

# Development of Spatial-visual Intelligence

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## Summary

*Due to development of mass media, greater attention has been shown to an image as a visual object. Development of visual competence has also been promoted so as to avoid the danger of visual analphabetism, and in order not to succumb to the power of the image. With the development of digital media and discussion about iconic turn, the awareness of the significance of images – not only in art – but also in natural and social sciences has been getting stronger. For active, critical and conscious perception of images, as well as for selection in yet bigger number of images, special competence, which is developed as basic competence in the sense of aesthetic education is essential. The subject matter of this paper's research is a possibility of developing spatial-visual intelligence. During learning and thinking process, visual intelligence plays a great role in creating visual image, memorizing by means of images and, accordingly, it should be developed in as greater measure. Spatial-visual intelligence can be developed via reading geographical maps, navigation, park planning, model construction, constructive games, plotting, making itineraries, or visual maps of any information (Mindmap). The degree of visual intelligence helps students to acquire knowledge not only through static images, but also to engage their imagination, to imagine objects from different angles. Through the dynamicity of video-clip they visualize gained information. Child's spatial-visual intelligence can be deformed by non-critical acceptance of mass culture's products, i.e. by predimensional visual impulses via media, films, the Internet, videogames.*

**Key words:** visual IQ, intelligence, perception, spatial-visual intelligence.

## Introduction

In the age of complete predominance of visual media and visual communication – that refers to computer and the Internet, mobile telephony, television, newspapers, advertising posters and shop windows etc. – we can notice that the awareness of visual education importance is very low. The reason can be found in insufficient art culture and in long-lasting decrement of importance of art subjects in school in general. In human perception, eyesight has the crucial role. We are able to aggregate and bank up an incredible amount of visual information. The question of identification of shapes and forms is subject-matter of psychologists, artists, but also of engineers and informaticians. Every information system contains reception and coding of information. In modern world, a need for fast decision making, choice skill, active initiation, creativity and constructive thinking is made. Fast, successful and opinionated thinking is precious in everyday work of engineers, managers and teachers. Each child is born with certain abilities. Though, a great number of children are not able to use their abilities, regardless the level of inborn talent. According to Bloom's taxonomy<sup>1</sup>, different levels of knowledge can be distinguished – from simple knowledge of facts, through apprehension, implementation, analysis, synthesis, to most complex evaluation, which all require a more complex ability of thinking. Symbolically, for presentation and quality gaining knowledge of graduated students, we have modified a model of Multiple intelligence<sup>2</sup>. Students' desirable features can be presented in a form of Multiple intelligence:

1. Linguistic
2. Logical-mathematical
3. Spatial
4. Physical-kinetic
5. Musical
6. Interpersonal
7. Intrapersonal

## Perception and visual communication

Human perception is a process of gaining, interpretation, selection and organization of stimulative information and, as such, presents a source of all knowledge. It can be viewed as an observation of relationships between reality (enchantment) and mind (intellect) reflection (thinking, judgement etc.) Depending on which sensory organ is dominant, we can distinguish visual, auditive, tactile,

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<sup>1</sup> In 1956 Benjamin Bloom developed the classification of levels within cognitive domain, together with a group of educational psychologists. Also, he discovered that the pupils in 95 per cent of cases come across questions which refer to the bottom level – recollection of information – during testing. Those six levels are: knowledge, comprehension, implementation, analysis, synthesis and evaluation.

<sup>2</sup> Theoretically elaborated by Howard Gardner in book *Frames of Mind*.

gustative and olifactive perception. In human perception, a crucial role belongs to eyesight. We are able to aggregate and bank up an incredible amount of visual information. The question of identification of shapes and forms is subject-matter of psychologists, artists, but also of engineers and informaticians. Perception is not only noticing of enchantment from surrounding, but also a complex process which takes place through organization and interpretation of meanings and provoking organism's reaction. Perception and comprehension of scene will depend on man, i.e. on his previous experience, motive and interest. Only things that we know, that we "see" with our mind, have influence on perception. In this way, for example, a simple sentence written on a piece of paper can be interpreted individually and in different ways. For those who are illiterate, paper contains only different lines and patterns, and someone who is not familiar with, for example, Croatian language, is able to distinguish only letters, without their real content. Every information system contains reception and coding of information. The written word "blind" is a carrier of meaning, and it is called 'signifier', and the meaning of the word is a term that signifies a man who is not able to see. Many of signs used in communication process incurred arbitrarily. Their decoding indicates how to learn the structure and language manners of their use. Communication is inevitable without people, sign and objects of universe. Contemporary science, which deals with signs and sign systems, has developed from two sources. In 1916 Swiss linguist Ferdinand de Saussure introduced presumptions about general science semiology. Opposing De Saussure's linguistic approach to issues, Anglo Saxon scientist Charles Sanders Peirce researched interrelationship between physical sign, object and human from a logical point of view, and is regarded as founder of semiology. The smallest element in De Saussure's semiology is a sign, which is composed of form and concept ('signified' and 'signifier'). According to him, majority of signs are symbolic and accidental, and their meaning can be understood as a process that connects the 'signified' with the 'signifier'. Communication is transmission of thoughts and messages. Elementary forms of communication are based on signs and sounds. Phrase 'communication' can be understood as comprehension of all procedures with which one mind can influence another. Such an extended definition contains not only speech, but music, art, theatre, ballet, etc. Communication with environment in which we live, and throughout it with broader human society, represents communication of ideas, attitudes or mental/psychological reactions on given conditions in society, problems and methods of their solving.

Expression 'communication' is derived from Latin word 'communis', which means 'common'. Therefore, communication can be specified as a process of communion or union of addresser and addressee. *Visual communication* manifests in linguistic and non-linguistic form. Linguistic form is, for example, language of the deaf and the dumb. Pitch of visual linguistic communication development is the development of alphabet. Communication systems as Morse

alphabet and traffic lights belong to this group. Typical non-linguistic forms of visual communication are facial expression (for example: smiling, scowl) and gestures (for example: shrugging). Visual-spatial intelligence refers to orientation in space, ability of figurative and abstract visualization, thinking via imagery (scenic) conception, capability of thinking in the third dimension, redefining and recombination of existing art compositions into new ones. Art creativity affects imagination, ability of forming in different two-dimensional and three-dimensional materials, creating different practical works (drawing, pictures, reprints, sculptures, reliefs, installations). Visual language is made of art elements (paradigms) and compositional principles (syntagms). Visual presentations are based on the system of conventions which has developed in process of attempts and mistakes throughout millenniums, to unite sign and signed. In that context, in relation between sign and signed, our reaction on image should respond to reality that the image represents. Creator of visual message demonstrates its presentation in scenic form, which is made of visual elements. Communication can take place only in some social context and linguistic environment. Visually coded message is subject to influences of social and cultural environment, as well as recipient's message interpretation is subject to same influences. Just as the recipient, communicator has to possess certain knowledges that have been acquired through learning and are predisposed by collective memory. Throughout the process of socialization, we acquire different kinds of knowledges. Similarly, we become sensitive to problems, so we develop an ability to perceive shortcomings or needs for changes, or improvements in the existing things. Also using redefinition, i.e. the capability of abandoning old ways of perception, a new and broadened meaning is given to familiar objects for some new purposes. The contemporary society demonstrates a need for acquisition of languages and techniques of visual media, as well as exploring the mechanism of their influence on forming a personality.

### **Intelligence**

Many people identify thinking and intelligence, even though the relationship between intelligence and thinking is like relationship between car and the driver. Intelligence is the car, and car's driver will, via thinking, decide which route he will take. Therefore, intelligence is ability that we can use via experiential thinking, or on contrary, it will stay uncultivated (Mozart in rainforest). Intelligence, as a badly used tool, can be a barrier for thinking.

Gardner's theory (Howard Gardner) of multiple intelligences based on understanding that different parts of brain are connected with those different types of intelligences, is well known. With that theory, Gardner abandoned contemporary theory according to which intelligence is conditioned and unchangeable. According to Howard Gardner's theory of Multiple intelligence, intelligence is not a homogenous mind skill. Gardner's model of Multiple intelligence indicates that there are numerous learning styles and cognitions of the world.

1. Linguistic intelligence refers to verbal expression (understanding of terms, reading, writing texts). Stories, puzzles, and debates are a motivation for learning.
2. Logical-mathematical intelligence, which is most frequently connected to scientific thinking (abstract thinking, mathematic problems, logical conclusion. Problem tasks, experiments, and problem solving encourage learning.
3. Visual-spatial (spatial) intelligence (visual thinking and memory, interpretation of maps, orientation in space, navigation). Tasks of visual expression, making mind maps, and activities of visualization motivate learning. Images, graphs, films, and demonstrations should be used in teaching.
4. Musical intelligence (singing, playing instruments, sense of rhythm). Listening to music for relaxation which inspires for visualization and rhythmic games should be used in teaching.
5. Bodily-kinesthetic intelligence (dancing, sport, body language in expressing emotions). The best way to acquire knowledge is via movements – dancing, movement, dramatization, learning in nature.
6. Interpersonal intelligence (empathy, pupils are communicative, understanding of knowledge, emotions, motives, they enjoy other people's company). Learning in pairs and group work motivate them for learning.
7. Intrapersonal intelligence (self cognition, understanding of oneself – who we are, how we can change). Independent activities and learning motivate learning. Writing diaries should be promoted in teaching.

The first modern test of intelligence was made by Binet in 1905, for measuring child intelligence. Joy Paul Guilford believed that intelligence tests can not measure the full extent of human intelligence. They are based on convergent thinking and are not able to measure creativity, which is so important for social development. He created a model of intellectual abilities. That three-dimensional model contains 4x5x6 mutually independent factors of cognitive abilities (1959). Each factor is marked by a letter which refers to operation, content and production. Guilford interpreted and distinguished convergent and divergent thinking in his three-dimensional model.

### **Visual intelligence**

Visual intelligence signifies ability of seeing things in the mind, i.e. it is an ability of visual perception of world that surrounds us and of creating an artistic view of the world. Visual intelligence signifies colour, line, form and space sensibility in itself. According to Gardner (1983), people who possess visual intelligence are great collectors, who satisfy their need for visual impulses. They encircle themselves with images of their own imagination, as well as with objects that enchant them. The influence of surrounding is indisputable.

In persons with expressed visual intelligence, a verbal deficit is also noticed. Since in traditional IQ tests logical-mathematical and verbal intelligence are primarily measured, persons with great visual intelligence often have worse re-

sults. Jola Sigmond first created tests for measuring visual intelligence. According to him, each individual possesses a great potential of intelligence, which is never used to its maximum. Yet in childhood we learn that we "learn" by imitating and that we don't use all our hidden potentials in that way. By training of visual thinking, "certain muscles of the body of the mind" can be built up, creating a condition for logical thinking, three-dimensional seeing and four-dimensional solving of problems (Jola, 2004). He was the first one who used colours in semantic sense, not only for illustrations. Through line of tests, trainings, and games, it is possible to stimulate visual, mathematical and logical intelligence, practice and extend mental skills, such as logic and attention, improve mental effectiveness, develop logical understanding, improve concentration. Influence of exercise on results in intelligence tests:

- effects of exercise can be produced in three ways:
  1. by giving a particular test or its parallel forms a number of times
  2. by analysis of mistakes in doing tests
  3. by discussion about principles of solving tests or coaching
- ability of reasoning and g-factor can not be significantly improved by exercise, and positive effects are obtained only on limited specific factors
- effects of exercise are different from individual to individual
- Milwaukee project – a goal was to prevent a development of mental retardation in a group of potentially endangered children in upgrowth through a program of enrichment of family environment
- no differences are obtained in accomplishment in mathematic and reading, in relation to comparative group
- there was no real increase of g-factor
- beside the influence of different forms of exercises on the result expressed in numbers, changes in ability structure that is enhanced with those tests occurred
- empiric data about the fact that no great progress was ever realized by exercises, show that testing of intelligence is justified

During learning and thinking process, visual intelligence plays a great role in creating visual image, memorizing by means of images and, accordingly, it should be developed in as greater measure. Spatial-visual intelligence can be developed via reading geographical maps, navigation, park planning, model construction, constructive games, plotting, making itineraries, or visual maps of any information (Mindmap). The degree of visual intelligence helps students to acquire knowledge not only through static images, but also to engage their imagination, to imagine objects from different angles. Through the dynamicity of video-clip they visualize gained information. Child's spatial-visual intelligence can be deformed by non-critical acceptance of mass culture's products, i.e. by predimensional visual impulses via media, films, the Internet, video-games. Many illusions of perception are no more than simple mistakes. Ac-

according to Helmholtz, a simple rule of each illusion is to believe that we see those objects which we could see in normal circumstances.

### Experimental research

The subject matter of this paper's research is a possibility of developing spatial-visual intelligence. We involved students of Faculty of Philosophy in Sombor and Faculty of Maritime Studies in Split in our research. Sample was made of students from The Faculty of Philosophy, from different courses:

- a) design of media, third year
- b) design of media, fourth year
- c) elementary school teachers, third year
- d) elementary school teachers, fourth year
- e) students of second year, pre-school teacher
- f) students of Faculty of Maritime Studies who attend course Communicology

250 students of Faculty of Maritime Studies in Split and Faculty of Philosophy in Sombor were tested. The examinees were split into five groups. The test consisted of 16 problems that identify perception of form and background in our test. The results of each group are presented in the table down (Table1).

Table 1. Results of successfully solved problems on the test

	1	2	3	4	5	6	7	8
1	21,43%	100%	92,86%	85,71%	92,86%	42,86%	78,57%	92,86%
2	16,66%	100%	100%	100%	100%	100%	100%	100%
3	0%	71,43%	66,07%	39,29%	64,29%	10,71%	17,86%	85,71%
4	14,29%	100%	85,71%	71,43%	100%	14,29%	28,57%	100%
5	2,94%	91,17%	52,94%	14,71%	73,53%	5,88%	23,53%	50%
	11,06%	92,52%	79,52%	62,23%	86,14%	34,75%	49,71%	85,71%

9	10	11	12	13	14	15	16	Total
71,43%	28,57%	50%	57,14%	64,29%	92,86%	85,71%	21,43%	57,86%
100%	66,66%	33,33%	66,66%	100%	100%	100%	50%	81,25%
50%	21,43%	26,79%	37,50%	16,07%	58,93%	35,71%	12,50%	30%
57,14%	71,43%	28,57%	100%	42,86%	100%	0%	100%	63,93%
47,06%	14,71%	44,12%	14,71%	20,59%	52,94%	35,29%	2,94%	22,65%
65,13%	40,56%	36,56%	55,20%	48,76%	80,95%	51,34%	37,37%	51,14%

One of the problems that was used in the test is so called Rubin's mirage. Rubin thought that any part of view field can be seen as an image, while other parts will represent the background. That is particularly true where the image is black or white. On borders of white or black field, especially in vertical direction,

they can be read as a white shape on a black background and vice versa (two human side faces or vase). If results for the group of problems which are based on the same principle are compared – almost everybody identified the form and the background of the first problem (92.52%), the percentage was smaller in the third problem (79.52%), and the percentage is almost twice lesser in the fourth problem (62.23%) in which the identification of letters, i.e. text, complicated the problem. The fifth problem is so called Hering illusion<sup>3</sup>, and many examinees solved it successfully (86.14%). Problem 9 and 10 identifies 3D seeing – to solve a problem, examinee has to move given objects in his imagination. Successful solving of problems 12 and 13 assumes visual imagination. Some of the problems are well known mirages (problems 5, 8 and 15). Judgment of one image greatly depends on background. Constant form indicates that form is judged by a constant, apart from size, colour or other characteristics. That means that we are not able to recognize a letter and geometric form if it is not in its usual colour, size or form (problem 8).

## Conclusion

Many social psychologists think that visual communication is one of the most important canals, if not the most important, of nonverbal communication. Visual communication refers not only to watching and eye contact, but also to seeing available and useful social signs. Visual message took over the role of verbal message in today dominant western civilization. Nonverbal communication has a lot of advantages over verbal communication, because an agent for interpretation of the meaning of the verbal message is not necessary. Human perceptive system is sensitive on images and graphic presentations of data, and in that way is able to process shown information easily. We come across terms such as infographics and data visualization/information lately. During last years, visualization is present in a field of information searching. We can also say that it is a recognizable characteristic of semantic web. Visual style of learning is dominant for students who learn the fastest when information is visually presented in a form of text. During visual learning, they mostly use information from course books and notes. Students with emphasized visual style of learning prefer to learn on their own.

Psychologist dr. Howard Gardner studied the ways in which adults and children learn for a long time. He discovered that there are different forms of intelligence. You may have musical intelligence, or social intelligence, or you are naturally intelligent. Gardner's theory of multiple intelligence changed methods

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<sup>3</sup> The Hering illusion is an optical illusion discovered by the German physiologist Ewald Hering in 1861. It looks like bike spokes around a central point, with vertical lines on either side of this central, so-called vanishing point. The two vertical lines are both straight, but they look as if they were bowing outwards. The distortion is produced by the lined pattern on the background that simulates a perspective design, and creates a false impression of depth.

of teaching throughout the world. Encouragement and development of visual-spatial intelligence in our experiment manifested in visual perception, coding and decoding visual messages in so called semiotic transfers (for example, identification and visualization of different natural shapes).

Visual communication has two tasks. The first one is expressive, that is, it refers to transmission of attitudes and emotions. The second one is informational – it operates with social meetings and supervises them. Since exactly these functions are said to be basic, when we speak about nonverbal communication in general, we can conclude that seeing of available social signs – visual communication – is really the most important channel which enables nonverbal interactions and makes verbal easier.

Our researches have showed that visual intelligence is still not identified as an important issue that needs to be researched within study programs on faculties, and indicate that learning of visual intelligence is essential, because it is very significant for future graduates on our faculties.

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