Theory and Practice of Training in Talented and Innovative Thinking in Schools

Part 1.

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Introduction

The concepts of innovation and innovative thinking today are amongst the key guiding concepts of education policies and practices in many countries and regions. Economic globalisation, increasing international competition and spread of the innovation-based strategies of competition in the business and public sphere, as well as fast technological change (e.g., advent of the 4th industrial revolution) are only few of many factors that make education policy makers, social partners and stakeholders, but foremost educational institutions and teachers to focus their attention to the innovations and innovative thinking in the learning and teaching practices.

Innovations and innovative thinking increasingly occupy the place of core objects of education and training processes and become the favourite objects and terms in the education strategies and policy documents. However, in many countries we can identify important gaps between the recognition of the strategic importance of innovations and innovative thinking for the present and future education from the one side and the implementation of the real practices and measures of development of innovative thinking in general education from the other side. It can be explained by referring to the different objective and subjective factors.

There can be noticed challenges in sustaining the needs of creative thinking in the period of implementation of innovations and innovative solutions, which is usually based on the standardisation approaches, what reduces the need of creative and original thinking. For example, the creation of innovations in the ICT sector has been followed by the spread of the “digital taylorism” which significantly reduced the complexity of work processes and lowered the demand of the high skills and creativity.

However, looking to the existing practices of education, the core challenges in the development of innovative thinking in the schools are related to the lack of methodological and didactical know-how on how to develop innovative thinking skills in the educational didactic processes. Despite of growing supply of the different methodical materials in this field in many countries, the problem of this shortage of know how remains important. Therefore this methodology aims to suggest systemic
theoretical and practical know-how on the education of talents and development of innovative thinking in the schools of general education.

Preparation of this methodology involved reviewing of the scientific literature and research-based materials as well as development of the methodical and practical recommendations on the different didactical, organisational and institutional issues of the education of innovative thinking in the general education.

The main target group of this methodology are teachers and educators working in the field of formal and non-formal education, the managers of educational establishments and experts involved in the curriculum design and development of the didactic materials.

Chapter one of the methodology “Are talents born or created?” discusses the question whether the process of becoming a talent is influenced more by nature and nurture. It discusses the concepts of intelligence, creativity, giftedness and talent by disclosing the components of these concepts and their main influencing factors.

Chapter two “Theories of Creativity and Creative Personality” presents the concept of creativity by referring to the context of education and reviews related theories of creativity. It also defines the main features of the creativity levels, provides the characteristics of a creative personality and discusses assumptions of creative education.

Chapter three “Existing model of talented thinking and its relation to innovative processes” explains the concepts of talent, thinking and creative thinking process. Afterwards it provides review of existing models of creative and innovative thinking concepts and indicates the essential principles of development of the innovative thinking skills. The chapter concludes with practical methodical recommendations for the development of innovative thinking skills.

Chapter four “Didactics of Talented Thinking” overviews the core didactic assumptions of development of creative thinking skills. This overview is followed by the presentation of the conceptual model of thinking areas and discussing of assumptions of the choice of didactic materials and teaching methods with provision and explanation of concrete examples and recommendations.

Chapter five "Methods with Wide Practical Application" is a short description of the so-called methods of creative thinking activation and TRIZ methodology (Theory of
Inventive Problem Solving). The methods of activation of creative thinking were the only methods with practical application in the first half of the 20th century. However, at the end of the century, it was clear that those methods helped to solve only comparatively simple problems, whereas TRIZ renders a possibility of solving even very complicated problems in a stable and safe way and provide a higher level of creativity.

Chapter six “Some Elements of the Theory of Talented Thinking” despite the modesty of it’s title provides very systemic and comprehensive introduction to the theory of talented thinking and it’s application in the practices of teaching and learning. This is one of the essential methodological and methodical contributions of this book for educators and researchers of the educational approaches to development of talented thinking.

Chapter seven “Problems of Educating 7-10 Year Old Children and Possibilities of Problem Solving”discusses the main typical problems of educating talented thinking of 7-10 year old children and suggests appropriate methodical solutions to these problems.

Chapter eight “Good examples and stories from teachers to develop talented thinking in classrooms” overviews the cases of testing of the exercises based on the above mentioned TRIZ method (Theory of Inventive Problem Solving) in two Estonian primary schools and three Latvian schools.
Chapter I.
Are talents born or created?

Viire Sepp

This chapter discusses the question whether the process of becoming a talent is influenced more by nature or by nurture.

Concepts of intelligence, creativity, giftedness and talent

Usually, when we speak of giftedness or talent, everybody has their own idea of what these concepts mean, or which characteristics or people are referred to. Such an implicit definition, i.e. a definition that is based on the individual’s (the deciding agent’s) own general experience, intuition or opinion, affects our perception and attitudes more often than we can imagine. A stereotypical approach is therefore very common, and this in turn spreads in the form of established myths. In the context of school or the educational system in a wider sense, the most wide-spread yet also the most dangerous myths are as follows: giftedness is manifested in any case – just like cream forms on milk; a gifted student is gifted in every field/everything; a gifted student gets top grades; a gifted student is a geek who has no interests other than studying and who cannot manage in everyday life, etc. This approach involves the danger that a great number of students potentially capable of outstanding achievements remain unnoticed and their development is not supported enough. Hence, it is important to first agree on terminology and familiarize ourselves with theoretical concepts, which also have an empirical science-based background.

Unfortunately, it is nearly impossible to provide an all-encompassing definition of giftedness. One can find dozens of different definitions, the differences between variations depending on the concepts or criteria that were taken as the basis for, or the purpose of, definition. For example, Sternberg and Zhang (2004) have found that giftedness can be defined by the following criteria:

- Excellence – the individual displays clearly better results in one or several fields compared to peers;
- Rarity – compared to peers, the individual has distinctively high attributes;
- Productivity – ability to achieve exceptional results or perform exceptional activities;
- Demonstrability – outstanding achievements in a field can be measured by valid metrics;
- Value – the individual expresses extraordinary potential in a domain that in the corresponding environment or culture is held in high regard.

Therefore, the concept of giftedness can be approached from the aspects of presumptions, results as well as (social) value, depending on when and for what purpose the definition is provided.

### Intelligence

When we speak of cognitive abilities, we cannot overlook the concept of intelligence. The most influential researchers of intelligence have agreed on the following definition: "**Intelligence** is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experience. It is not merely book-learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings, ’catching on’, ’making sense’ of things, or ’figuring out’ what to do", (Gottfredson, 1997). Intelligence is measured by the intelligence quotient IQ. Just like many other psychological attributes, IQ values are divided in society based on normal distribution, which is also referred to as Gaussian distribution or the “bell curve“. Intelligence tests are among the most common methods of defining giftedness based on the verification criterion. Usually, a standard group average is regarded as equal to 100 points and one standard deviation is 15 points. Those whose IQ differs from the standard group by 2 standard deviations (IQ ≥ 130) are regarded as highly intelligent. Approximately 98% of people receive a lower result. Tasks requiring mental effort or intelligence tests measure general mental ability, i.e. the g-factor, as well as specific ability attributable to a particular test type (such as verbal flow, mathematical skills, spatial imagination,
memory, etc.). It has been found that general ability affects the likelihood of solving all these specific tasks in a certain manner – a higher g-factor in a positive manner and a lower g-factor in a negative manner. In recent times, researchers have come to a common conclusion that the structure of intelligence is hierarchical: all activities requiring mental ability are based on general mental ability (g), which in turn has sub-facets that are mutually relatively independent. These sub-facets, however, do depend on the g-factor. Hierarchical models describe an individual’s cognitive abilities using three decreasing levels: general intelligence (g); broad abilities; specific abilities. Specific abilities, which are located on the lowest level, can be related to a narrow skill or area of knowledge (such as a specific job or profession). Ability groups of a more general nature are located on the broad ability level. For example, in J. Carroll’s model (1993), these were fluid intelligence, crystallized intelligence, general memory and learning, broad visual perception; broad auditory perception; broad retrieval ability; broad cognitive speediness; processing speed. Abilities located on different levels are interrelated, as they all have a common portion. This common portion is g.

Allik and Mõttus (2011) point to a relatively recently published explanation of g, according to which during an individual’s development, abilities mutually influence each other (e.g., if attention capacity increases, then memory capacity also increases, and may in turn influence processing speed). It has also been found that as a group’s average intelligence increases, the proportion of the g-factor decreases respectively. One explanation for this pattern is that as children develop, their abilities become more varied, new skills and abilities emerge and differentiate them from others; the children’s giftedness is revealed more in one field and less in another (ibid, p. 81).

Although the changes occurring in the development of mental abilities are common to all individuals, the differences in people’s mental abilities are rather constant, i.e. an individual who displays higher than average mental abilities at one point of their life, will likely also do so at later stages of life. In childhood, intelligence depends heavily on environmental factors, which makes it the most favourable period in life for developing mental abilities. To generalise, it could be said that genetic factors contribute to only about 40% of differences between individuals’ intelligence levels; the environment contributes to 60%. The older people get, the more they are influenced by genetic factors, because their choice of environment increasingly depends on themselves and their genetic predispositions. Research shows
that active participation in a child’s development is crucial. The tendency to prefer new stimuli and the time it takes to get adjusted to them correlates with cognitive, linguistic and general intelligence levels at later stages of life. Children’s speech development levels and over two and a half year old children’s intelligence test results predict their later performance at school rather well.

As we know, the correlation between the IQ test score and the average grade or educational level is usually around 0.50 or even above that; therefore, to a certain extent grades also reflect individuals’ giftedness, albeit not in absolute terms. Judging mainly by grades, the gifted underachievers are left unnoticed. These are students who do not maximise their inherent gifts. According to research conducted in Estonia, there are two times more underachievers among intellectually gifted students compared to average students, and over 70% of them are male. Among the latter, the number of underachievers increases in time (Laidra, 2010). This data refers to the fact uncovered in the research that on the one hand, male students have more confidence in their giftedness and they overly rely on this, but on the other hand, the school system does not cater to the needs of gifted male students. Gifted female students tend to associate their success with effort rather than giftedness and are therefore willing to put in more effort.

**Multiple intelligences**

By contrast to the IQ-based definition of giftedness, there are approaches that place the focus on specific abilities and extraordinary achievements in different fields. Howard Gardner (2006), professor at Harvard University, who researches individuals with brain damage and gifted children, has postulated that nine relatively autonomous “intelligences” are exhibited in different domains of achievement. These specific “intelligences” are logical-mathematical, visual-spatial, verbal-linguistic, musical, bodily-kinaesthetic, naturalistic, interpersonal, intrapersonal, and existential intelligence.

- Logical-mathematical intelligence – the ability to form equations and create solutions, to calculate, to solve abstract problems;
- Verbal-linguistic intelligence – the ability to analyse linguistic information and create written or oral text, feeling for language;

- Visual-spatial intelligence – the ability to find one’s way on surface and in a room, to comprehend graphically presented information;
- Musical intelligence – the ability to create a variety of sounds; sense of rhythm;
- Bodily-kinaesthetic intelligence – the ability to use one’s body to create something and to solve problems;
- Naturalistic intelligence – the ability to identify and differentiate between living and non-living objects of nature;
- Interpersonal intelligence – the ability to sense and comprehend other people’s moods, desires, motives, and intentions;
- Intrapersonal intelligence – the ability to analyse oneself and recognise the abovementioned aspects in oneself;
- Existential intelligence – high level of spirituality, the ability to ask and discuss “big” questions.

Gardner does not dispute the existence of \( g \), but he treats it as a specific factor relevant chiefly to academic achievement, to situations that resemble those at school. The main issue that arises when analysing Gardner’s theory is that it is not very clear, to which effect the intelligences presented by him are related to personal characteristics and motor skills, and to which extent they are related to mental ability. Furthermore, there is no clear proof that these intelligences are indeed mutually independent (and therefore also independent of \( g \)).

In any case, Gardner’s theory of multiple intelligences is the closest to the approach that allows us to claim that every individual, even if not very gifted, is strong in some field. **Gardner’s theory reminds us to pay greater attention to children’s strengths, and motivates us to also adjust the environment accordingly.**

In addition to Gardner’s multiple intelligences theory, there are a number of other theories that are different from the so-called mainstream approach to the structure of intelligence. Raymond Cattell divided mental abilities into **fluid intelligence**, i.e. intrinsic ability to learn, to ’connect the dots’ and solve problems, and **crystallized intelligence**, i.e. experience and skills acquired in the course of life (Gleitman et al, 2014: 505-506). Fluid intelligence develops faster than crystallized intelligence, but after achieving its maximum level at around 25, unfortunately also starts to decrease.
fast. Crystallized abilities, i.e. the skill to use acquired knowledge, however, improves in time and also decreases in a slower pace.

Robert Sternberg (2003) has also said that we should differentiate between several types of intelligence. He highlights **practical intelligence** as one of the subforms of mental intelligence alongside analytical and creative intelligence, and defines it as the ability to solve everyday problems. Practical intelligence is largely based on tacit knowledge, i.e. untutored knowledge acquired unknowingly in everyday situations. Such “street smartness” cannot be measured with ordinary IQ tests or learned from a book. At the same time, such knowledge is crucial for managing in a practical situation, making reasonable decisions in daily life or, for instance, surviving in grave environmental conditions.

One particular form of intelligence, which in daily life can often be even more useful than academic ability, is **emotional intelligence**. This is an ability to comprehend one’s own and others’ emotions and to control personal emotions. Emotional intelligence comprises of four parts: 1) ability to correctly perceive one’s emotions; 2) ability to use emotions to facilitate thinking and reasoning, and the ability to trust one’s “gut feeling”; 3) ability to understand emotions and describe them verbally; 4) ability to restrict one’s emotions. Emotions play an important role in solving problems and making decisions; they participate in directing one’s attention, and they also affect memory. Emotional intelligence can be learned and developed. This topic has been covered in works of popular science by Daniel Goleman, which have also been translated into Estonian.

### Components of giftedness

#### Creativity

As we saw above, it is impossible to provide an unambiguous definition to giftedness even at the level of mental ability. Research into the biographies of outstanding creative individuals and others who have achieved extraordinary results has revealed a great deal of components, which influence the manifestation of giftedness. One such component is **creativity**. Renzulli’s view, which is based on the “three ring model”
(Renzulli, 2005), regards intelligence and creativity together with motivation as different components of giftedness. Another, processual approach, emphasises overlapping skills – giftedness and creativity presume similar cognitive skills, such as defining a problem, selective coding, the ability to apply existing knowledge in new situations, or overcoming limitations (or constraints) (see Sepp, 2010 for a more detailed overview). In recent times, researchers have started to increasingly highlight different levels of creativity – the “Big C”, which is a rare phenomenon and can be seen in famous creative personae like Mozart, Einstein or Picasso, as opposed to the “little c”, i.e. conventional creativity that is expressed in daily life and can be seen in almost every individual. Kaufmann and Beghetto’s (2009) Four-C creativity Model also adds professional creativity and learning creativity (mini-c). Mini-c is defined as personally meaningful interpretation of experiences, actions and events. It is expressed in the process of learning, the creative process results in new mental constructions created during acquisition of new material, whereas the constructions have not (yet) been expressed in a tangible way. Creativity as a predisposition to create something new and original is related to divergent thinking, in which case there are many “right” end results. With children, an appropriate approach is also to concentrate on the creative process and the environment that supports creativity. M. Csikszentmihályi describes flow as a process of utmost motivation and concentration, where one loses the sense of time and space. The utmost compensation for this is the creative process itself (Gleitman et al., 2014. 733-734).

How to nurture children’s creativity? (Sepp, 2010)

- Encourage children to learn and act independently
- Offer various opportunities to acquire new experiences, knowledge and skills
- Facilitate flexible thinking
- Refrain from criticising children’s ideas and suggestions; be supportive
- Tolerate and accept ‘reasonable’ mistakes
- Facilitate self-assessment and help them cope with setbacks
- Take children’s questions seriously
- Accept alternative solutions
- Regard courage as highly as the right answer
Deliberate practice

The importance of deliberate practice is emphasised particularly by theoreticians, who view giftedness as proficiency or an expert level at something. To illustrate, there are examples of experiments where short term memory test results improved drastically as a result of specific memory training. In one test, an ordinary college student’s short term memory capacity (usually, a person remembers 7 decimal points) had increased to 80 decimal points after a few hundred hours of training (see Sepp, 2010). There is a widely recognized claim that it takes 10,000 hours of work to become an expert in any field. Even though the effect of systematic practice cannot be underestimated (this is most evident when comparing the volume of individual training sessions of high class athletes or virtuoso instrumentalists and the less successful representatives of these groups). These concepts are criticised mostly because they leave out creativity as an important component of giftedness, and environmental factors.

Motivation

Work and practice are directly related to the level of an individual’s motivation. Intrinsic motivation or dedication is one of the most important components in most giftedness models. It has been found that intrinsic motivation is accompanied by an internal desire, stimulated by personal interest and curiosity, to acquire more integrated skills. Intrinsically motivated students are more immersed in learning, are better at making connections between facts and subjects, good at linking theory with practice, and their knowledge is durable. When parents and pedagogues support children’s natural curiosity and intrinsic interest in learning, they help them perceive learning as a satisfactory activity, which in turn increases their motivation to engage in learning activities (or set motivating goals) in other forms. On the other hand, external compensation that vicariously controls students’ learning behaviour sends them the signal that learning is not an activity that brings joy and satisfaction, and should only be engaged in to get compensation or avoid punishment. Research has revealed that if emphasis is placed on extrinsic motivators, intrinsic motivation as well as creativity and cognitive flexibility may decrease. It has been found that extrinsic compensation which is perceived as controlling activity has in fact a more profound negative effect on gifted children.
The feeling of self-efficacy is also closely connected to motivation. Self-efficacy is an individual’s belief in their ability to solve a specific problem, complete a task or achieve a goal (Bandura, 1994). The feeling of self-efficacy determines whether a child is prepared to undertake a task and make efforts to complete it. The feeling of self-efficacy is affected by direct experiences of success or failure, opportunities of success perceived alongside other children, encouragement received from adults, and children’s physical condition.

To improve the feeling of self-efficacy in children, teachers and parents should help them recognise success and development in specific areas of life. With gifted children, self-conception may also be affected by the understanding whether a gift or intelligence is a quality that can be little improved by oneself (fixed mindset), or they believe that giftedness can be improved through personal effort and work (growth mindset). Research proves that younger children’s beliefs correlate more with the growth mindset, and as children get older, the fixed mindset starts to prevail. It is believed that gifted children reach this breaking point in older age. Dweck (2000) has found that in an intellectually unstimulating environment, the proportion of children with a fixed mindset is actually unfortunately larger among gifted children. Children with a fixed mindset always try to seem “smart”, yet make as little effort as possible. They are primarily focused on short-term performance goals (a good grade or reward, approval from adults, etc.). They strive for something new only when they are certain that they will succeed. In case of criticism they express learned helplessness instead of going for another try. Children with a growth mindset are focused on challenges and they enthusiastically experiment with complex tasks. They are engrossed in learning and their goals are geared towards achieving mastery. These people are characterised by a sense of satisfaction from overcoming difficulties; they are focused on gaining more knowledge and using it rather than demonstrating their existing knowledge. They are also motivated primarily by intrinsic interest sparked by the activity itself, the key elements of such interest being curiosity, investigation and solving problems. Whether or not a child becomes oriented towards making an effort, depends greatly on the modelling behaviour of adults/teachers. If such children are only rewarded for being “smart” and not for the effort they made, their vulnerability and sensitivity increases, so that they become fearful of experiencing setbacks and failures. We often see that children are only praised for their innate gifts, which decreases their intrinsic
motivation. Praise should be directed towards the efforts that a child has made to acquire the skills. The effectiveness of this “positive attribution” technique has been proved by several scientific studies. It is also clear that the success experienced after solving complicated tasks increases the feeling of self-efficacy to a greater extent than that of simple tasks, and increases the child’s willingness to make efforts.

Factors influencing the expression of giftedness

Cognitive disparities

Although gifted children usually stand out with the speed of solving a task, some disparities have also been found – the speed of task-solving may be affected by gifted children’s tendency to pay attention to details and aim for perfection. It has been found that gifted children spend more time on a few specific elements of the cognitive process. One study of children aged 12-13 concluded that children with higher mental abilities solved tasks faster, but spent more time at the stage of analysing the task and planning the solution compared to their peers with average abilities. At the same time, gifted children are more flexible in replacing unsuccessful problem-solving strategies with alternative ones, they are able to spontaneously generate sequences of strategic steps towards a solution, and set priorities in defining a route towards the solution, they are more resourceful in defining a problem and can differentiate between important and unimportant matters (Barfurth, Ritchie, Irving and Shore, 2009).

Many psychologists believe that a key role in the development of giftedness is played by the fundamental level of knowledge (Shavinina, 1997). They have found that a common denominator among gifted children is a well-structured, well-functioning and advanced knowledge base, which enables easy access and activation at any moment. The question of the level of knowledge among gifted children, however, has not been researched much – it is not clear why some children acquire knowledge with less effort than others. As gifted children’s cognitive capabilities are more similar to children who are older than them, their wider knowledge base enables them to perform well at a higher level compared to their peers. It has also been found that greater experience in a field plays a far larger role in the processes of learning and memory than, for instance, intelligence.
Gifted children’s “thinking curriculum” should be based on the following principles:

- Thinking and contents are learned simultaneously (to learn thinking, it is not necessary to wait until the child acquires extensive knowledge in a field);
- Learning about thinking, while also learning how to think (learning “about thinking” teaches metacognitive skills; learning “how to think” teaches the organisation and practice of thinking);
- Helping students become autonomous learners;
- Paying attention to transfer (learning to use strategies in different contexts).

### Personality factors

Personality factors play a crucial role in realising giftedness, and may often become the deciding factors in children’s development. Contemporary personality research has defined five basic tendencies, how an individual reacts to the surrounding environment (see Gleitman et al, 2014), and the “Big Five” is as follows:

- **Neuroticism** – a tendency to feel negative emotions (fear, sadness, anger, guilt, etc.), inclination towards depression or inability to control one’s impulses in stressful and critical situations;
- **Extraversion** – a tendency characterised by keywords such as warmth, sociability, activity, self-confidence, seeking excitement, experiencing mainly positive emotions;
- **Openness to experience** – openness to new ideas and sensations, flexibility of thinking, fantasy, interest towards the surrounding world and one’s inner processes;
- **Agreeableness** – tendency to trust other people and help them, being selfless and compliant;
- **Conscientiousness** – tendency to plan one’s activities and to control one’s desires and impulses, self-discipline and perseverance in implementing one’s plans.

The tendencies are generally stable through time, but as people get older, there is a perceivable increase in sociability and fortitude and decrease in neuroticism, openness and extraversion. Although studies have shown that tendencies are independent of mental abilities, i.e. the interrelation of personality-related tendencies and mental
abilities is very weak or non-existent, some results have indicated that there are disparities in relation with mental ability. Based on research conducted so far, the most valid negative correlation is probably between fortitude and mental abilities: Students who achieved higher scores in mental ability tests tended to regard themselves as incompetent, disorderly, directionless, thoughtless, or undisciplined.

In 2001, a study conducted among 2746 Estonian 6-12-grade students analysed their individual personality traits in connection with the results of their Raven’s Progressive Matrices Test, a non-verbal ‘culture fair’ multiple choice IQ test (Laidra, 2008). Compared to ordinary students, gifted children achieved lower scores in neuroticism and higher scores in openness. No differences were detected in extraversion, sociability or fortitude.

Several studies have found that gifted children achieve higher results in openness and introversion compared to average children (Sepp, 2008, Saul, 2006).

Although openness is sometimes described as a certain predisposition, which allows an individual to increase capabilities during life and is intuitively also relatable to creativity, there have been no research findings proving that there is a permanent connection between abilities and openness (Allik, 2003).

Such contradictory results refer to the fact that conclusions about the interconnection of mental abilities and personality-related tendencies are not yet very trustworthy.

**Practical recommendations**

Comprehension of the multifaceted nature of giftedness triggers us to integrate new approaches into the teaching practice – constantly gathering information about students’ strengths and interests, understanding how teachers can support their motivation and creativity. The efficiency of the process can be improved by the following steps:

- Providing different options for learning the essence of a subject or task (Hattie, 2011)
- Providing an opportunity to demonstrate one’s knowledge and skills in a variety of ways, thus enhancing the level of involvement and depth of the learning process (Darling-Hammond, 2010)
The learning process should follow the students’ strengths, needs and developmental goals as much as possible (Tomlinson, 2014)

Alongside best practices and theories, the teacher’s own intuition and creativity will also remain important, as will do the teacher’s partnership with the student as a personality.
References


Chapter II.
Theories of Creativity and Creative Personality

Odeta Norkutė

The Concept of Creativity

Creativity is one of the elements of the humanity. Human being invented a thing and made it. To be creative means to have ideas. Nowadays, creativity has been more and more related to the future of the mankind. The future depends on the fact how many people who are creative, acting creatively in the world, capable to generate ideas and to form alternatives we will have (Daujotytė, 2010). As indicated by Daujotytė (2010), creativity includes mathematicians, physicists, economists, lawyers, and librarians. Even more – it does not abandon people who are involved in manual labour. Nature, agricultural work encourages creativity: nature is creative, it manages sophisticated sound scores, colour combinations, creates landscapes. We know that it is also remorseless – creates and destroys. Human being’s creative powers can be not only constructive but destructive as well.

Creativity is a complicated concept and has a lot of definitions, the most widely used definitions are related to an individual, product or process and some of the used definitions are privileged due to a social context. Referring to creativity as the feature of an individual, his cognitive features (intellect) or personal features (motivation) are indicated. The studies of personality often include internal motivation as the essential feature of a creative individual – a creative individual tends to be guided by internal interests (Černevičiūtė, Strazdas, 2014).

The direction of the performance is typical for the concept of creativity: a person who performs creatively finds unexpected solutions, spots the ways out, turns to an unexpected direction and notices the things which have not been noticed or perceived yet. In the opinion of Runco (2002), Jovaiša, (2007), Girdzijauskienė (2005), Grakauskaitė-Karkockienė (2006), creativity is the whole complex of abilities, intellectual and personal characteristics including the person’s approach to life. It is noted that creativity is mostly determined by individual personality characteristics:

originality, flexibility, fluency, curiosity, sensitivity, energy and independence, ability to solve problems and accept challenges. (Numgaudienė, Ramanauskaitė, 2014).

Summarizing the variety of creativity concepts, Černevičiūtė and Strazdas (2014) classify them into four categories based on two dimensions:

**I dimension**: creativity can be classified as “creating something new” (Majaro 1988).

*Creating new* is creating new elements or new combinations of already existing elements with the only aim – to create a new element, although without knowing where it can lead. The creator can have an idea of the message, but he is not sure whether it will be understood by the receivers – this happens when the painter starts painting in different styles (for example, new art styles – impressionism, “pop art”, conceptual art).

**II dimension**: “Problem solving” is when the direction is already selected, but there are some obstacles that have to be overcome. For this, new ways and new means should be used, but the aim remains the same. Such situation is in a scientific laboratory when a method of creating new medication already exists. If the experiment using a new combination of the same chemical is not successful, then one chemical should be replaced by another. The researchers emphasize the *problem solving* as the most important aspect of creativity and consider originality to be only a part of creativity (Runco 2004).

Another side of creativity is that it can be individual (very common belief in art) or a collective phenomenon (example 1). Psychological studies show that creativity is being formed in a collective environment.

<table>
<thead>
<tr>
<th></th>
<th>INDIVIDUAL</th>
<th>COLLECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CREATING THE NEW</strong></td>
<td>Artistic process</td>
<td>Work in a laboratory</td>
</tr>
<tr>
<td><strong>PROBLEM SOLVING</strong></td>
<td>Daily work challenges</td>
<td>Development projects</td>
</tr>
</tbody>
</table>

Example 1. *Classification of Creativity Conceptions* (Černevičiūtė, Strazdas, 2014)

**Levels of Creativity**

Though all adults and children are able to be engaged in creative thinking and activity, their levels of creativity can be different. Taking the A.Taylor's theory as the basis,
Wilson (2005) has adapted it and has distinguished 5 levels of creativity. Wilson (2005) states that the first three levels are available for everybody having motivation and the last two levels can be achieved only by very talented people:

1. **Intuitive expressive level.** This creator’s self-expression is primitive, intuitive and straightforward only because of the intrinsic joy to create.

2. **Academic and technical level.** This creator is learning certain methods and skills, thus his creative expression becomes more powerful, because he has mastered academic and technical skills related to creative work.

3. **Invention level.** An inventor who has acquired academic and technical skills is not limited by them and throws down the challenge to the restrictions aiming at the experiments beyond the limits of traditions.

4. **Innovation level.** The distinguishing marks of this level – originality and unusual products and ideas.

5. **Genius level.** The ideas and achievements of these creators are unique and hard to be explained rationally. This is the creative production level which is the most difficult to explain.

People who are not disclosing all of their creative abilities often stay on the first level of creativity expression and avoid acquiring academic and technical skills worrying that such skills will be in a conflict with personal, spontaneous and unique, as per their understanding, creativity. It is not an easy task to persuade such people, that the teachers can teach them different ways that can help them to reach a higher level of creativity. Usually they tend to think that only intuitive spontaneity will be sufficient for reaching not lower than the fourth level.

Csikszentmihalyi (1996) contracted these five levels to two:

- "**big C**“ – creative people who are famous in their professional area and
- "**small c**“ – creative people whose creativity is revealed in their daily lives.

It can also be noted that there exists such a level as "**average c**“, and the majority of the people contributing small, but creative things to their professional areas, though not becoming famous, belong to it.

Some other authors ((Non)education of creativity at school, 2009) believe that each person is creative, therefore, taking into consideration these statements, two levels of creativity have been distinguished:
Exclusive creativity is an ability of an individual to create original ideas, insights, knowledge, rearrangements, inventions, art works or other novelties which are considered to be valuable by others and change fundamentally the activity area and even all human world. The people who are able to do this are called talented or genius.

Ordinary creativity is a common to each individual feature to create something new through imagination, improvisation, problem solution and critical thinking. These works might not be very valuable and original – some other people are able to create similar or the same thing – but they are new for their authors.

**Characteristics of a Creative Personality**

Wishing to find out where the secret of creativity is, the scientists are interested in creative and, due to this reason, famous personalities. Though it is said that creative people “*have a bit different receptors for the information coming from other minds and a bit different mechanism of information processing*”, the researches performed during a few decades make us acknowledge not only the role of inherent talents, but also the role of the personality who is becoming a creator.

As stated in the pedagogical researches ((Non)education of creativity at school, 2009), the teachers distinguish the following characteristics typical for creative people (table 1):

<table>
<thead>
<tr>
<th>Characteristics of Creative People</th>
<th>The Description of Manifestation of the Creativity Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curious and observant</td>
<td>Are thoroughly and fully interested in different things; Are able to see problems, shortages, oddities as well as the ideas relevant to their work;</td>
</tr>
<tr>
<td>Tolerant to indeterminacy</td>
<td>Are not afraid of a disorder, lack of facts and rules, contradictions, incompatibilities as this provides a lot of possibilities to create a new order;</td>
</tr>
</tbody>
</table>
Flexible | Adapting to changes and striving for them, open for new ideas and experience, requirements and risks;
Thinking originally | Are able to see ordinary things differently, to break away from the traditions and conventions, to generate alternative ideas; Are able to visualize problems in the imagination and are thinking in metaphors;
Independent | Possessing strong self-consciousness, thinking independently, believing in their ideas and the significance of their activity, resistant to others’ disapproval, misunderstanding, opposition; neglecting others’ opinion and preferring to work alone; Not thinking about quick reward;
Persistent | Having the goals of their activity and tending to implement them, therefore very motivated, enthusiastic, energetic, devoted to the selected activity, able to work long hours, hard and concentrated.

Even more characteristics of creative people have been noticed. For example, their social maturity is often late – they undertake the duties of the adults later and all their lives remain childish and playful. The stereotypes of gender roles are not very typical for them: creative girls like to dominate more than other girls, and creative boys are more sensitive than others and not as aggressive as other boys of the same age; in the teens it often determines bigger than usual isolation and the feeling of loneliness.

The thinking style of the creative people is versatile – they are able to combine analytical and intuitive, convergent and divergent thinking strategies.

Creative people can also be characterized as very self-confident, independent, taking risks, enthusiastic, brave, curious, playful, having sense of humour, idealist and thoughtful. Usually they are interested in artistic and aesthetic issues, they get involved in the things which are sophisticated and mysterious, and they also need privacy and time to be alone. Usually they are more perceptive and have more intuition than others. The important feature characterizing these people is that they are ready to tolerate the confusion usually related to the solution of creative problems. Most of these features were first disclosed by Barron (1969, 1988) and MacKinnon (2005) in their classical studies of creative architects, writers and mathematicians, which were carried out at Barkley University. These characteristics were being observed in all three different areas.

Piirto (2005) (table 2) has summarized the following four main attitudes of especially creative people that can be applied for all creativity areas:
Table 2

The Attitudes of Creative People
(according to Piirto, 2005)

<table>
<thead>
<tr>
<th>Naivety</th>
<th>Self-discipline</th>
<th>Taking Risks</th>
<th>Confidence in Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness with which creative people observe what is obvious from a different angle.</td>
<td>Focused namely on the expression in the creative area selected by the creator; to the disappointment of the teachers, the self-discipline not necessarily means that the plans of other people will be taken into consideration.</td>
<td>Creativity related risk taking does not mean that the person will climb up the mountains or will do bungee jumping from a bridge. Instead of that, the person who tends to take risks needs the courage to stumble, to experience a failure and to recover without being upset if somebody repudiates him.</td>
<td>An obligatory provision of confidence in group, especially in the case of creativity based on cooperation, could be applied to stage acting or dancing, preparation to launch a satellite to Mars or establishment of a new advertising company.</td>
</tr>
</tbody>
</table>

The characteristics listed above should help the teacher to identify creative children and teenagers in their class. Besides, this list can help to be more patient with students, demonstrating too many negative features. Maybe a huge amount of energy, exaggerated assertiveness, originality, opposition to the adults, stubbornness, curiosity and other features should be redirected. The attention should also be paid to the fact that a number of the students whose results are average or below the average, are possessing great creativity abilities, manifesting, for example, in art, dancing, IT, or any other field the specific knowledge of which such a student possesses.
Is it possible to identify a creative talent?
(According to Davis, Rimm, Siegle, 2011)

Though knowing the features typical for creative people we will be able to identify the creative students easier, but most probably we will not be able to identify perfectly a creative talent.

- Albert Einstein learnt to speak when he was four, to write when he was seven, he was bad at almost all subjects at school.
- Thom Edison was told by his teachers that he was too stupid to learn something.
- Werner von Braun failed in mathematics exam in the ninth grade at school.
- Winston Churchill’s learning results were the worst in his class, and twice he failed to go to a higher class.
- Pablo Picasso almost could not read and write until he was 10. His father hired him a tutor who refused to teach him after some time.
- Louis Pasteur’s chemistry skills were evaluated as average by the Royal College.
- Charles Darwin was learning poorly at primary school, and he was not able to finish a course of medicine at the university.
- F.W. Woolworth at the age of 21 was working in a fabrics store, but his employer did not allow him to serve the customers as he “was lacking common sense”.
- Walt Disney was fired from a position in a newspaper, because he was not able to come up with anything good.
- Caruso music teacher told him, “You can’t sing, you do not have any voice at all!”
- Louisa May Alcott was told by one of the editors that she would never write anything popular.
- Charles Dickens, Claude Monet, Isadora Duncan and Mark Twain did not finish primary school.
- George Gershwin, Will Rogers, brothers Wright and the announcer Peter Jennings left secondary school;
- Harrison Ford (Indiana Jones) and Lev Tolstoj were dismissed out of the university because of the poor progress.
- The letter which was found in 1991 and was written in 1938, said that a western star Gene Autry “has to improve his acting”, that the courses of acting “were evidently in vain” and that “he needs a darker make-up to give him more
manhood”. 83 year old Autry’s reaction to this was, “The majority of these things are true.”

- Katie Couric was fired from her first position in CNN, and the producer told her that she would never be able to work in television.
- Bill Gates, the founder of “Microsoft”, left Harvard University (but we should remind the students that he had achieved enough for getting into the university).

As noted by Davis, Rim, Siegle (2011), we can find not surprising facts in the biographies of creative people, for example, that they are interested in a creative activity and have a lot of hobbies. We can find more than one performance in the theatre which is a very clear indicator of creativity, because in order to perform in the theatre one should possess some important features, for example, a sense of humour, aesthetical interests, self-confidence and willingness to take risks, etc. However, there might appear some more delicate characteristics in the biographies of creative people: such people might prefer communicating with older or younger friends, and they could have an imaginary friend in their childhood.

It is obvious that not all characteristics are typical to creative students, and some of them are related to specific areas. For example, Piirto (2005) noted that a young poet gets his inspiration from a language, meanwhile the scientists, musicians or artists who are striving for their careers get the inspiration from such things as a telescope, a piano or a brush.

**Development of Creativity**

Can creativity be acquired or is it inherent? The answer to both these questions is “yes” (Davis et al. 2004). Some people have an inherent combination of creative talents and intellect which is being activated by a strong motivation and sense of destiny, and which makes such people create their dreams and implement their creations due to which the world becomes better.

The teaching of creativity should have its structure, the assumptions of which are made by the main goals and tasks of such teaching. These goals and tasks were defined by Davis in his works from 1987 to 2004:
1. To improve the perception of creativity, to teach creative attitudes and to enhance creative personal features;
2. To improve the way how the students understand creativity;
3. To enhance creative abilities, using different exercises in order to achieve this;
4. To teach the methods of creative thinking;
5. To involve students into creative activity;
6. To foster academic creativity.

**Didactic Recommendation for Creativity Development Based on the Consistency of Goals**

**Creative Perception, Creative Attitudes and Creative Individual Features**

Enhancing creative perception and developing creative attitudes is the most important part of the teaching which aims at the development of creativity. Creative attitudes are being taught in all courses or programs of creative thinking, and there are good reasons for this. In order to think creatively a person has to have an understanding what creativity is. He has to estimate creative thinking, new-fashioned and unreal ideas, to be impartial and receptive to funny ideas generated by other people and also to be inclined to take creative risks, to make mistakes or even to fail. Sternberg (2003) was trying to prove that high creativity occurs out of deliberate decisions, for example, to define once again the problems, to overcome obstacles, to do what one likes to do and to believe in oneself.

Creative accomplishments can be achieved by the majority of students. However, they do not think about creativity and do not value its significance to their personal development – to the development of their talents and their potential, to the ability to deal successfully with the surrounding world and to the opportunities to get more out of the life. Besides, students should know better the importance of the application of creative novelties in the history of civilizations, as well as in solving existing and future problems of the society (Davis, et al., 2004).
**Improving Creative Individual Features**

The features of a creative personality are closely related to creative attitudes and perceptions. Usually it is not said that there is the need “to develop individual features”. However, the teachers can reward and stimulate the required individual features and behaviour related to creative thinking, i.e. self-confidence, independence, enthusiasm, courage, wish to take risks, curiosity, playfulness, sense of humour, ability to devote some time for being alone and thinking, interest in complicated things, perceptivity, interest in art and aesthetical things (Davis, et al., 2004).

Cropley and Urban (2000) have listed the important attitudes and individual features which could be enhanced in the class: independence, ego strength, positive personal concepts, inclination to what is complicated, tolerance to obscurity and acceptance of all (even contradictory) individual aspects.

Talking about “contradictory” individual aspects, Barron (1969, 1988) noted already long ago that creative people assimilate the features which usually are typical to the opposite sex. Cropley and Urban (2000) described the following “integration of the opposites”: such stereotypically male features as independence, self-confidence and hardness overlap with stereotypically female features, such as sensitivity, intuition and responsibility. However, even possessing a high inherent potential the biker will hardly dream to become a ballet dancer.

The teachers may foster creativity by encouraging the students to learn autonomously, not assessing strictly their ideas, tolerating “clever” mistakes, encouraging to think flexibly, encouraging self-assessment, usage of their fantasy and imagination, helping to overcome disappointment and failures, accepting the students as they are, helping the students to resist the pressure to be like everyone from their contemporaries, rewarding for the courage and correct answers and knowing that the child’s creativity could be expressed through the “troublesome” behaviour (Cropley and Urban, 2000.; Fleith, 2000; Rejskind, 2000). Besides, the teachers can also choose a direct method: to help the students understand each creative attitude and feature and why it is important when striving for creativity.
Formation of Creative Atmosphere

Creative attitudes and consciousness are closely related to the concept of creative atmosphere, i.e. the environment where creativity is being encouraged and rewarded. Rogers (1959) named it *psychological safety*, the prerequisite for development of creative thinking.

When speaking about generating the ideas, as noted by Davis et al. (2004), the environment is called a *postponed decision*, it means a receptive environment where there is no criticism, assessment and where new, even crazy ideas can be suggested. When the teacher calls the “different” child a creative thinker, the students most probably will not call him an oddity and most probably he will be acknowledged and not repudiated. The fact that the rewarded behaviour will remain and become stronger, whereas the behaviour for which the student is punished or which is not paid attention to will vanish – this is an old and respected principle of psychology. The creative atmosphere rewards for creative thinking and helps it to become a habit.

When performing the majority of the exercises and activities which aim at development of creativity during the lessons, the creative consciousness is being increased and creative attitudes are being developed. The main things which distinguish the people *possessing* creative abilities from the people *using* their creative potential are the attitudes, consciousness and relevant creative individual features due to which people tend to think and behave creatively. Sternberg (2003) listed the suggestions how to encourage the students to develop creative habits and features and to use them (table 3):

Table 3

**Exercises Enhancing Creativity**

(according to Sternberg, 2003)

<table>
<thead>
<tr>
<th>Be aware of when to be creative and when you have to follow the norms.</th>
<th>Be creative when implementing artistic and scientific research projects. Do not be creative when taking exams in the case you have to choose an answer from a few optional variants or breaking common school rules.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find out what subjects you are the best at.</td>
<td>Experiment and investigate, take risks and challenges. You might succeed in finding new talents.</td>
</tr>
</tbody>
</table>
### Improvement of Creativity Perception

Any of the ways to teach creativity will be more efficient and its effect for the students will last longer if the students will get a support in understanding what creativity is and what its typical features are. For this purpose a lot of existing information and material can be used. Cropley and Urban, 2000, Davis, 2011, Treffinger, Sortore and Cross, 1993, present a variety of subjects which can be used when preparing for the lessons “about creativity”:

- The importance of creativity for the individual and the society;
- Characteristics of creative people;
- The nature of creative ideas as modifications, combinations and analogue relations;
- The nature of creative activity – its stages, changed perception, modification, connection, analogue thinking;
- Creative abilities;
- Theories and definitions of creativity;
- Creativity tests and their logical substantiation;
- Ways of creative thinking;
- Other.
As it was already mentioned, the biographies of creative people are valuable material to teach about desirable creative personalities, attitudes, habits and ways of life. Besides, the students can find out about the following principles of creative thinking:

- Creativity will make your life more interesting, successful and nicer.
- Creative people are not conservative; they are looking at different things from different angles.
- Creative people are familiar with the pressure to follow the common norms – to be like all.
- It is not the case that creative people constantly do not follow the common norms.
- To think creatively means to take risks and make mistakes and the more creative the idea is, the more risks to make mistakes and fail occur.
- Creative people are playing with ideas, considering a lot of options, using methods, thinking analogically, estimating their ideas and transferring them into actions.
- Creative people are using their talents instead of wasting them.

Enhancing the Creative Abilities

Enhancing of the creative activities should be based on the same logics of teaching strategies as the enhancing of all other skills in the learning process, for example, reading, mathematics, solving chemistry tasks, throwing the ball into the basket, etc. However, it should be noted that when enhancing the creative abilities many kinds of activities are not only being related to creativity, but they are also improving the perception of creativity and are directing the attitudes of an individual in the creative direction.

Development of the Abilities of Fluency, Flexibility, Originality, Detailed Exposition

The abilities listed above are ascribed to the traditional and well known abilities, and their development is related to solving problems and looking for the answers to different questions.

Students can do such exercises together with all classmates, may be guided by the rules of idea generation, or individually. One of the most helpful ways to involve the

students into work is to divide the students into the teams for solving problems. All teams are trying to solve the same problem and then present all or just the best of their ideas to the class. The students are often surprised when from other groups they find out the different ways to interpret the problem as well as the methods and ideas how to solve it. Such surprising differences encourage them to take risks and present their own creative ideas (Davis et al., 2004).

Davis et al. (2011) give some didactic advice how the fluency can be encouraged during the lessons.

1. Doing the exercises requiring the answer to the questions which start with “What would happen if...?” the students list the consequences of incredible events. Such events might be imaginary or rather realistic.

What would happen,...

…if people had an eye in the back of the head?
…if there were no books?
…if the only instruments were drums?
…if there was no gravity in this room?
…if fair haired people were not allowed into hotels and restaurants and did not have a right to vote?
…if the earth leant and your town moved to the North Pole?
…if Edison was a plumber and we did not have light bulbs?
…if nobody ever smiled?
…if all people littered in public places?
…if there were no bricks or wood from which we could build houses?
…if there were no cars, television, video games, peanut butter, bikes, football?

2. Thinking of how the products could be improved is another type of the questions, and the answers to which cannot be only “yes” or “no”. The students might be asked to think of the ways how to improve the product or the type of activity – pencils, school desks, classes, boards, soft drinks, sinks, school (or public) bus system, popcorn, baths, computers, bikes, running shoes, etc.
3. Maybe the oldest task of the development of creativity is to think of unusual ways to use ordinary things; besides, this is a good exercise as well. How could the old tires be used? A clothes hanger? Empty plastic bottles? Plastic bags? A wooden cane? A piece of paper? Food leftovers in the canteen?

4. Creating problems and paradoxes is an interesting and complicated activity. It might be necessary to solve a problem or to explain logically the situation that is difficult to understand. The problem might be both realistic and unrealistic. For example: how all the bike thefts could be prevented? How could the lunch menu be improved? What 20 EUR worth Christmas present could be bought for the parents? How could the school (family) bill for the electricity be reduced? How could our health be improved? How could we help Mr. Smith, 55 years old former night watch, who is unemployed and has no special skills? How could a stubborn elephant be expelled from the living room? How could three bears prevent robberies?

Some of the examples of the problems requiring explanation:

- The school principal all of a sudden cancels the breaks. Why?
- The grass growing behind the advertising stands is usually lush. Why?
- It was noticed that ten paintings had disappeared from the art gallery without any burglary signs. How could they disappear?

5. While solving designing problems the students can design an ideal school, the plane for transportation of timid kangaroos, an improved grass mower, more functional clothes, safer ways to travel, more efficient way to supply food in the canteen, new sandwiches or other delicacies for "McDonald's", a better mousetrap, etc.

6. When developing the fluency ability, the students might be asked to name the things which are, for example, round, square, sweet, salty, blue, white, made of metal, made of wood, long and thin, short and thick, which smell nicely, which are not tasty or have sharp edges.
7. When developing the **flexibility**, the students are asked to look at things from a different angle:
   - What would this room look like to a tidy housewife? To a hungry little mouse? To an alien?
   - What does the highway look like to a tire? To a crow? To a lost pilot?

8. When developing the **detailed exposition**, the students are asked to start from a simple idea and to develop it, for example:
   - To create a device for walking a dog or caressing a cat (describing dimensions, material and price of such a device);
   - To embellish and improve a short story, drawing, invention, class excursion.

**Teaching the Methods of Creative Thinking**

*Individual Methods of Creative Thinking*

Individual creative thinking methods are the ways which are deliberately and not deliberately created and used by each creative person irrespective of the object or context used in his works. This topic is the basis of such important questions as “Where do the ideas come from?” and “What is the nature of inner creative activity?” (Davis, 2011).

The majority of individual methods are **analogical** by their nature. This means that the innovator took the idea for his work from the event, which he had heard of in the news, from a historical event, the book that he had read before, the film that he had seen, the melody that he had heard, from the art or architecture style, an invention, scientific discovery, business idea, some novelty that had been created before or some natural phenomenon. In fact, when we hear the phrase “he was inspired...”, or “it was based on...” we can be sure that the innovator deliberately or by chance used the analogue method.

The examples of the individual methods of creative thinking (according to Davis et al., 2011):

1) Einstein was performing as what he called “mental experiments”. One of the most memorable examples of such experiments is that once he imagined being
a small creature which can fly in the space on the light ray. This helped him to formulate his general relativity theory.

2) Speaking about art, we see repetitive objects and styles typical for each famous painter and reflecting his individual methods of creative thinking. For example, Picasso was famous for his African, Joker, Blue or Rose periods during which his paintings were inspired by a certain topic. Besides, he used to deliberately destroy faces and other parts and to put them again together in an original way. Paul Gauguin used to paint the natives of the Pacific Ocean region in his unique way. Edgar Degas was famous for his graceful ballerinas. Renoir’s brand is light pastel colours, the women and landscapes depicted in the paintings.

3) Andrew Lloyd Weber's musical “Cats” was based on T.S. Eliot’s collection of poems “Old Possum’s Book of Practical Cats”.

4) It is said that even Leonardo da Vinci was wandering along the streets in Italy carrying a sketch book and looking for interesting faces for his painting “The Last Supper”.

5) All Franz Liszt’s “Hungarian Rhapsodies” were based on Hungarian Gypsies’ folk songs. Tchaikovsky also used to turn folk songs into symphonies. Aaron Copland's suite “Appalachian Spring” was based on a folk song “Simple Gifts”. Even the popular song “Star Spangled Banner” was created on the basis of an English drinking song.

6) Cartoonists keep using a deliberate analogical thinking to generate ideas. For example, after the First Gulf War Saddam Hussein was shown as a helpless Wizard of Oz, hiding behind the curtain, “I am Saddam, great and powerful!”

7) At the end of XVI century Holinshed’s historical book “Chronicles” was published. William Shakespeare took a number of ideas from there and used them in his plays “Macbeth”, “Henry IV”, “Henry V”, “Henry VI”, “Richard II” and others. When writing “Antony and Cleopatra” and the tragedy “Coriolanus”, he used the Plutarch’s “Biographies”. The play “Troilus and Cressida” was based on different narrations of the Troy story.

8) Modern novelists and screenwriters likewise continue to take ideas from the obvious sources. For example, Japanese attack against Pearl Harbor during the
World War II inspired to create the films “From Here to Eternity”, “Tora, Tora, Tora!” and “Pearl Harbour”. In one of the interviews the screenwriter of the film “High Noon” admitted that the inspiration to write this awarded and full of tension western came from the fear which in the sixth decade of the last century was felt by Hollywood writers and actors due to criminal gangs.

9) The popular series “Star Wars” was created partially on the basis of George Lucas’s individual creative thinking method. When writing a script for “Star Wars” Lucas was reading the books about mythology. In the interview for the magazine “Times” Lucas said, “I wanted my “Star Wars” to be epical that is why I turned to an epic”. Therefore, in the film we meet a young man who has to prove his manliness to his father and who saves a princess in trouble, who has an older and a wiser tutor (in fact two tutors – Ben Kenobi and Yoda), and who is fighting with the villain Darth Vader.

There are several ways to encourage the students to develop their individual creative thinking methods. First of all, the students should understand that even very creative people “find” their own ideas. This demystifies creativity and helps to persuade the students that they have the right to use the existing ideas without feeling “not creative” because of that. After all, if William Shakespeare, Franz Liszt, George Lucas and Art Buchwald can borrow stories, melodies and ideas, the students can also do it (based on Davis et al., 2004).

Students can also be taught several repetitive individual methods of critical thinking. These methods consist of the following strategies (Davis et al., 2004):

1. To use the analogue and metaphorical thinking deliberately. For example, when creating aesthetic products students can find ideas by revising what was created by others and what the origin of their ideas was. The students can learn to ask the following questions: What else does it remind of? What pleased other? Which aspects of similar problems or situations could I use? Does history, Bible or other literature offer any ideas? What would the professionals do? (Davis, 2004).

2. To modify, combine and improve the existing ideas.
3. To start from the goal – it may be an ideal or perfect decision, for example, to achieve that the problem would solve itself – and to work reverse trying to identify what is necessary in order to achieve such a goal.

4. To ask oneself how such a problem could be solved after 50, 100 or 200 years.

**Incorporation of Students into Creative Activity**

When developing creativity it is obligatory to involve students into activity requiring their creative thinking and problem solving. Only then we can be sure, that when participating in such a creative activity, the creative attitudes, abilities and skills will be strengthened.

The teacher striving for children’s creativity have constantly to look for the possibilities how to develop their thinking using the solution of different problems which are related to the existing knowledge and teaching material (Rimm, 2004).

**Using the existing knowledge base.**

It should be taken into consideration that it is possible to think creatively “abstractly”. It is not necessary to have a big “fund” of specialized knowledge in order to generate new ideas, for example, how to improve traffic conditions in your area, how to make parents evening more interesting or Guinea pig Vanda a bit happier.

In order to involve the students into an active creative activity, the basis of the ideas is related to daily life, however new ideas and their generation occur when a creative task which suggests finding a variety of solutions is given.

While looking for new solutions certain knowledge is required when it is necessary to find ideas or the solutions in specific areas, or when it is intended to motivate one’s choices, and it is desired to implement one’s ideas.

Though a number of researches have been performed proving the efficiency of teaching of creative thinking strategies or a higher level of divergent thinking, Hunsaker (2005) reminds that the missing detail is that the researches of creative thinking cannot ensure the transfer of students’ skills into their world existing outside the school if they are not involved into a real activity.
Development of Academic Creativity

Involvement of students into creative activities and development of their creative thinking at school should be related to the improvement of academic achievements, that is why the real work or generated ideas should be related to the ways of their application in school subjects: mathematics, science, languages, social sciences, etc. The example of Torrance and Goff (1990) illustrates the way how it could be done at school: the students can be asked to remember the date when Columbus discovered America, or to tell how the history would change if Columbus would have stepped off in California. Which question is more interesting? Which question would help to remember the date better?

Shallcross (1981) created the system of exercises which can be used in the material of certain subjects:

1. Make a sculpture using leaves, stones, clay and paper bags (arts).
2. Name the ways how teeth cleaning can be made a pleasant activity for children (science, human and nature (health)).
3. Invent a simple and quickly prepared meal (technologies (housework)).
4. Plan a series, a mystery or a soap opera using the method of morphological synthesis (language and literature).
5. Think of new ways to measure time, water, air and height (mathematics).
6. Ask somebody to play three notes on the piano. Create a melody on the basis of these three notes (music).
7. Invent muscle stretching exercises for runners (PE).
8. When generating ideas, think of the ways to save vanishing species of animals (sciences).
9. When generating ideas think of the ways how different nations could know each other better (social sciences).

References


Chapter III.
Existing Model of Talented Thinking and its Relation to Innovative Processes.

Odeta Norkutė

Models of the Concepts of Talent

In his Act of Program for Skilful and Talented Children presented to the USA Congress in 1988, Javits indicates that talented children are those who give evidence of high achievement capability in the areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need the services and activities which are not ordinarily provided by school in order to fully develop those capabilities.

Barbe and Renzulli (1981); Roedell, Jackson and Robinson (1980), Rabinowitz and Glasser (1985) state that children’s talents are disclosed through showing high level complicated abstractions, formulating questions and answers that reflect extraordinary perception, sensitivity to relations and unusual knowledge structure. Such children are also especially able to identify the essence of the problem, to choose a strategy to solve the problem and to distinguish important information from unimportant ones. Clark (2002) makes it even more specific and states that a talented person is able to achieve self realization only through integration of perception, thinking and emotions.

Marland (1972) indicated that children’s talents are revealed through the demonstration of high results in all or some of the following fields:

- General intellect,
- Specific academic achievements,
- Creative or productive thinking,
- Leadership, artistic activity,
- Psychomotor abilities.
Due to the fact that talent is being expressed in different fields at the same time, Marland (1972) suggests creating programs, applying specific methods for development of the skills of such children, thus allowing them to use and apply their talents in the best way.

According to the concepts of the talent and the aptitudes, there are a few universally recognized models of talent. The main structural element in these models is a general intellect and its manifestation in various fields, because application of intellectual talents is directly related to not only the external indicators, such as level of learning achievements or quality of practical activity, but also to the amount of income, social meaning of creative achievements, etc. (Czeschlik and Rost, 1988; Jensen, 1996; Feldhusen and Jarwan, 2000). Beside the manifestation of a general intellect, talent can be defined by the following structural elements: motivation, working capacity, persistence, self-estimation.

**Assumptions of Educating Thinking Abilities**

How should the teacher work in order students’ creativity and innovative thinking skills were improved and finally new or innovative products were developed? Beresnevičius (2010) reviews critical theories of the education of creative (talented) thinking. Some authors believe that both the creativity of the individual and thinking are inherent features therefore education process does not affect them much. Cattell (1963) and Horn (1967) indicate that it is not possible to educate the creativity. Gage, Berliner (1994) point out that creativity, like intellect, is a rather invariable attribute. Csikszentmihalyi (1976, 1996) believes that children’s creativity cannot be educated and creative productivity is increased only by the right combination of personal characteristics and creation of the environment enhancing creative work.

Another group of authors (Torrance, 1986, Lukas, 1983, Clapham, 1997, McFadzean, 2000, Tanner, 2001) indicate that the results of both creativity and thinking can be significantly modified if favourable conditions are created and special methods and education technologies are used. Malzman (1960) found out that after children had been taught certain creative actions their originality test results were improved.
It has been identified that the variety of the means determines the changes of the person’s abilities, thinking, creative behaviour and creative potential. The practitioners who are promoting creativity are using different methods starting from setting of the goals, motivation and ending with teaching of special techniques. (Nickerson, 1999). These methods are based on creative thinking, perception, processing of memory information and other theories. (Beresnevičius, 2010)

The researchers of the education of creative thinking (Clapham, 1997, Scott, Leritz & Mumford, 2004, Tanner, 2001) describe the techniques of creative thinking that can be learnt by the majority of people and that help generating more innovative ideas. Of course, the people who have better associative abilities and who are able to relate distant ideas will generate more original ideas. However, as the practice shows creative thinking techniques can be mastered and the majority of those who have mastered them significantly improved the parameter of their creative activity.

Costa (2003) formulated four components of thinking skills program (table 4) and the list of 16 “thinking types”:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of the part of the program</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Teaching material</td>
<td>The essential thing which is associated with the thinking skills to be learnt and applied. The material determines the selection of thinking skills, e.g., the solution of a scientific problem will require the skills related to logics and scientific control, meanwhile social and aesthetical material will require the skills related to ethics and artistic solutions. Besides, interesting material increases students’ motivation: “Teaching material activates and interests curious mind.”</td>
</tr>
<tr>
<td>2.</td>
<td>Teaching of thinking skills</td>
<td>Essential means of efficient thinking that need help to be understood by direct teaching method.</td>
</tr>
</tbody>
</table>

Table 4

The Components of Thinking Skills Program

(Costa, 2003)

<table>
<thead>
<tr>
<th></th>
<th>Solving of the problems requiring masterful thinking skills.</th>
<th>Systematization of thinking skills according to strategies: creativity, problem solution and decision making. Students have to solve the given ambiguities, abnormalities, contradictions, dilemmas, secrets, obstacles and paradoxes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Thinking types</td>
<td>Attitudes or inclinations to use thinking skills under appropriate circumstances. Students have to value the thinking skill and to know when it can be used, to be able to employ it and to commit to improve a certain thinking skill.</td>
</tr>
</tbody>
</table>

Though the number of thinking types is huge, Costa (2003) named the following 16 rather complicated and, in his opinion, especially important thinking skills:

- To be persistent when the solution is not evident;
- To resist impulsiveness;
- To listen to other people with understanding and empathy;
- To think flexibly;
- To think of one’s own thinking (meta-cognition);
- To aim for accuracy and precision;
- To ask questions and raise problems;
- To apply previously acquired knowledge in new situations;
- To think and communicate clearly and with precision;
- To collect data using all senses for this purpose;
- To create, imagine, implement novelties;
- To react with surprise and respect;
- To take reasonable risks;
- To understand humour;
- To think autonomously;
- To be constantly open to continuous learning.

A big and significant part in the education of thinking skills is teaching of “attitudes” and “characteristics”. As it was indicated by Davis (2004), de Bono (2000), some important thinking skills are closely related to personal attitudes, for example, creative pause (respect to evidences; desire to look for the reasons and alternatives; desire to refrain from assessment or even to change it on the basis of the facts; tolerating
ambiguities; sensitivity to others’ viewpoints (Alvino, 1990, Lipman, 1991), and of course, understanding of creativity (Davis, 2004).

Davis, Rimm, Siegle (2010) distinguish several ways or technologies of educating thinking which might be used in regard with the dominating models of a child’s/children’s talents or creative thinking. The authors indicate three strategies of the development of thinking skills, according to which, the didactic recommendations for the implementation of these strategies are provided:

- Indirect teaching,
- Direct teaching,
- Meta-cognition.

**Indirect Teaching of Thinking Skills**

As indicated by Davis, Rimm, Siegle (2010), thinking skills can be taught in a rather subtle way, *indirectly*, practicing to use them and doing exercises separately from the subject material or together with it. For example, during the teaching process the teacher can enhance the skills of classification by presenting the classification (including multiple and secondary classification) tasks and giving practical work to solve them.

Costa (1985), Costa and Lowery (1989), Swartz (2001), Perkins (1990) recommend the teachers to add variety to the teaching material by raising problems and asking questions, for example, to ask the questions: "Why?", "What if?" and "How?", not only "What?"

The teachers can ask the students to investigate paradoxes, dilemmas and discrepancies. Besides, they may ask the students to compare, classify, evaluate, find similarities and differences, analogue relations, using induction to think of principles, etc.

"The box of problems" gives the students an opportunity to suggest the problems which could be solved by all class. In the “place for thinking” arranged in the class the students can go deep into the topics they are interested in or work on the implementation of the projects.
Besides, the teachers can project appropriate thinking skills during “thinking loud” analysis, assessment, consideration or creative work.

**Direct Teaching of Thinking Skills**

The majority of complicated thinking skills can be taught *directly* presenting them as deliberate ways of consideration and solving problems (Beyer, 1991, Costa, 2003, Costa and Lowery, 1989, Reis, Burns, Renzulli, 1992). Teaching of creative or innovative thinking can be based on the fact that the students have maximum opportunities to evaluate the tendencies of the phenomena through observation, and after that they have all the conditions to present their estimations or opinions about these phenomena and to draw conclusions and generalizations. Thus, the teaching of creative thinking becomes direct because it allows generating ideas and applying different individual thinking methods (Davis, 2004).

The example of a direct teaching of creative thinking can be CoRT (Cognitive Research Trust) *Thinking Programme* prepared by de Bono (1976, 2015). This programme was designed to teach such skills as evaluation, ability to see things from a different angle, planning, identifying priorities. These skills are considered to be the strategies of deliberate and conscious thinking. The students get support in understanding each skill and *why, when and how* it should be used.

De Bono (2015) formulated the following thinking skills, which could be educated during the teaching process:

1. Thinking about good aspects (“pluses”), bad aspects (“minuses”) and interesting aspects of the ideas and suggestions;
2. Consideration of all factors when choosing something or making decisions;
3. Thinking about consequences of actions (short term, average term and long term);
4. Thinking about goals and tasks, seeing the tasks of other people;
5. Planning, consisting of the consideration of all factors and indication of the goals and tasks;
6. Skills of list-making;
7. Identifying priorities, for example, speaking about important factors, tasks and consequences;
8. Thinking of different alternatives, possibilities and options, for example, when explaining the reasons or discussing alternative actions;
9. Decision making – in order to do that it is necessary to discuss all relevant factors, tasks, consequences and possible alternatives;
10. Seeing other people’s attitudes existing due to the fact that others can take into consideration different factors, imagine different consequences or have other tasks or priorities;
11. Choice of the things according to what has to be done and according to the requirements – what is the most suitable;
12. An action which should be done and what is being done and what should be done, after that the systematization and analysis – for this purpose all factors should be discussed and the alternatives should be thought of;
13. Attention to different situation aspects, i.e. knowing when the analysis is being done, the factors are being discussed, the consequences are being considered, etc.
14. Project implementation related to thinking may be through formulating the ideas, finding answers to the questions or problem solutions, or admitting the failure to solve the problem;
15. Perception that opinions and facts are two kinds of evidence;
16. Recognition of weak, strong or essential evidence;
17. Recognition of the things which are agreed or not agreed about and the insignificant things;
18. Rightness in accordance with facts, authorities, etc.;
19. Justification of an argument with valuable words, such as “fair”, “proper”, “honest” or “sincere” instead of such words as “ridiculous”, “dishonest”, “cunning” or “stupid”;
20. Wrongness in the dispute about exaggerated things, mistakes (e.g., when providing facts) or about tendentious (fixed) ideas;
21. Doubting in existing work methods as the means to stimulate the generation of new ideas;
22. Improvement of different things by identifying shortages and thinking of the ways to eliminate them;
23. Solution of problems by thinking about the requirements of the problems;
24. Understanding what information is provided and what information is not
   provided but is necessary;
25. Understanding what is contradictory information which might lead to drawing
   wrong conclusions;
26. Recognition of which guesses are based on good information (“small guesses”,
   e.g., tomorrow the sun will rise), and which ones on bad (“big guesses”, e.g.,
   the final result of the future football match);
27. Ability to distinguish usual emotions (e.g. anger, love, fear, sadness) from the
   emotions related to the personal opinion about oneself (personality emotions,
   e.g., pride, the feeling of power or insecurity);
28. Understanding which values determine thinking, decisions, options and
   actions.

Though analogue thinking can be taught indirectly by using problems based on simple
analogies, it can also be taught by presenting it as a deliberate skill. For example, the
students might be asked to write an essay with a title “What did I do the last summer”
using the vocabulary which is usually used talking about a rocket launch or a football
match; “to borrow” some of the ideas from a fairy tale about Cinderella and to draw a
cartoon about some actual recent events in the way the painter would do it, or to
create school security system against breaking in on the basis of animals’ natural
security system.

**Meta-cognition in Development of Thinking Skills**

*Meta-cognition* is thinking about the way how we think. The basis of meta-cognition
activity is self-observation and personal reflection. This is one of the main
characteristics not only of the experts, but of the people thinking creatively too. Of
course, students should understand how they think and how their thinking is different
from the others (Sheppard and Kanevsky, 1999). Hong (1999) noticed that some kinds
of activities of a higher thinking level are closely related to meta-cognition, for
example, planning, forecasting, setting tasks, asking questions, evaluation, rehearsing,
choosing actions and strategies, usage of existing knowledge for generation of new
ideas and selective linking of new information to existing knowledge.
In order to stimulate personality reflection and accordingly meta-cognition, during the learning process of this type of thinking the students can write diaries, summaries, write down expectations and perform self-estimation, arrange final lessons. For example, the students can search the answers to the following questions: "What have I learnt?", "How have I learnt this?", "What do I still want to know?", "Which way of learning is the easiest for me? Why?", "What are my strong sides?".

In order to help the students to think about how they are thinking Sheppard and Kanevsky (1999) recommend the analogy of "mind – machine". When solving some problems the students had to draw and describe a machine which reflected the work of their mind. For example: one girl said that her mind is similar to steam iron which irons wrinkled pieces of information. Another student made the analogy with video camera, "When I know how to use it, then it works. But when I don't know that, then it becomes difficult to understand".

The students agreed that after such lessons they started understanding better how their mind was functioning (Sheppard, Kanevsky 1999).

The students being taught and encouraged by such simple methods and means start understanding why one or another method should be used, when it should be used and the stages of the usage of this method.

Meta-cognition is an aid to the students to understand the sources of their own ideas, attitudes and values and the origin of the ideas and values of other people. Barell (1991) recommended the students not to reason their own point of view, but try to defend the positions of the others, for example: what do students think about the suggestion to build a new swimming pool? What do tax payers think about this? Supervisors? Teachers? Besides, the teacher (or the students) can ask a question why have they thought of a certain question and what does it mean to them.

Besides, the teaching about the differences between the research and learning methods selected by different students could be attributed to meta-cognition as well. Some of the students prefer visual methods, meanwhile others audio or sensory. Some prefer lectures, autonomous investigations, team work, games, intensive activity, etc.
The abilities and activity of meta-cognition determine, control and stimulate the adaptation of thinking skills.

**Models of Teaching and Development of Thinking Skills**

**Application of De Bono’s CoRT Thinking Programme**

In 1973 – 1999 Edward de Bono created a consistent material for teaching direct thinking skills and later it was named CoRT Thinking Programme (CoRT Thinking Programme – *Cognitive Research Trust Thinking Programme*).

The advantage of this programme is that its implementation does not require any or only very little special preparation of a teacher.

The basis of the programme is so called PMI strategy:

- **P** – pluses;
- **M** – minuses;
- **I** – interesting.

Students have an opportunity to estimate new ideas, suggestions, phenomena and activity on the basis of these three provisions: pluses (positive things), minuses (negative), and the aspects which are neither positive nor negative, but just interesting to them.

The application of this strategy allows the students to learn argumentation and looking at things from different angles, for example, the ideas which at first seemed not very good will not be rejected. On the other hand, there will be no hurry in accepting the idea which sounds good and has serious shortages that have been missed. Some ideas are neither good nor bad, they are just interesting and important, furthermore they might stimulate the appearance of more ideas.

In the case PMI strategy is not used, the emotions can hinder clear decisions. When PMI strategy is used, the decisions about the idea are made after it is investigated, but not before.
Davis (2010) recommends different sets of lessons with the following sequence and structural parts (table 5):

Table 5

**Structural Parts of the Lesson, Implementing de Bono’s CoRT Thinking Programme**

<table>
<thead>
<tr>
<th>Part of the lesson</th>
<th>Purpose</th>
<th>Example of implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>Introduction</em></td>
<td>Defining and explaining the skill</td>
<td>While learning the skill of <em>all factors consideration</em>, the students find out that when making a decision or a choice there always exist many factors that should be taken into consideration. If one or more factors are being ignored, the option that was chosen might be wrong. Besides, students can try to see the factors that were ignored by others.</td>
</tr>
<tr>
<td>2. <em>Example</em></td>
<td>The example of a problem (or statement) is given and the skill is applied.</td>
<td>In London there is a law, according to which all new buildings must have underground parking lots. It was not thought about the fact that people would prefer going to work by personal vehicles due to the underground parking lots and thus the traffic in the streets would become worse.</td>
</tr>
<tr>
<td>3. <em>Practice</em></td>
<td>Four or five trial problems give the students the opportunity to gain personal experience using a respective skill.</td>
<td>What factors do you take into consideration when choosing a hairdo? What should be taken into consideration during the interview with a person applying for the teacher’s position?</td>
</tr>
<tr>
<td>4. <em>Activity</em></td>
<td>Distinguishing and discussing the main factors</td>
<td>During the class work or group discussions the students are discussing, for example, whether it is easy not to take into consideration important factors when it is important to consider all of them, and what happens when others do not take into consideration important factors, and whether it is necessary to consider all factors or only the important ones, etc.</td>
</tr>
</tbody>
</table>
5. **Principles**

| Generalization | Usually there are five reasonable principles that compare the arguments to use the skill and the advantages of the usage of such a skill. Everything should be reasoned. |

6. **Project**

| Solution of an extra teaching problem | A specific topic is being selected and its implementation project is being prepared. |

Thinking skills which are taught according to the CoRT thinking programme are not related to any specific subject area. Thinking is presented as a separate issue, a deliberate skill of meta-cognition.

**Feuerstein’s Instrumental Enrichment Programme for Teaching Skills**

Being a teenager, Reuven Feuerstein spent a few years in Nazi concentration camps. Later he helped children and adults to migrate to Israel and studied at the universities in Geneva and Sorbonne.

In Israel he was investigating the education needs of the immigrants, the majority of whom would be assessed as mentally retarded at the intellect tests. He developed a programme that was meant to change the cognition structure of mentally retarded people and to turn them into autonomous thinkers able to generate and explain ideas (Makler, 1980).

Feuerstein’s (1980) Instrumental Enrichment programme was meant to solve the questions related to such issues as impulsiveness; egocentric thinking and behaviour; recognition, definition and solution of the problems; consideration of one or two sources simultaneously; analysis, comparison, sorting; planning, trial; perception of the need of logical evidence; proper usage of time and space dimensions.

Feuerstein’s (1980) instrumental enrichment is a 3-year programme created for the children of 9 years and older, who are prepared for the formal operational thinking activity defined by Piaget.

Cognitive functions that are taught according to the instrumental enrichment programme are divided into three categories:

- **Input** (e.g., systematization of information);
- **Detail explanation** (e.g., estimation of information relevance);
- **Output** (e.g., presentation of problem solutions).
During implementation of instrumental enrichment programme the comparison exercises enhance the classification abilities and the ability to notice differences and similarities of the objects, events and ideas. Verbal and non-verbal syllogisms are enhancing formal logics, including the ability to use sets, subsets and repetitive sets. Students make conclusions regarding the validity of the things, find relations, principles, choose and process the data.

There are 13 types of exercises and each of them is enhancing certain essential abilities. The teacher should have a special preparation in order to implement the programme and has to prepare the teaching material and the means in advance, however some exercises or tasks can be used by relating them to daily teaching material or programme.

**Examples of exercises:**

**TO CONNECT THE DOTS.** The students are given a set of shapeless dots of different complexity. Their task is to identify and to draw geometric figures by connecting the dots, for example, squares, rhombus and stars.

This exercise enhances the projection of visual relations, the ability to distinguish shape and size, to maintain consistency of shape and size when orientation is changing, to use important information, to find strategies, to see perspectives, to control impulsiveness, to mark corresponding things, comply with precision and accuracy, to make plans, to set the start point, to perform systematic search and comparison according to the example, and it also increases motivation (Feuerstein, 1980).

**ORIENTATION IN SPACE.** The picture in which, let us say, a house, a bench, a garden and a tree are shown is presented (picture 1). There is a boy on the right side looking to the left, to the right, forward and backward. Imagine the picture of the boy in the middle of the garden.
When filling in the table, the student describes the location of every object displayed in the picture from the point of view of each direction the boy is looking in.

This exercise helps the children:

1) to use concepts and stable (specific, abstract or interpersonal) systems of standards in order to orientate in space,
2) to see how the problem should be defined,
3) to use several information sources simultaneously,
4) to work systematically,
5) to think of the basis of hypotheses and conclusions by making logical conclusions,
6) to understand how the data in the table should be summarized,
7) to present the information precisely and exactly,
8) to subdue the egocentricity.

**Socratic Method of Asking Questions in Education of Thinking Skills**

The purpose of asking questions in the process of learning is to give an impulse to the students’ active thinking. Asking questions is described as a support in learning, identifying and solving problems, mastering the material and concepts. Asking questions helps the children to identify their experience.

According to Bonz (1999), the questions have to be related to higher cognitive levels, to develop students’ intellectual abilities and also to enhance the skills of autonomous activity. If the teacher’s questions are oriented at a lower intellectual level, then the recollection of factual knowledge is requested (Gayle, Preiss, Allen, 2006). If the
teacher wants to achieve a higher level of intellectual cognition, he is striving for the assumptions and reflections that create a positive effect of learning achievements (Gall, Artero-Boname, 1995).

Asking questions is attributed to an interactive form of learning, as it is feasible only in the case if at least two players are involved: the student ready for the active activity and the teacher prepared for the expedient activity. The teacher’s task while implementing this method is to ask students the questions related to the problem, experiment, text, etc., which is being analysed, and to get their answers. Therefore, a proper preparation of the teacher is required, which is manifesting itself not only in the planning of the teaching and implementing of the teaching plan, but also in versatility (when the teacher is prepared for unexpected situations or students’ statements and questions). The results of the researches show that sometimes teachers ask from one up to four questions per minute. Unfortunately, the majority of the questions are usually related to the lowest (according to the Bloom’s taxonomy) level of knowledge or memory (80 %), and only the other 20 % are related to other five levels (understanding, application, analysis, synthesis, assessment).

On the basis of the system of cognitive levels the model of four questioning levels can be defined. It includes (Bonz, 1999):

- **Cognitive memory** questions related to the recalling and listing of specific facts (numbers, dates, propositions, definitions, etc.), for example, “What parts does a bike consist of?”, “Can you explain why do the trees grow?”
- **Convergent questions** when the asked questions cause reflection, considerations (for example, “What would happen if a bike lost one wheel?”, “What would happen if there were no trees?”).
- **Divergent questions** when a creative discovery of the connections is encouraged (for example, “How should I learn to ride a single wheel bike?”, “Does the growth of the trees with leaves differ from the growth of the trees with thorns?”).
- **Estimating questions**, encouraging the formulation of estimation and substantiation (for example, “What benefit do people get of a bike?”, “Why should the trees be preserved?”).

According to Kerry (1982), the following levels of questioning can be indicated:

Formation of the Concepts:
- listing (What have you noticed, read...?)
- systematization (What is attributed? In what order...?)
- classification (What are the related concepts? How can we define...?)

Interpretation and generalization:
- information collection (What did clear up...?)
- explanation and substantiation (How are you going to come back? How could this be explained...?)
- presentation and transformation of conclusions (What influence does it have...? What conclusions can be made on the basis of...?)

Making and checking the hypothesis:
- Explanation of the phenomenon and prediction (What would happen if...?)
- Substantiation of the hypothesis (How can you explain that...? How can you explain the assumption that...?)
- Checking the assumptions (What will we discover if...? How can this proposition be proved...?)

Kerry (1982) indicates the following types of questions that encourage the development of thinking:
- Hypothetical prediction: “What would happen if...?”
- Listing the reasons: “Why...?”
- Estimation: “What can be the evidence that...?”
- Problem solution: “How...?”

In the process of learning it is important to teach in order to understand, not to know. According to Kerry (1982), “in order to know it is enough to remember, and in order to understand it is necessary to think”. So, during the questioning the students have to think themselves, and it is one of the main advantages of the questioning method. For the students the questioning is more interesting than teacher’s monologue, because they are actively involved and the questions stimulate curiosity – Why (is happening)...? Besides, the students have to think; the logical links are shown and students are encouraged to follow them (What should be the temperature of the water in order fish could be bread?).
The method of questions emphasizes perception, not only knowing. When the teacher gives a verbal presentation, the students are told what they have to know. In this way the perception is not encouraged and it is unlikely that the memory will be active.

Questioning has a direct link to motivation of learning, as nothing can motivate better than a feeling of satisfaction that comes to the student after he answers the question or gets a compliment from the teacher (referring to psychology: stimulus-response learning method encourages motivation).

The advantages of the questioning method:

- Shows the logics of the subject that will be further followed and encourages perception rather than superficial memorizing;
- Ensures that new knowledge is based on the previous knowledge;
- Allows to transfer knowledge into another situation;
- Gives an immediate response to the teacher and the students revealing students’ understanding;
- Ensures acceptable for the students pace of lessons;
- Students find it an active and interesting activity;
- Students have an opportunity to use in practice the concepts and vocabulary they have just acquired;
- Shows wrong thoughts and attitudes (checking and corrections are being done);
- Motivate students as they get an opportunity to see how they succeed in learning;
- If the questioning is individual the teacher finds out the difficulties the students are facing;
- Allows the teacher to make assessment of learning;

Teaching and encouragement of thinking through asking questions sometimes is called “Socratic questioning” (Paul, Elder, 2005). It encourages students:

- To explain,
- To analyze assumptions,
- To investigate arguments and evidence,
- To analyze attitudes and perspectives,

- To analyze implications and consequences,
- To ask questions.

Paul and Elder (2005) note that the thinking model through questioning helps both teachers and students to apply the main concepts of Socratic critical thinking in any subject which is being taught or learnt. Davis, Rimm, Siegle (2010) present a questioning taxonomy allowing to observe the evolution of students’ thinking level – from elementary up to sophisticated:

**Explanatory questions:**

What do you mean by saying ___?
What is the point of your proposition?
Could you give an example?
Could you expand on this?
How ___ is related to ___?
Could you explain that in other words?
In your opinion, what is the main problem here?
How is it related to our discussion (problem, question)?
Jane, could you make a summary of what Richard said? Richard, did you mean that?

**Questions for the analysis of assumptions:**

What are your (their) assumptions?
What assumptions could be done instead?
All your argumentation is based on the idea that ___. Why do you base your arguments on ___, and not on ___?
It seems you are making an assumption that ___. How can you justify your opinion?
Is that always like this? Why do you think that this assumption is valid in this case?

**Questions for the analysis of reasons and evidence:**

Where do you know this from?
Are such reasons adequate?
Do you have (good) evidence to justify that?
Are there any reasons to doubt such evidence?
How could we make sure that it is true?
What other information should we be aware of?
Questions about attitudes and perspectives:

Why have you chosen this perspective and not the other?
Can anyone see the same thing differently? Why?
What would a person disagreeing with you tell?
How would you react to the objection from ___ side?
What is the alternative?
What do Roxanne’s and Ken’s ideas have in common?

Questions for the analysis of implications and consequences:

What do you imply by this?
When you say ___, do you imply that ___?
If this happens, what else could happen because of that? Why?
Would it happen for sure or maybe?
If this is the truth what else can be true?

Questions about the question:

How can we know that?
How anyone could solve this question?
Is this the same question as ___?
What assumption is hiding under this question?
Why is this question important?
Does this question ask us to estimate anything?
Do we all agree that this question is exactly like this?
What questions should be answered first in order this question could be answered?
References


"Thinking is a skill, therefore as all skills can be developed and improved" – stated a famous researcher of thinking de Bono. It has been proved by the researches that the children and adults, who have been taught purposeful thinking, are thinking more efficiently.

The development of thinking activity allows to develop a versatile cognition of different areas of life, improves the perception of these areas and general mentality. Due to all these factors the talent can be revealed and the success and satisfaction can be achieved after performing an attractive task or creating a product. Properly formed thinking processes help students to process the received information better and more quickly and to apply it properly and purposefully in the performance of academic tasks. In the learning process such students are efficiently employing creative and critical thinking abilities by using versatile processes of thinking skills, especially in the case when they need to perform complicated and complex tasks.

Speaking about didactic recommendations or teaching material for the development of thinking processes, referring to Parks and Black (2012), it can be indicated that teachers emphasize the necessity of critical and creative thinking development, but the training material has not been properly prepared yet, as there is a lack of the tasks or material for logical consideration and principles in the textbooks. This causes difficulties to the teachers who want to educate and improve students’ techniques of abstract thinking, technical logical perception, etc. Finally, there are no clear definitions given to the teachers what parts constitute the thinking processes, i.e. what the model of thinking processes is and what the training should be started from. Swartz and Perkins (1990) formulated a clear enough and not complicated model of thinking processes, where they not only named thinking elements, but also indicated the skills which help to identify these elements (Picture 2).
Creative thinking
Aim: to generate an original result
Skills:
- Plenitude of ideas (fluency)
- Variety of ideas (flexibility)
- New ideas (originality)
- Comprehensive ideas (explanation)

Analytic thinking
Aim: deep understanding
Skills:
- Comparison / juxtaposition
- Defining sequence / giving priority
- Classification
- Relation between separate parts / the whole
- Analogy
- Identifying reasons / consequences
- Identifying the main idea / the details basing it
- Revealing assumption

Critical thinking
Aim: to estimate the validity of decisions
Skills:
Identifying the reliability of initial conclusions
1. Using evidence
   a) Explanation of reasons
   b) Prediction
   c) Generalization
   d) Consideration according to analogy
2. Deduction
   a. Presumptional arguments
   b. Categorical arguments

Decision making
Aim: reasonable decisions
Strategy:
To consider options and the evidence of probability of appearance of consequences, to choose the best option referring to important consequences.
Skills:
To understand and restore precisely the information, to think of options, to estimate the validity of ideas.

Problem solving
Aim: the best solution
Strategy:
To identify the problem, consider possible ways of solving it, consequences, to choose the best solution and to define the most efficient means for its execution.
Skills:
To understand and restore precisely the information, to think of options, to estimate the validity of ideas.

Picture 2. The Map of Thinking Areas According to Swartz and Perkins (1990)
Teaching How to Use the Knowledge

It is not enough only to remember the knowledge, it is important to learn to apply it and to know when and how to use it. Students often are not able to apply the things they have learnt at school in the real life. One of the reasons of this is not completely understood material, missing relation between the constructs created by the student. The students should get used to learn more efficiently, practicing to apply the things they are learning. They should develop the need to think about relations between their created constructs, link them with each other and find out what relations there exist between the concepts and the procedures of the same and of different things. The tasks of a practical character not only help learning to apply the knowledge but also motivate to learn. Why should a student wish to go to school if he does not learn anything that could be applied in practice?

People of any age reach the best results in learning when they participate in the activities that seem to them meaningful in real life and important from the cultural point of view. The concept of culture here should be understood widely, this can be children and youth culture as well as the culture of different ethnical groups. A lot of activities at schools, according to children, are not significant as they do not understand why they are doing them and what is their benefit. The teacher can make learning more meaningful by relating it to the authentic context. For example, he can choose the activities characterizing the students’ daily life.

Didactic Recommendations

Linking the Existing Knowledge to the New Knowledge:

1) When learning fractions, a lot of children make mistakes because they apply the same rules for fractions as for natural numbers.

2) When learning a second language (foreign or state), children incorrectly apply some patterns of their mother tongue to the second language and do not understand that.

The teacher should foresee such learning difficulties and take corresponding actions: to draw students’ attention to the possibility of wrong understanding; to create such situations in which the wrong convictions would be exposed and the mistakes would
be understood; to give the students some examples of wrong perception; to give the students enough time to restructure their previous perception and knowledge.

**Strategies of the Knowledge Acquisition:**

Some children even in the first form, on their way to a shop, on their own initiative are loudly repeating the list of goods they need to buy. These children have already found the benefit of the strategy of repeating words aloud for memorizing things.

This shows that people are learning more successfully when they are applying efficient and flexible memorizing, thinking and problem solving strategies. Already at primary school children start developing individual learning strategies. Researches show that good results are achieved when teachers systematically teach students the learning strategies.

The strategies can be taught directly and indirectly. When the teacher raises the problem and suggests the steps for its analysis or asks significant questions which help the students to find the final answer, this means that problem solution strategies are taught indirectly.

**Learning as a Social Activity – Cooperation:**

It is often beneficial for students to learn in pairs or small groups, especially when they perform special tasks or activities that are dedicated for learning through cooperation. Properly organized work in small groups accustoms the students to speak, listen and handle the information related to the task, encourages thinking and generating ideas. Learning through cooperation improves the climate in the class, the learning motivation of the students, and educates their social competencies.

**Knowledge Construction:**

The student constructs his own knowing. The knowing of each student is individual.

- Learning is impossible without active participation and thinking of the student.
- The student, when starting to learn new material, has to activate the knowledge he already has.
- The most efficient learning takes place in the student’s closest surroundings.
One of the most important roles of the teacher is to provide the support that the student needs in explanation, training, learning planning, evaluation, learning to think and other.

Recommendation on how to prepare a programme for thinking skills teaching
(Costa, 2003)

Arthur Costa (2003) described four components of a well prepared programme for teaching children”skilful thinking habits“ or ”thinking types“.

Imagine four concentric circles similar to a dart table.

- **Reasonably selected material**, which is placed in the centre, is the subject in relation to which thinking skill will be taught, and then such skills will be applied. The selection of thinking skills depend on the teaching material in the sense that, for example, the solution of a scientific problem will require the skills related to logics and scientific control, meanwhile social and aesthetic material will require the skills related to ethics and artistic solutions. Moreover, interesting material increases the motivation of the students: ”*Teaching material activates and interests curious mind*“ (Costa, 2003, 326).

The second circle is **teaching of thinking skills**: essential means of efficient thinking, the understanding of which requires some help through direct teaching.

The third circle is called **"solution of problems requiring masterful thinking skills"**. Students encounter ambiguities, abnormalities, contradictions, dilemmas, secrets, obstacles or paradoxes that need to be solved.

Thinking skills are systematized by creating strategies that are called *creativity, problem solving, and decision making*.

The external circle is **thinking types** – suppositions or inclinations to use thinking skills in favourable circumstances. The students must value the thinking skill, know when to apply it, be able to use it and have obligations to improve a certain thinking skill.

Although the number of thinking types is infinite, Costa (2003) listed the following 16 rather complicated and, in his opinion, particularly important thinking skills:
– to be persistent when the solution is not clear;
– resist impulsiveness;
– listen to other people with understanding and empathy;
– think flexibly;
– think about one’s own thinking (meta-cognition);
– strive for accuracy and precision;
– ask questions and raise problems;
– apply knowledge acquired earlier in new situations;
– think and communicate clearly and precisely;
– collect data using all senses;
– create, imagine, implement novelties;
– react with surprise and respect;
– take reasonable risks;
– understand humour;
– think autonomously;
– be constantly open for the continuous learning.

Development of Meta-cognition

1) **Variety of the activities:** diaries, summaries, writing down expectations, self evaluation, preparation and presentation of the reports, answering such questions “What have I learnt?”, “How have I learn it?”, “What else do I wish to know?”, “Which way of learning is the easiest for me? Why?”, “What are my strong sides?” (Leader, 1995).

2) **Not to reason your own point of view, but try to defend the positions of the others** (Barell, 1991), **for example:** What do students think about the suggestion to build a new swimming pool? What do tax payers think about this? Supervisors? Teachers? Besides, the teacher (or the students) can ask a question why have they thought of a certain question and what does it mean to them.
The Lesson of Development of Thinking Skills

Usually the structure of each lesson consists of the following six parts:

1. **Introduction.** During introduction the skill is defined and explained. For example, while learning the skill of problem solving, the students find out that when making a decision or choosing something there are always a lot of factors that should be taken into consideration. When one or more factors are being ignored the selected variant might seem to be wrong. Besides, the students can try to find out the factors, which were not considered by others when they were thinking.

2. **Example.** An example of a problem (or a statement) is presented and the skill is applied. For example, there was a law in London according to which all new buildings had to have an underground parking. The fact that an underground parking will encourage people to go to work by their own cars was not taken into consideration therefore traffic jams in the streets became worse.

3. **Practice.** Four or five trial problems give the students opportunity to gain personal experience by using a corresponding skill. For example, what factors are taken into consideration while choosing a hairdo?

4. **Activity.** When working in a class or discussions groups, the students discuss, e.g., whether it is easy not to take into consideration the important factors, when it is important to discuss all the factors, what happens when others do not take into consideration the important factors and whether it is necessary to consider all the factors or only the most important ones.

5. **Principles.** Usually five reasonable principles are presented and they can be compared to the arguments to use the skill, and to the advantages of the usage of such a skill.

6. **Project.** These are additional teaching problems.

**Development of Thinking Skills and Assumptions** (based on Lipman, 1988; Lipman, Sharp and Scanyan, 1980; Sharp and Reed, 1992 “Philosophy for Children”).
- **Relation of the reason and the consequence.** Determine whether the following statement means relation between the reason and the consequence: “He threw a stone and broke the window”.

- **Recognition of consistent and contradictory statements or ideas.** For example: can you be a true animal lover and still eat meat?

- **Identification of not clearly expressed assumptions.** What supposition is hiding behind the following statement: “I love your hairdo. In which beauty salon were you?”

- **Finding out the relations between separate parts and the whole complex, the whole complex and separate parts.** The students might be asked to evaluate whether, for example, the statement “If the features of Mike’s face are nice so Mike’s face is nice” is correct.

- **Making generalizations.** The students make generalizations on the basis of series of facts such as “Raspberries make me sick; strawberries make me sick; blueberries make me sick.”

- **Analogical thinking.** The students practise to think in analogies when solving such problems as “Bacteria for the disease is the same as candle for (a) wax, (b) wick, (c) whiteness, (d) light”.

- **Invertible and non-invertible statements.** The statements that include the words “any” / “none” are invertible, for example, “none of the submarines are kangaroos; meaning none of the kangaroos are submarines”. However, the statements including the word “all” usually cannot be inverted: “All plain models are toys, but not all toys are plain models”.

- **Independent thinking.** Should we always have to follow the majority?

- **Ability to look at things from a different angle.** Can you look at this question from a different perspective?

- **Taking care.** Taking care of other people’s well-being.
Teaching Methods for Teaching of Thinking

Frayer's Model for the Development of Vocabulary – Formation of Concepts by Creating Definitions

The variant of application of concepts’ formation through the analysis of the features of objects and the presentation of the definition of the concepts is the model of vocabulary development by Frayer (1969), further the model of Frayer. The application of this model in the teaching process helps to develop thinking by expanding the perception and formation of concepts.

By using the model of Frayer (Frayer, Frederick & Klausmeier, 1969), a graphical structure, which helps the students to find the meaning of words and concepts and to describe them, is presented. This process helps the students to enhance the understanding of words. The students are asked to consider important features (characteristics) of the word (concept), to provide appropriate to the concept examples and not appropriate nonexamples, to formulate definition (example in the table 6):
Table 6

Filled in Graphical Scheme of the Model of Frayer

<table>
<thead>
<tr>
<th>Description</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>“a person who is exploring nature and physical world by performing tests, experiments and measures”</td>
<td>It is typical for the scientist:</td>
</tr>
<tr>
<td></td>
<td>– To raise questions</td>
</tr>
<tr>
<td></td>
<td>– To observe</td>
</tr>
<tr>
<td></td>
<td>– To foresee results and/or formulate hypotheses</td>
</tr>
<tr>
<td></td>
<td>– To collect, classify and analyse data</td>
</tr>
<tr>
<td></td>
<td>– To prepare (plan) an experiment</td>
</tr>
<tr>
<td></td>
<td>– To draw conclusions</td>
</tr>
<tr>
<td></td>
<td>– To present (communicate) the results to others</td>
</tr>
</tbody>
</table>

A SCIENTIST

Examples
- Astronomers – are exploring the universe (planets, stars, etc.)
- Biologists – are exploring the nature (plants and animals)
- Geologists – are exploring the earth structure (rocks and soils)
- Physicists – are exploring materials and energy.

Nonexamples
- An entertainer
- A poet
- A banker

Practical Application of the Model of Formation and Perception of Concepts by Frayer in the Lesson

1) Prepare a table. On a large sheet of paper draw a table and write down the statements which students will have to work on.
2) Discuss the nature of the future activity in order the students could understand how to work: what should they do autonomously, which sources should they use, in what way should they present the information, etc.

3) In order the work principle was clear to the students you could start from the analysis together in the class of a well known word, for example, a stone, a shoe, an umbrella, etc.

<table>
<thead>
<tr>
<th>Description</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SHOE</td>
<td></td>
</tr>
</tbody>
</table>

The Scheme of the Model of Frayer

4) First, ask students to describe the word in their own words. Write down a definition corresponding to their knowledge.

5) Then ask students to give typical features (characteristics) of a word (concept) or the facts which they know about this word (concept).

6) Finally, ask students to give the examples and nonexamples which are appropriate for the concept and finish filling the table.

After students have mastered the principle of the nature of activity the model of Frayer can be used in other ways as well:

1) At the beginning the examples and nonexamples are given and students are asked to discuss what word or concept it might be.

2) Similar exercises might be given when some parts of the scheme are filled in and students are asked to fill in the rest of the scheme.

When students are exchanging ideas, it is recommended to pay attention at the level of understanding of a group and of each student in order not to divert from the main goals or the topic which is being analysed.
Usage of Systematized Tables

Using the tables the teachers and the students can see, organize and show the complicated information which is used for estimating questions, solving problems or making decisions. The systematized tables can be also used for monitoring thinking, project planning and assessment of students’ achievements.

The systematized tables contain names, titles or the questions which have to be answered or the statements which have to be clearly presented, therefore in this case the purposefulness of thinking is very important as it is necessary:

- To estimate the reliability of information sources,
- The reasons of conclusions,
- To think according to the analogy,
- To estimate the explanations of the reasons,
- To make reasonable predictions,
- To estimate general laws or to form them,
- To be guided by conditional or categorical thinking.

The systematized tables can be used for several purposes:

- To provide and systematize the information for researches and assessment;
- To show interrelationship;
- To stimulate and handle thinking process.

The Example of Usage of the Systematized Table

The table contains the information which is used to estimate what sources of energy and in what way can be used and developed (Swartz, Parks, 1994). The references, given in the table of the variety of energy sources, can help the students to collect requested miscellaneous information and to make observations (table 7).
Table 7

**The Example of the Systematized Table**

<table>
<thead>
<tr>
<th>Variants</th>
<th>Relevant consequences</th>
<th>Environment protection</th>
<th>Costs</th>
<th>Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power</td>
<td>Is it simple to produce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive Photovoltaic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy from the chemical products of petroleum</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Energy from coal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An important aspect which should be mentioned when the usage of the table is related to the development of thinking abilities is that the table has not only to be filled with relevant information, but also all information has to be analyzed in reference with the approach to the consequences for the environment, human, etc. (the line on the top). This means that students during collection of the information have to consider the anticipatory solutions, for example, when indicating the employment possibilities of a certain energy source, it is necessary to estimate the accessibility, costs or impact of this source.

Students can fill in the table in groups or individually, however later the collected information is systematized and moved into one table. This process is very intensive because of meta-cognition: every student or group has to substantiate and reason his/its choices or decisions.

As it is shown in the table which contains the example of the systematized information, students have not only reasoned, but they have also found out the meaning of each statement, e.g. the group of students which had to collect information about solar power prepared their generalizing statement in which they had synthesized the important information about solar power received during investigation (table 8).
<table>
<thead>
<tr>
<th>Variants</th>
<th>Is it simple to produce</th>
<th>Environmental protection</th>
<th>Costs</th>
<th>Accessibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active Photovoltaic</td>
<td>Simple if the place,</td>
<td>Doesn’t cause undesirable air or water pollution. Plain equipment or circular mirror fields</td>
<td>Solar power plants are expensive (the price could get down if mass production is started).</td>
<td>Limited by place, latitude and weather.</td>
</tr>
<tr>
<td>Passive</td>
<td>latitude and weather</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>conditions are</td>
<td></td>
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<tr>
<td></td>
<td>favourable.</td>
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<tr>
<td></td>
<td>Requires not much</td>
<td></td>
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<td></td>
<td>maintenance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doesn’t require much</td>
<td></td>
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<tr>
<td></td>
<td>repair.</td>
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<tr>
<td></td>
<td>Photovoltaic</td>
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<td></td>
<td>systems are</td>
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<td></td>
<td>not economical, the</td>
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<tr>
<td></td>
<td>existing technologies</td>
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</tr>
<tr>
<td></td>
<td>should be improved.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear power</td>
<td>Complicated, requiring</td>
<td>Danger of radiation.</td>
<td>Expensive safety measures, maintenance and the establishment of power plants.</td>
<td>Uranium is a rare raw material.</td>
</tr>
<tr>
<td></td>
<td>sophisticated equipment,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>specialized techniques and unusual safety measures.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Waste removal is risky, requiring long term storages.</td>
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</tbody>
</table>

(Swartz. Parks, 1994)
### Energy from the chemical products of petroleum.
- Complicated but widely used.
- Risk of petroleum spill.
  - The stock of petroleum is being wasted.
  - Hydrocarbon is polluting the air, damaging ozone layer, causing acid rains.
  - Refining petroleum the air is polluted.
- High costs of research, tests, distribution and cleaning.
  - Expensive import; dependence on the price in international markets.
- Used not only for getting energy.
- Limited, dependent on the region stock.
- Not renewing source.

### Energy from the coal
- Complicated but widely used.
- Open mines destroy the landscape.
  - When the coal is used the surface is covered by a grey layer.
  - The parts’ emission is polluting air.
  - Acid rains pollute air and water.
- The researches of the usage and spreading of soft coal are very expensive.
  - Expensive manpower, transport and storage.
- Declining stock.
  - The soft coal is not widely enough used.

When the filling of the table is finished, the information in each column is generalized and the common principle helping the students to answer another important question—which consequences are more important than others, identified. This generalizing statement tells which factors have more weight in making the decision concerning energy sources. When reflecting about the generalizing statements of the lines and columns, the students can prepare recommendations which energy sources should be used by a country.

## Verbal Communication in Development of Thinking Skills

Through verbal communication students are acquiring, perceiving new knowledge and linking it into the whole. When students talk they show their ability to solve problems. Language is only the thinking medium; however it is also an important means to teach thinking.
Karnes, Bean (2014), referring to Tchudi and Mitchell (1999), defined the process of five stages during which communication is used as a teaching tool:

1. **To involve and interest.** Teachers involve the students through the presentation of new material. Students are generating ideas or discussing what they know about one or another subject. The goal is to give every student an opportunity to be listened to and to help them “to be convinced” by this subject.

2. **To explore.** Working in a small group, students start to understand information through asking each other questions about a specific subject and discussing the areas they are interested in.

3. **To transform.** Students start to concentrate their thinking and to make decisions in order to acquire new understanding of a specific subject.

4. **To present.** Students prepare formal presentations for a bigger group. The aim is not only to provide information, but also to give the group an opportunity to react to their thoughts. During this period the formal presentation skills become very important.

5. **To reflect.** Students are again divided into smaller groups and discuss what they have learnt and how their learning process has been affected by communication with other people and present the impact on their thinking.

Most often four verbal communication areas with two participating parts – the speaker and the listener, the interaction of which is called communicating, are distinguished:

- speaking (e.g., a lecture),
- group discussions,
- interviews,
- debates.

### The Examples of Teaching of Verbal Communication

**Interview**

For the students it is important to know how to speak to people and listen to them in order to get first-hand information and to record it. Sebranek, Meyer and Kemper (1990) gave a few useful pieces of advice regarding how to arrange a good interview.
They set the milestones which the students should be guided by during preparation for the interview, during the interview and after the interview.

<table>
<thead>
<tr>
<th><strong>Before the interview</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose carefully a person who has specialized knowledge of the investigated area.</td>
</tr>
<tr>
<td>Write down all questions which you are going to ask.</td>
</tr>
<tr>
<td>Make an appointment for the interview with a person at convenient time and place.</td>
</tr>
<tr>
<td>Inform the person about the nature of your project in advance.</td>
</tr>
<tr>
<td>Study your subject in advance in order the amount of new information would not astonish you and you would appear to be a well-informed listener.</td>
</tr>
<tr>
<td>Practice to work with a microphone in order to know how to use it and how the cartridge and elements could be replaced quickly.</td>
</tr>
<tr>
<td>Rehearse asking questions and writing down answers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>During the interview</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Start with introducing yourself, say thanks for the interview and ask whether you can make notes or use a voice recorder.</td>
</tr>
<tr>
<td>Ask a good first question and listen carefully.</td>
</tr>
<tr>
<td>Keep an eye contact with the informant, pay attention at his facial expression and gestures.</td>
</tr>
<tr>
<td>By active listening show that you are actively involved in the subject you are discussing and that you are interested in it.</td>
</tr>
<tr>
<td>Do not interrupt the informant without a serious reason.</td>
</tr>
<tr>
<td>Before finishing the interview look through the notes – is there anything that should be cleared out or are there any extra questions that should be asked?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>After the interview</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Say thanks to the informant for the interview and ask whether he would like to get the copy of the final product.</td>
</tr>
<tr>
<td>As soon as you can, write down everything that you can remember. Later write down the transcription of the interview from the voice recorder.</td>
</tr>
<tr>
<td>Once again ask the informant or any other authoritative person the questions about all doubtful facts or information prior to including it into the final product.</td>
</tr>
<tr>
<td>Make sure that the informant will get the copy of the final product if he wished to have it.</td>
</tr>
</tbody>
</table>

Students can prepare the interview about one subject but choose different ways:

- TV interview;
- Radio interview;
- Newspaper interview;
- Scientific research interview.
Several groups can perform the interview according to one method and one subject, e.g., the scientific research interview, and to do the research of a specific subject, but together with different participants of the research by asking different questions about the selected subject therefore the collection of information will be complex and detailed.

**Debates**

This way and ability of communication gives an opportunity to investigate, to define and to defend both sides of any argument or question. It is important to teach acceptable formal terminology and order. Students should be able to perform investigation, to distinguish the essential information from the non-essential, to substantiate the statements by firm evidence and arguments, to work together with other students and to express thoughts clearly and efficiently (Summers, Whan and Rousse, 1963). In many cases debates can be one of the pithiest ways to develop leadership skills.

It is said that the stage of the preparation for formal debates is as important as the formal debates and even more important. For the beginners of debates it is especially useful to use the defined format. In accordance to this clear and concise method of debates, important skills of debates become accessible for every talented student. Debates encourage the students to be interested in hot news, help developing the abilities of critical thinking, improve communication skills and ability to explore at the same time demonstrating how deliberate, positive and well organized changes can be made in a democratic society (Karnes, Bean, 2014).

<table>
<thead>
<tr>
<th>Recommendations for Arranging Debates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Preparation for debates</strong></td>
</tr>
<tr>
<td>A. Analyse a statement.</td>
</tr>
<tr>
<td>B. Choose a position.</td>
</tr>
<tr>
<td>1. Positive position</td>
</tr>
<tr>
<td>2. Negative position</td>
</tr>
<tr>
<td>C. Allocate the duties for the team members.</td>
</tr>
<tr>
<td>D. Prepare arguments.</td>
</tr>
<tr>
<td>E. Substantiate arguments.</td>
</tr>
<tr>
<td>1. Find evidence</td>
</tr>
</tbody>
</table>
2. Use logical argumentation

F. Create strategies.
   1. Positive strategies
   2. Negative strategies

<table>
<thead>
<tr>
<th>II. Participating in Debates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Choose a format.</td>
</tr>
<tr>
<td>1. Standard format</td>
</tr>
<tr>
<td>2. Cross-examination format</td>
</tr>
<tr>
<td>3. Lincoln – Douglas format</td>
</tr>
<tr>
<td>B. Say speeches.</td>
</tr>
<tr>
<td>1. Constructive speeches</td>
</tr>
<tr>
<td>2. Cross-examination</td>
</tr>
<tr>
<td>3. Denials</td>
</tr>
<tr>
<td>C. Estimate the efficiency.</td>
</tr>
</tbody>
</table>

Application of Questioning in the Development of Thinking Abilities

The teacher who is asking questions is constantly receiving a feedback on how the students have understood the subject.

The purpose of questioning is acquisition of new knowledge

– The essential thing that should be aimed at during questioning is that students could acquire as much as possible new knowledge during the lesson.
– Each question must raise an interest, only then the knowledge is acquired easier.

The Basics of Questioning Techniques

Nobody can tell which type of questioning is the best. Everybody has to judge according to the situation. However, it is worth knowing some rules of the questioning:

– The question must be formulated correctly in the sense of language and content, avoiding any ambiguities: Where is the coal mined? I have in mind not the mining company but the location.
The question should have only didactic propositions, double questions or asking the same question twice should be avoided: What are the perspectives of an urbane photographer? Why?

From the point of view of the language the question cannot be reverse (opposite), the questions with explanation should be avoided: Are they only the citizens of a pension age?

The question cannot contain too much information: What is the capital of Italy? Does it start with a letter “R”?

Mysterious, vague questions should be avoided.

After asking a question, the teacher should give the students some time for thinking and giving an answer. This time cannot be interrupted. It is recommended to wait for at least 3 seconds (try to count!). Most often not more than one second is given for the answer.

The teacher cannot spend too much time for presenting the question (it will ruin the curiosity).

The student has to tell everything, and he has to get a reaction and comments to his answer.

“The teacher’s echo” must be avoided. It is not necessary to repeat each student’s word unless the student is answering fragmentally, then some additions or modifications could be suggested.

The teacher cannot be responsible for the student if he gives wrong answers, it is better to give extra questions that could lead to the right answer.

The question can be given to the whole group.

It should be observed that not too many questions have been asked – one question each half a minute (unless chain questions have been asked).
The Examples of Using Questioning Techniques

<table>
<thead>
<tr>
<th><strong>What do you see?</strong> (it is recommended to choose real things representing the topic of the lesson)</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Why are candles made only of wax (paraffin)?</td>
</tr>
<tr>
<td>– What can be done with a candle?</td>
</tr>
</tbody>
</table>

**What could be the topic of the lesson?**
- It can be formulated by all together
- Children can guess
- The formulation can be prepared by the teacher

<table>
<thead>
<tr>
<th><strong>What do you see?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>– What materials is this thing made of?</td>
</tr>
<tr>
<td>– Why is it used in darkness?</td>
</tr>
<tr>
<td>– What would happen if we did not have this thing?</td>
</tr>
</tbody>
</table>

**Further activity when the topic of the lesson has been formulated**

**What aspect do you imagine further?**
- I am interested in...
- Now we are going to discuss...
- Could you now name...
- Name what comes into your mind...

**How did you understand it?**
- Substantiate your statements
- Explain why do you think so
- What reasons allow doing such generalizations?

**What did you like the best in this situation?**
- I would like to know what you liked the most in this story;
- Say your first impression;
- What main aspects can be distinguished in this situation?
- I was thinking much about this situation, why?

**What did you not understand?**
- Is there anything we have not talked about?
- Why have we not talked about these things?

**How can it be described?**
Can you give any suggestions?
What are other options?
How can it be described?
Can it be somehow recorded?

These questions can be further developed in detail or only a part of them can be chosen – it depends on the intended goal.

**Assessment of Thinking Skills**

It is difficult to evaluate how the students’ thinking has changed, however in any case the students are waiting for their work and efforts to be assessed and noticed. The assessment of work results is the most significant way to assess the higher thinking level.

One of the most difficult questions of the assessment of the changes in students’ thinking and their success in acquiring teaching material is related to the planning of assessment tasks, the assessment of work results among them, and the assessment of students’ works by giving the grades. The teachers always face difficulties in giving grades, especially if critical and creative thinking is being emphasised during the lessons and in the tasks.

As thinking of a higher level reveals itself the best when students are demonstrating their ability of skilled thinking and understanding of the teaching material and this requires a lot of time for preparation, Karnes and Bean (2014) recommend ranking such assessment procedures by importance as indicated in the table below:

- The assessment tasks related to critical or creative thinking require to develop time consuming products therefore they are the most valuable;
- The tasks of analysis can be assessed by filling in the forms, which is less time and effort consuming;
- The tasks related to the knowledge, perception and application might be assessed by performing the tests that are less time and effort consuming, therefore such tasks are valued the least.

Below there is an examples of assessment distribution, after the tasks for the subject “The Civil War” have been performed (table 9).
### Assessment Tasks

(according to Karnes and Bean, 2014)

<table>
<thead>
<tr>
<th>Importance</th>
<th>Assessment of learning</th>
<th>Assessment procedures</th>
<th>Material (The Civil War)</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>What main concepts that should be additionally analysed and estimated have I learnt during this lesson?</td>
<td>The results of activity (speeches, projects, work in laboratory, detailed written answers).</td>
<td>Reasons and results, argumentation of each side, differences of resources.</td>
<td>What influence did the government form have on the outcome of the Civil War?</td>
</tr>
<tr>
<td>20%</td>
<td>What concepts are related to consistent or rational thinking?</td>
<td>The results of activity (projects, diagrams of concepts, drawings) Detailed written answers, Classification Options</td>
<td>Events or leaders and battles Resources of Southerners and Northerners Life in slavery</td>
<td>Classify the presented events and retell them by heart. Write down the events in their sequential order. Prepare the diagram of the concepts of leaders and battles. Compare the resources of southerners and northerners.</td>
</tr>
<tr>
<td>20%</td>
<td>What important definitions were not mentioned in the previous paragraphs?</td>
<td>Concise written answers Detailed written answers (descriptive essays) Options</td>
<td>Abolitionism Sea blockade Isolation</td>
<td>Did Abraham Lincoln declare for abolitionism? Why? Tell about the sea blockade as about the war strategy. What is isolation?</td>
</tr>
<tr>
<td>10%</td>
<td>What facts are necessary for increasing literacy or avoiding confusion?</td>
<td>Concise written answers Coordinating options Options</td>
<td>Decision of Dred Scott Isolation Compromise of Missouri Skills of map reading</td>
<td>Which of these things encouraged the opposition to slavery in the North before the war: fight anthem of the Republic, “Uncle Tom’s Cabin”, Dixieland?</td>
</tr>
</tbody>
</table>
The efficiency of analytical and critical teaching is revealed in the quality of students’ written works. They are reflecting students’ thinking. If student’s thoughts are vague, not concentrated and unfinished, his written works will be the same. The improved quality of written works is the best and direct evidence of the efficient teaching of critical and analytical thinking.

The table shows the relations of thinking processes and different tools aiding students in writing. Though the questions in the thinking strategy column can be treated as standards for creating headings, often students’ thinking is implicit and not evident. If teachers do not revise students’ notes they might not find out whether students analysed the main questions related to various thinking strategies, when they were doing their written works (Table 10).

Table 10

The Relations of the Types of Written Works and Thinking Strategies
(according to Parks, 1999)

<table>
<thead>
<tr>
<th>Types of written works</th>
<th>Thinking strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Narrative</strong></td>
<td></td>
</tr>
<tr>
<td>Create a story about the following situation: _______.</td>
<td>Decision making</td>
</tr>
<tr>
<td><strong>Explanatory</strong></td>
<td></td>
</tr>
<tr>
<td>Compare and juxtapose ______ and _______.</td>
<td>Comparison and juxtaposition</td>
</tr>
<tr>
<td>Describe the events which caused _________.</td>
<td>Making up a sequence</td>
</tr>
<tr>
<td>What caused _______.</td>
<td>Explaining the reasons</td>
</tr>
<tr>
<td>What would happen if _______.</td>
<td>Prediction</td>
</tr>
<tr>
<td><strong>Persuasive</strong></td>
<td></td>
</tr>
<tr>
<td>Why should ______ do ______?</td>
<td>Reasons / Conclusions</td>
</tr>
<tr>
<td>Why did ______ do ______?</td>
<td>Explaining the reasons</td>
</tr>
<tr>
<td>Prepare an argument for _______.</td>
<td>Reasons / Conclusions and disclosing the assumptions</td>
</tr>
<tr>
<td>How should we behave with _______?</td>
<td>Decision making</td>
</tr>
<tr>
<td><strong>Creative</strong></td>
<td></td>
</tr>
<tr>
<td>Write a poem or a story about _______.</td>
<td>To create a metaphor</td>
</tr>
<tr>
<td><strong>Descriptive</strong></td>
<td></td>
</tr>
<tr>
<td>Describe _______.</td>
<td>To create opportunities</td>
</tr>
<tr>
<td>Describe how _______.</td>
<td>Parts of the whole or classification</td>
</tr>
<tr>
<td></td>
<td>Making up a sequence</td>
</tr>
</tbody>
</table>
References


