equipped with possibilities to consider and substantiate choices and to identify and resolve problems by logical reasoning.

A second reason for more emphasis on teaching thinking comes from the notion that a limited command of thinking skills is one of the reasons for falling behind at school (Halpern, 1992; Resnick & Klopfer, 1989). In arithmetic, comprehensive reading and composition all kinds of activities occur in which these skills play an important role. Examples of these activities are: being able to describe and compare objects, classifying objects, making connections, conceptualising and generalising. Considered from this point of view, thinking skills are not limited to "higher order" cognitive skills, but also play an important role in the traditional school subjects. This means that stimulation of these skills should form an integral part of the curriculum of primary and secondary school.

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This issue of adjustment or innovation of educational aims is an actual topic in education (e.g., Adey & Shayer, 1994; Hamers, Van Luit, & Chapo, 1999; Demetriou, Shayer, & Efklides, 1992). However, the realisation of these aims is not simple. The reason is, that too many questions are still not, or insufficiently, answered. For instance: What is thinking? Are we able to teach children to think? Which thinking skills can be assessed? Thinking is partly the result of an autonomous process in the development of children. The question that arises from this fact is: What is left to be taught? Which part of behavioural changes in children can be attributed to spontaneous "development" and which part to "learning"?

Generally, in education no attention is paid to explicit stimulation of thinking skills and there is no such thing as a school subject called "thinking" or "stimulation of thinking". Usually educators assume that thinking skills develop spontaneously as a by-product of the teaching of the regular school subjects. Nowadays, the current view is that this assumption is only partly true (Resnick, 1987). Deprived children and children with learning difficulties could benefit from explicit stimulation of thinking and children not belonging to problem groups should learn to think more efficiently.

In the United States many proposals are made to explicit stimulation of thinking and a variety of general and specific programmes have been developed and described (Chipman, Siegel, & Glaser, 1985; Costa, 1991; Nickerson, Perkins, & Smith, 1985). In the United Kingdom Coles and Robinson (1991), Fisher (1990), Nisbet and Davies (1990) and McGuinness and Nisbet (1991) have published reviews of (mainly) British programmes. Hamers and Overtoom (1997) have published an inventory of programmes as well, but extended the field of research by including a greater part of Europe in their inventory (see Appendix). These programmes and methods appear to be of diverging theoretical orientation: Vygotskyan, neo-Piagetian and from the ´ direction of information processing. Furthermore, the range of themes is wide: programmes for training general reasoning skills, critical thinking, problem solving, memory, comprehensive reading, composition, arithmetic and subjects of secondary education such as science.

In this article we will describe some theoretical and practical trends in the research of the stimulation of thinking. The basis of this article is the inventory of programmes of teaching thinking by Hamers and Overtoom (1997). In the next paragraphs we will go into some theories about thinking and the teaching of thinking. We will also report about the carried out inventory, discuss some programmes and give a number of conclusions and subjects of discussion.

Theories of learning and thinking

Although the need for more explicit teaching of thinking is acknowledged, no agreement and clarity exists concerning the most effective ways to teach thinking. Thinking is a broad and relatively abstract concept that is being discussed and defined in many different ways. This fact is reflected in the prorammes and methods of the inventory that shows clear differences. Figure 1 shows a global schematisation of these theories.

The most well-known theory of thinking is Piget's rationalism or universal-constructivism. According to this theory the development of thinking in children progresses according to successive, discrete stages.Thinking in a certain stage is qualitatively different from the thinking in the previous or next stage. Piaget sees development as the emergence of new structures of knowledge or schemas and as the transformation and refinement of these schemas. The result is equilibration, the attainment of balance between the schemas and the environment. On this principle Piaget's classification into stages of development is based. The four stages distinguished -the sensori-motor, the pre-operational, the concrete-operational and the formal-operational stage- are always passed through in the same order and

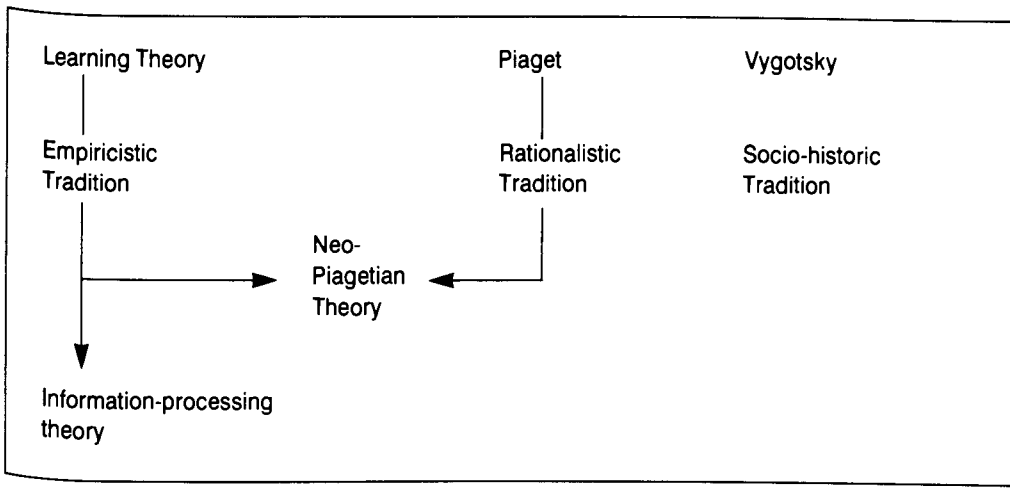

Figure 1
Theories underlying (most of) the programmes

they are seen as universal. In the neo-Piagetian option the issue of universality of developmental stages is dropped. Partly as a consequence of the learning theory the possibility of stimulating thinking is being studied, as well as breaking through the stages and establishing larger individual differences in cognitive schemas. Case (1985) integrates Piaget's theory with the information-processing theory. By learning or training, children will become more skilled in the processing of information. This means that they are increasingly able, and sooner than Piaget assumed, to perform cognitive operations. In this way the learning environment plays a more balanced part in development. It makes development more heterogeneous.

The socio-historic theory of Vygotsky is primarily a learning theory and from this point of view applies to learning to think. Vygotsky values the interaction between parents and children throughout their development. A central concept in his theory is the so-called Zone of Proximal Development (ZPD). This zone refers to the difference in what a child can accomplish on its own and what it might be able to perform with the help of competent others. With this help the child can reach a higher level of development. In this process language plays an important role. The first words of children are communicative actions that shape the interactions with others. According to Vygotsky, during the first two years of life the development of language and thinking occur following more or less parallel, relatively separate lines. About the age of two a fundamental change takes place in the relation between language and thinking. Thinking becomes verbal. By way of thinking, language originates but subsequently language fosters a further development of thinking.

In the learning theory (information processing), characteristic learning processes that occur between the input and output of information processing are determined. Research is carried out on cognitive processes involved in the perception, storing, memorising and application of information. Duijker (1977) describes the concept of thinking as follows: "Thinking denotes for psychology a coherent complex of specific theoretical problems, dealing with the complexity of the information processing activities (what de they consist of and how are they controlled?) and with the roles these representations of information play (how are they established, what is their nature and structure?).

Cognitive psychology mainly occupies itself with problem solving, which means that activity of information processing in which the subject tries to find an answer to a question that is difficult for him" (p. 89). The central concepts in this quotation are: information processing, representations and problem solving. In today's cognitive psychology these concepts are crucial. In the information processing theory much attention is paid to incorrect and inefficient thinking. These evaluations of the thinking processes are considered as essential and useful in improving thinking. Especially differences in the use of control mechanisms or metacognition and in the speed of the processing of information account for differences in the development of information processing activities. One of the central questions is how metacognition can be guided or influenced (Boekaerts & Simons, 1993).

A fourth theory that receives attention, nowadays, is the so-called constuctivism (Boekaerts & Simons, 1993; Phye, 1997). This theory is a variant of the information processing theory and emphasizes more strongly that learning is an active constructive process. Learning is good only if the student himself is actively involved in the subject matter. The art of learning is to connect new information to existing knowledge. This active connecting process consists of involving all kinds of foreknowledge in the construction of new representations of information. Because each individual has other experiences and other foreknowledge, these new representations are unique. Possibilities are sought to facilitate the active, constructive learning in so-called "rich learning environment" by, for instance, involving modern technologies.

The aforementioned learning and thinking theories put emphasis on learning (information processing theory, constructivism), on the *development of thinking* (Piaget) or on *both* (Vygotsky). Especially the views of Piaget and Vygotsky are often compared. In general it can be stated that both agree on the order in which thinking develops: from concrete actions through growing reflection to abstraction. There are also important differences. Piaget emphasises the universal nature of development which leads to a certain pedagogical or educational pessimism. In his view development leads to learning. Vygotsky, on the other hand, stresses the importance of learning and education: learning leads to development. An important statement of Vygotsky was (in Van der Veer & Valsiner, 1991): "The school-child has to learn to transform an ability «itself into an ability» for «himself»" (p. 331). An example to illustrate this is the following. Potentially a child has the possibility to come from spoken to written language, but education has the aim to clarify the relation between both modalities by identifying sounds, analysing them and changing them into abstract signs.

In "teaching thinking" the various theories mentioned in Figure 1 come together, they are compatible and complementary (Sternberg & Berg, 1992). They all contribute in their own specific way to understanding and optimalising learning conditions for the teachiing of thinking.

Teaching thinking and thinking tasks

A general aim for designers of methods to stimulate thinking is, among others, children to become more efficient thinkers by gaining insight in their own thinking processes and, by actively guiding these processes. An important tool to reach this goal is "reflection", which means inciting to "thinking about thinking" or metacognition (Boekaerts & Simons, 1993): "People possess, to a greater or smaller extent, knowledge of (the functioning of) their own cognitive system. This knowledge may refer to their own thinking, memory, fantasy, reasoning, etc., and to those of others..." (p. 88-89). In general, it is assumed that people possessing relatively much metacognitive knowledge are better able to guide and improve their thinking.

As mentioned earlier, especially in the United States, many programmes to stimulate or train thinking have been published (Costa, 1991; Chipman et al., 1985; Nickerson et al., 1985). In Europe the subject is not yet that widespread but of older age. Important impulses from the past

come from the Wuerzburger School (Kuelpe, Selz) and from gestalt psychology (Wertheimer, Duncker, Maier). Selz (1935), for instance, studied inductive reasoning. His basic assumption was that the thinking process consists of the application of structuralising thinking schemas that define the course of the thinking process by their solution-oriented character. From this starting point, Selz considered it possible to bring human intelligence on a higher level of functioning by providing the necessary means. In his opinion, the application of problem solving methods can be trained. In his experiments "Versuche zur Hebung des Intelligenzniveaus" (Attempt to raise the intelligence level) he worked according to the principle of the "kleinstmoegliche Hilfe" (minimal help), in contemporary terms the heuriistic problem-solving method.

An important question is how human thinking proceeds and what limits it. If we regard thinking as a mental activity that must meet certain demands, we are able to distinguish less good or inefficient thinking. To answer the question about which demands we are talking, one could be informed by philosophy and especially by logic. Logic provides a certain amount of thinking rules that are true or not true, despite the meaning or contents to which the rules are applied. An example of a thinking rule is a syllogism or deduction: All A are B, all B are C, so all A are C. However, the actual thinking of people not always proceeds according to the rules of logic, but the result may be judged by these rules (De Koning & Hamers, 1999).

In the process of designing programmes for teaching thinking the choice of tasks is of great importance. There are many kinds of tasks. Some demand almost only motor activity, others more mental or thinking activity, like in analogies (for instance, lawyer : client=doctor : ...), completing series (for instance, 2, 6, 11, 17, ...) and classifying (for instance, What does not belong here: cat, dog, elephant, guinea pig?). Cognitive psychologists have tried to describe and analyse characteristic difficulties and processes of these and other thinking tasks. The most well-known classification of tasks or problem types is the one Guilford designed (1956). Guilford constructed a division of tasks from three starting points: a) the contents of the thinking task or the nature of the material that has to be worked with; b) the actions (operations) that have to be performed; c) the result or product of the actions. In this option a problem of analogy like "leg : knee=arm : ..." could be characterised as convergent thinking (operation), as semantic (concerning the contents) and as relation (product). Particularly in the field of inductive rasoning many new tasks have been added and investigated (Jacobs & Vandeventer, 1972). Jacobs and Vandeventer taught subjects to solve so-called double classification tasks. These tasks consist of a 2 by 2 or a 3 by 3 matrix, in which figures are presented that vary horizontally and vertically and in which the figure below right is omitted. The tasks belong to what Guilford (1956) calls the Cognition of Figural Relation in his Structure of Intellect (SI) model. During the last decades many new tasks have been developed and examined (e.g., Sternberg, 1985; Vosniadou & Ortony, 1989).

Classification of programmes

As stated before, thinking is theoretically approached in different ways. Theoretical starting points have implications for the construction of a programme. A logical conclusion is that there is no such thing as one kind of stimulation for thinking. Furthermore, a discussion is going on concerning the question whether thinking skills apply to all domains of the school curriculum or are specific to special school subjects (domain-specific). This discussion has resulted in two approaches (Maclure & Davies, 1991): 1) the *general approach* with separate courses for teaching thinking; 2) the *specific approach* with integrated courses, which means that the thinking skills are embedded in the school subjects.

In the first approach the basic assumption is that thinking skills can be taught explicitly and independently of the regular school curriculum

(the "skills" or "across-the-curriculum" approach). In this vision there exist certain more or less universal thinking skills that can be generalised towards the school subjects. A prerequisite for the occurance of a positive effect on, for instance, reading, writing and arithmetic is that during the training a "bridge" is laid between both. These general thinking skills are mostly trained with content-poor tasks (see Figure 2). The question in this case is: In which of the four squares would fit best the figure on the right?

Elsewhere (Hamers & Overtoom, 1997) this approach is discussed in the light of educational aims and denoted as such: Programmes of the General Aims Approach (see Appendix).

In the second approach the assumption is that thinking skills should best be taught embedded in the school subjects (the "infusion" or "within-the-curriculum" approach). Thinking skills are being taught in specific or "content-rich" domains like reading, writing and science. The following text is an example of this approach.

The zoo

The teacher visited the zoo with the pupils of the third grade. The children were very glad. Most of all the crocodiles attracted their attention in this wonderful zoo. How big they were! The elephants were funny. With their long trunks they sprayed each other. And then those beautiful birds in all kinds of colours ..., etc.

At the end of this reading lesson the teacher will categorize the animals from the story into, for instance, land animals, winged animals and water animals. In this text the same processes are involved as in Figure 2.

This integrated mode of operation requires fundamental changes in content and presentation of the subject matter. Examples of this approach can be found in arithmetic, comprehensive reading and text composition (see Appendix). In the Netherlands in this context several programmes for reading comprehension have been developed (De Koning & Hamers,

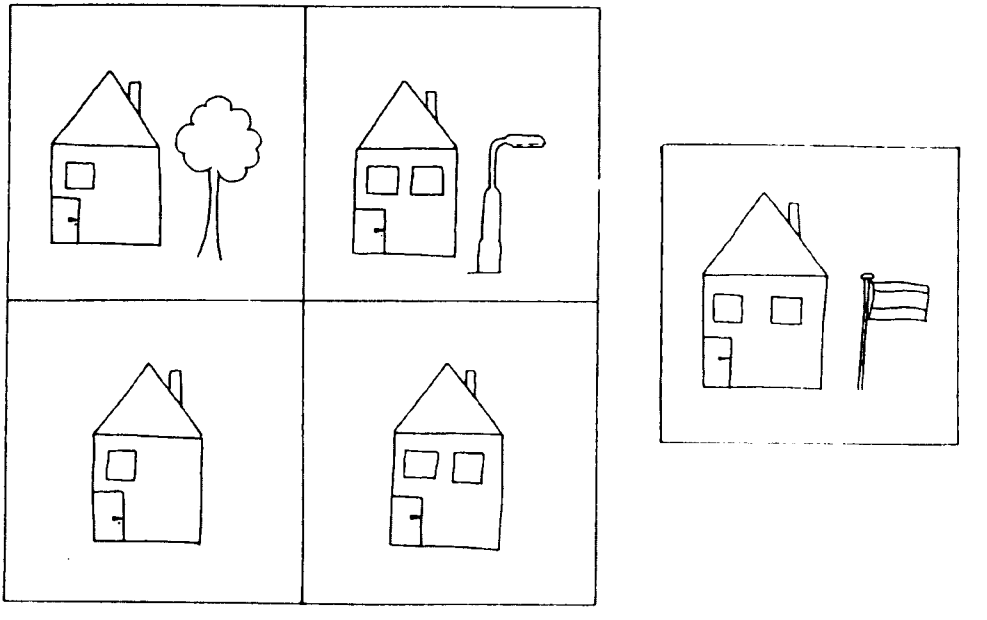

Figure 2
Example of a content-poor item (test item of De Konig, Hamers, & Sijtsma, 1996)

1997; Werkgroep Bol, 1988). For example, in the programme of De Koning and Hamers (1997) texts are used in which thinking operations are brought up like classifying (grouping on the basis of attributes of objects in the text) and seriation (the formation of a logical sequence on the basis of, for instance, cause-effect relations in the text).

Considering the existing educational aims, these and other programmes are called Programmes of the Specific Aims Approach in the Appendix (see also Hamers & Overtoom, 1997). This last category is divided in two types of programmes, namely *Infused 1*: Thinking skills aplied in one school subject and, *Infused 2:* Thinking skills applied in more than one school subject.

The basic idea of both approaches is illustrated in Figure 3. The figure shows that we presume a relation between academic skills and general functions like language, perception, sensori-motor skills, memory and thinking. Considered from the point of view of thinking (or one of the other functions), the current opinion is that general thinking skills should be trained in certain situations like falling behind in school, having learning problems, etc., in order to solve problems or stimulate people to think more effectively. Considered from the viewpoint of school subjects, the idea is that thinking skills can and should not be seen as separate from the relevant contents of reading, writing and arithmetic. Opinions differ greatly on this matter. Advocates of the first approach are of the opinion that weak students might be overloaded when they have to learn at the same time the contents of the school subjects as well as thinking skills. Advocates of the second approach, however, hold the view that teaching thinking programmes should be embedded in the school subjects because a great number of these skills are content-specific and are not easily transfered to other content domains. We are of the opinion that specific programmes are referable to general programmes, unless the students have great difficulty with the domain contents.

A further differentiation and more specified categorisation of programmes can be found in Nickerson et al. (1985). These authors propose five approaches:

a. *Cognitive operations approach.* In this approach it is assumed that thinking problems are caused by an insufficient mastering of basic operations like classification and seriation. The training programmes in this approach might be suitable especially for the weaker students that do not master these operations yet (e.g., in the Appendix the programmes of Klauer and Hamers & De Koning).

b. *Heuristic approach.* In this approach all kinds of problem-solving operations are taught like problem analysis, planning, representation and verification. The essence of this approach is the task analysis in which a task is split up into manageable part-tasks. After the analysis attempts are made to improve the performance of a person on the part-tasks by training the mentioned problem-solving strategies and by involving metacognitive skills (in the Appendix several programmes).

c. *The formal thinking approach.* In this approach the starting point is the (neo)Piagetian theory. The programmes aim at effectuating the transitions between the different stages, for example between the concrete-operational and the formal-operational stage. A characteristic of this approach is the integration of thinking operations into school subjects like sciences (e.g., in the Appendix the programme of Adey).

d. *Thinking as manipulation with language and other symbols.* In this approach teachers stimulate the use of thinking skills by means of the regular school subjects (e.g., in the Appendix the programmes of the Specific Aims Approach).

e. *Thinking about thinking (metacognition).* In this approach it is assumed that a better understanding of the nature of one's own thinking process will improve one's competence in thinking. Students are stimulated to think about thinking in general and to become more aware of one's own thinking processes (in the Appendix several programmes).

There exists an overlap among the five approaches. For instance, in the last mentioned approach (e) heuristics (b) are being used, and in

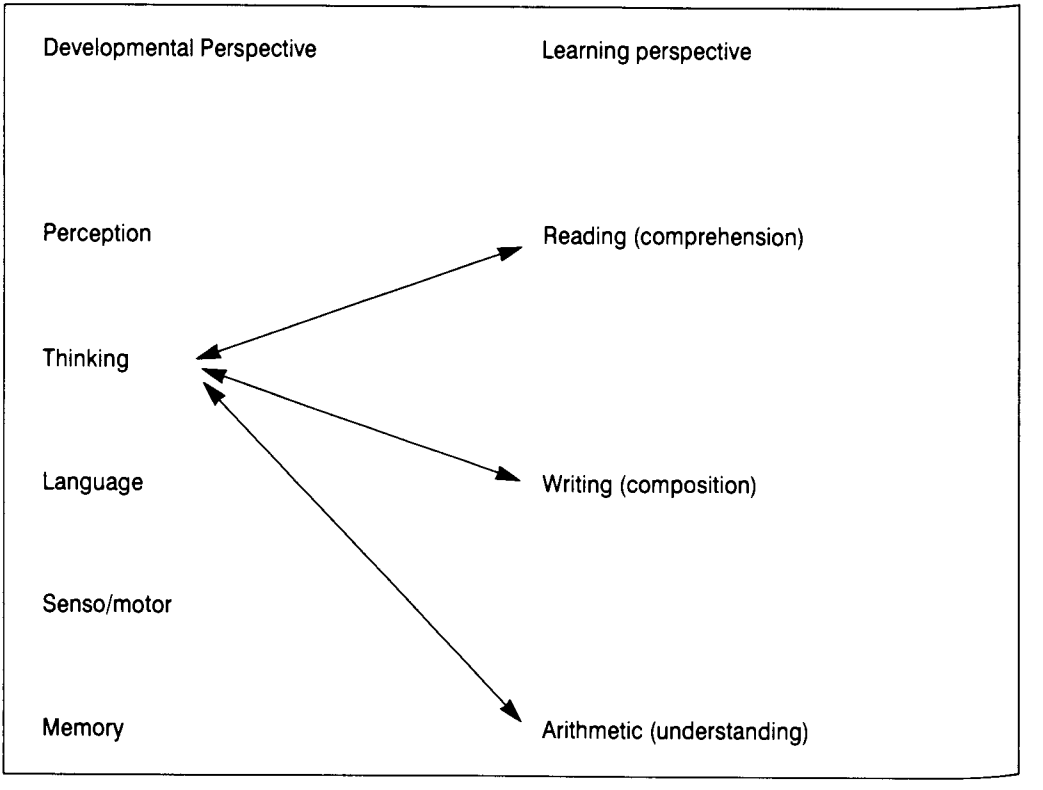

Figure 3
The relation between (among others) thinking and some school subjects

thinking through the curriculum content (d) are various elements of the other approaches. Besides, none of the mentioned approaches is superior to others. And lastly, within the different approaches the quality of the programme is diverse.

Transfer of knowledge and skills

Transfer can be regarded as the ultimate object of education. The belief in the possibility of transfer is implicit in the very existence of the institute of school itself and in the proposition that whatever might be learned at school can be of use in the life outside school. A "transfered" skill plus knowledge is called [4]competence". Learning in general, and learning to think specifically, in this vision take place as follows. We teach children to solve a certain problem by using available knowledge and strategies, The child has learned a skill. If children are able to apply this skill in a relatively new situation, we call it competence. In short, intellectual skills refer to specific strategies for problem solving. They activate the cognitive processes of (re)organisation of information in order to solve the problem. Intellectual competence refers to situations in which a person is able to apply this specific knowledge and strategies on a new problem (transfer). For instance, the person is able to (re)organise the problem and to identify which information is appropriate.

Various kinds of transfer can be distinguished (Simons & Verschaffel, 1992). One

of the most well known distinctions is the one between the so-called "near" and "far" transfer. Near transfer means that a skill is learned in a certain context and applied in a quite similar situation. The distinctive features of the transfer task show great resemblance with those of the original task. For instance: the use of the alphabet when looking up a word in a dictionary. Far transfer refers to the application of skills in an essentially different context. For example: compare in this chapter Figure 2 and the reading text "The Zoo". In both tasks the same processess for solving are found, but they are introduced in completely different contexts. Far transfer is taking place when someone spontaneously applies the processes learned in Figure 2 to the reading text.

Discussion end evaluation

Hamers and Overtoom (1997) invited about 150 scholars in the teaching thinking field in Europe to take part in the inventory. Eventually 42 programmes have been described, some diagnostic procedures and several non-European programmes that are applied in Europe included (see Appendix). The general aim of the inventory was to offer schools, teachers, school advisory services and others a helping hand when they are about to choose a programme for teaching thinking. The inventory is best regarded as a source of information in which: a) all programmes are shortly summarised; b) is indicated for which target group the programmes are suitable; c) the theoretical assumptions of the programmes are discussed; d) evaluative studies are given; e) names and addresses of the authors and publishers are provided. The inventory can be looked upon as an illustration of what is being undertaken in Europe concerning teaching thinking.

Stimulation of thinking is an important subject since the criticism on and reinterpretation of Piaget's theory on the development of thinking (e.g., Brown & Desforges, 1979). This criticism was concetrated on the supposed limitation of the reasoning and abstract thinking capacity in children. It should be possible to train or remediate thinking (Sternberg, 1984) and, it is claimed that children with an apparent limited capacity should process more potential (Hamers, Sijtsma, & Ruijssenaars, 1993). One could wonder if this potential indeed could be reached or exploited by goal-oriented training. Opinions differ on that matter. We refer to the nature-nurture debate about thinking in which the question whether intelligence should be regarded as innate or acquired is disputed. Intelligence could be defined as the raw intellectual power of a human being and thinking as the "skilful" use of that power. In other words, thinking is about how people use their intelligence, what they actually do with it. It should be possible to stimulate thinking to a certain height (that we call potential). If a child has been able to experience enough stimulation it should be able to reach that potential. In the absence of experience the child will underachieve. Programmes for the teaching of thinking are being exerted to compensate the lack of experience or remediate it.

The categorisation in general and specific programmes and the preference for either category is subject of discussion. Arguments for the use of general programmes are that they give children and their teachers a clear view on thinking skills and the possibility to evaluate them apart. Arguments for the use of specific programmes are that they do not require a special course, that relevant knowledge is being applied and that the thinking skills can be enbedded in the broad context of the school curriculum. Both approaches include certain risks. The teaching of thinking with general, content-poor tasks might lead to a deficiency in relating the learned skills spontaneously to situations where they are appropriate. The teaching of thinking skills with specific, content-rich tasks might lead to the impossibility of children to detach or abstract the learned skills from the situation in order to transfer them to other contexts. Possibly the best programme will

consist of a synthesis or an alternation of both approaches in which the thinking skills are labeled explicitly as useful means in diverging general and specific contexts.

The teacher plays a crucial role in the implementation of programmes to stimulate thinking and a new look at instruction has to be developed. Specified interactions between students and teachers should make students more active participants in the learning process, for instance by creating new modes of cooperation and by role changes between students and teachers. We too think (Hamers, De Koning, & Sijtsma, in press) that implementation of these programmes requires a drastic reorganisation of the way the teacher teaches. The teacher will need at his disposal a greater variety of didactic strategies and he must have mastered them (process-oriented versus product-oriented teaching; thinking aloud; teaching in dialogue form; algorithmic versus heuristic; reciprocal teaching; stimulating reflection on one's own thinking, etc.).

Nickerson et al. (1985) state that certain criteria have to be met if we want the teaching of thinking to be successful. According to them the most important conditions are: acceptance of the programme by the teacher, formulation of targets, instruction and evaluation procedures, spending enough time on a task, training of transfer, creating favourable classroom conditions and working towards intrinsic motivation. In order to make the right choice among the various programmes the authors give, among others, the following recommendations: a) formulate clear targets; b) choose a programme that aims explicitly on training the intended skill. Do not expect other skills than the trained one to develop; c) choose a programme with clear theoretical assumptions; d) review carefully evaluation studies; e) think beforehand of how the programme is to be evaluated by the teacher himself, choose interesting tasks that satisfy the natural curiosity of the students and show a clear connection with school and daily life; f) adjust the targets to the level of knowledge and the skills of the students; g) give the students feedback concerning content, explaining what was right or wrong and how they might handle the task differently; h) discourage the simplifying good/fault thinking. There might be interesting reasons for making mistakes. Utilize faults as learning possibilities; i) pay attention that general problem-solving skills will be trained in various contexts. Let the students themselves think of situations to apply them; j) find ways to connect the teaching of thinking to the content of the other school subjects.

If we look at the programmes in the Appendix in the light of some of Nickerson's (Nickerson et al., 1985) criteria we find the following. Six programmes aim at all groups of the primary school (which means children of 4-12 years old). Twelve programmes are designed for young children up to adults. Two programmes are meant for university students (Supplemental Instruction and Personal and Legal Skills by Guest). An example of a programme training in a very specific domain is Arithmetic Help for Toddlers by Van Luit and Van de Rijt. In a number of cases the programmes are meant for children that have fallen behind in certain areas.

In about 45% of the programmes we find one of the mentioned theoretical trends (Vygotskyan, neo-Piagetian and information processing theory). Constructivism forms the theoretical foundation in a single case (Promoting the Generation of Usable Knowledge by Neber). The programme Teaching and Learning to Think by Scheinin and Methaelaeinen is based on a so called epistemological theory, without making explicit what is understood to mean. In seventeen programmes we find a combination of two theoretical trends. The combination we find most (in six programmes) is the one with Piaget and Vygotsky. In seven programmes the theoretical basis is formed by three theoretical trends. One programme, Training Domain-Specific Abilities by Efklides is based on the neo-Piagetian and psychometric theory. The importance of metacognition is acknowledged in twelve programmes.

The programmes differ greatly in the investment expected from teachers concerning

training themselves and creating favorable classroom conditions in order to reach a transfer of knowledge and skills that is broad as possible. The programme designs vary from ready-made prescribed steps to follow, through training in special courses to advising how a teacher might be able to adjust matter to make it suitable for stimulation of thinking.

When we made this inventory we noticed that there is still little information available about programme effects. In other words, there is a need to effect studies executed according to prescribed methodological guidelines. In the effect studies mentioned in the inventory it appears that this is not always the case. In only six programmes we find a pretest-posttest design with a control group. In three descriptions of programmes long-term transfer is investigated by, for example, a follow up measurement. In 86% of the programmes no investigation is made of the reliability: Are the same effects measured when the programme is repeated under more or less equal conditions or under varying conditions? In nine cases a certain amount of far transfer, that is, transfer to situations and problems outside the context of intervention, occurs. When this happens, transfer takes place to tasks within the curriculum, to daily activities and to different ways of thinking that are not trained explicitly.

The preceding leads to the conclusion that a broad and promising movement is in progress in the field of stimulation of thinking, a young and (so far) theoretically diverse oriented discipline. The question of transfer is very important and deserves more profound research in order to obtain a clearer view on the way thinking skills might be used to as an instrument to be able to meet the demands of this modern time.

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Appendix

Programmes of the general aims approach

Almeida, L. S., & de Fatima Morais, M. (Portugal). *Promocao cognitiva: A Cognitive training programme for adolescents.*

Buechel, F. P., & Buechel, P. (Switzerland). DELV: *A metacognitive program for adolescents and adults.*

Chapman, J. (UK). *The MENO thinking skill service.*

Efklides, A. (Greece). *Training domain-specific abilities: The case of Experiential Structuralism.*

Fisher, R. (UK). *Stories of thinking.*

Guest, K. (UK). *Supplemental instruction.*

Hamers, J. H. M., & De Koning, E. (The Netherlands). *Inductive reasoning in the classroom.*

Klauer, K. J. (Germany). *Training of inductive reasoning: A developmental programme of higher order cognitive skills.*

Kovac-Cerovic, T. (Yugoslavia). *Cultivating metacognitive experience: Teaching thinking through educational workshop and games.*

Lake, M., & Needham, M. (UK). *The top ten thinking tactics.*

Lake, M., Fisher, F., & Carey, W. (UK). *The primary thinking skills project.*

Lebeer, J., & Sasson, D. (Belgium & Israel). *Instrumental enrichment.*

Mora, J. (Spain). *Comprehending and transforming.*

Murris, K. (UK). *Philosophical enquiry with picture books.*

ONeill, W. (UK). *A tool to think about thinking.*

Paour, J.-L. (France). *A method to induce the basis of inductive and analogical reasoning.*

Pennings, A. H., Boonman, J. H., & Erkens, G. (The Netherlands). *Creative thinking for children.*

Pollicina, C., Cobis, A., D' Amico, M., Tomasseti, P., & Luigi Gigli, G. (Italy). *The COT method for the induction of concrete operational thought.*

Resong, W., & Slenders, R. (The Netherlands). *Training inductive reasoning skills. Constructing a structural training procedure.*

Stawski, S., Seltser, R. M., & Seltser, A. N. (The Netherlands and Russia). *Tactics for thinking.*

Sydow, H., & Meincke, J. (Germany). *DenkMit: A programme for the stimulation of cognitive development in preschool age.*

Vizcarro, C., & Leon, J. A. (Spain). *Teaching and studying for learning.*

Warmez, J. (Belgium). *Bright start: Cognitive curriculum for young children.*

Programmes of the specific aims approach

Infused 1: Thinking skills applied in one school subject

Adey, P. (UK). *CASE: Cognitive acceleration through science education.*

Chanquoy, L. (France). *Thinking skills and composing assessment (and treatment) strategies for text revision.*

Guest, K. (UK). *Personal and legal skills.*

Hasemann, K. (Germany). *The use of concept maps for evaluating students' arithmetical understanding.*

Kuyk van, J. J. (The Netherlands). *Ordering.*

Luit van, J. E. H. (The Netherlands). *A special mathematics training programme for multiplication and division.*

Luit van, J. E. H., & Rijt van de, B. A. M. (The Netherlands). *Arithmetic help for toddlers: A specific programme for teaching arithmetic.*

Mannhaupt, G. (Germany). *Teaching monitoring strategies in early literacy acquisition.*

Nelissen, J. M. C., & Kraemer, J. M. (The Netherlands). *Stimulation of mathematical abilities of low achieving children.*

Paour, J.-L. (France). *TransMedia. A Multimedia environment to enhance reading comprehension skills.*

Infused 2: Thinking skills applied in more than one school subject

Csapo, B. (Hungary). *Operational enrichment: Improving operational reasoning through the content of teaching.*

Ivic, I., Pesikan, A. Jankovic, S., & Kijevcanin, S. (Yugoslavia). *Active learning.*

Matsagouras, E. (Greece). *Teaching thinking through the curriculum.*

Neber, H. (Germany). *Promoting the generation of usable knowledge.*

Salema, M. H. (Portugal). *At risk students and teaching and learning to think.*

Scheima, P. M., & Mehtaelaeinen, J. (Finland). *Teaching and learning to think. An epistemological approach.*

Steinert, I. (The Netherlands). *Learning subject languages in secondary education. Becoming an independent learner.*

Valente, M. O. (Spain). *Projecto DIANOIA: Learning to think.*

Van Hest, A. J. A., & Ruijters, M. C. P. (The Netherlands). *SMILE: Stimulating mediated interactions and learning experience.*