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ANALYSIS OF VISUAL THINKING MEANING IN SCIENCE EDUCATION

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Abstract

Western culture coding mostly all information in verbal codes influenced all Europe human thinking and its skills that is why verbal thinking was broadly analyzed in science. However, the meaning of visual thinking is visibly developing because of spreading technologies and visual culture. It is very important to turn scientists' attention to the meaning of this phenomenon in education process because encoding of the views is getting daily pupils' need during the learning process. The pupils have to learn from the visual images in science education. Decoding of them conditions the structuring of the mental models in conscious. The quality of knowledge depends on the last mentioned objects. The built model explains the meaning of visual thinking processes in science education.
Key words: *visual thinking, visual perception, imagery, visualization, science education.*

Introduction

More visual information floods in the education process: the base of modern technologies is expanding in schools (Glackin, 2007; Reid, etc. 2006; Borthwick, etc. 2005; Webb, 2005), the Internet is used (Sorensen, etc. 2007; Yang, Kun-Yuan etc. 2007; Rubino, 2007). The pupils are adapting to such conditions naturally and they are learning with pleasure.

Every seen view requires perception. The last mentioned object should be developed because of the Media getting more difficult and not developed visual thinking will be unable to decode the views. The more images there are the better pupils understand and realize information. This happens because the scientific concepts depend on human perception which happens in the right or wrong way. For example, it is very difficult to understand the molecules in chemistry because you can not see them by "the naked eye", there is special visualization needed; "unseen" organs in biology after visualization become "visible". There are lots of concepts that are needed to be visualized in science education so that they could form the right mental models in pupils' conscious (Bilbokaite, 2007). Last mentioned objects are of service as guarantee of comprehension.

According to the thesis that any view requires visual perception and decoding of visualization, it is possible to assume that visual thinking is very important in science education. The works of scientists that are directed to the visual thinking researches in particular science education disciplines give sense to the significance of this kind of thinking. According to Rinner C., etc. (2006) visual thinking is essential in geography. The meaning of it highlights while assessing the maps, distance of locality and etc. It is worth to notice that the map in geography is of service as one of the oldest known visualization tools used from immemorial times in all cultures in this discipline. Undoubtedly, the map contains a lot of information in a small area. The map is clear and presents purposeful information which is lacking in verbal language.

Visual thinking presents information structurally and serially. Visual thinking helps to understand the centre, lines and lets mentally move to the other place. It fixes partial figures and that is why it is needed for orientation in the maps in geography (Sui, Goodchild, 2003). Gazit E. (2005) proves the importance of visual thinking in astronomy. Visual thinking can help to understand the movement of stars and the laws of the solar system in this range.

Visual thinking is important for spatial processes in science education (Zeithamova, Maddox, 2007; Lee, 2007; Olp, etc. 2007; Guillot, etc. 2007; Brownlow, etc. 2003; Black, 2005; Olsen, 2006) and etc. Spatial thinking is a kind of visual thinking or, it could be said, the part of visual thinking because it contains all operations suited with the location in space and perception of its variations. Since spatial thinking has very clear functions it is analyzed as an independent kind of thinking in scientific literature. The importance of visual thinking in natural science disciplines is growing because of spatial abilities. These abilities are frequently needed for perception, comprehension and realization of the concepts.

Visual thinking is given a sense because of visual representations. The last mentioned objects are the mostly recommended communication mode. The visual presentations show the full-scale perspective view of functions and connections *(Van Dyke, White, 2004). The more symbols are used in the lesson the better information is memorized, that is why* Snambaugh R.N. (1994) recommends for pupils to code information in visual symbols while listening. It is very important to clear and ground the meaning of visual thinking in science education, and to explain it for the reason to attract more researchers to this range.

The object of research – the meaning of visual thinking

The goal of research – to induct the meaning of visual thinking in science education

The research tasks:

1. to explain the meaning of visual perception in science education;
2. to induct the meaning of visual imagination in science education;
3. to analyze the meaning of visualization in science education;
4. to create a model of the meaning of visual thinking processes.

Methodology of Research

This article is based on the opinion that visual thinking is essential in science education and it must be educated in secondary schools. It is appealed to Arnheim's R. (1997) visual thinking theory which declares visual thinking equivalent to verbal thinking or even more important than verbal thinking. As visualization is frequently actualized in science education, there is a premise that visual thinking should also be actualized in science education because visualization is a part of visual thinking structure. It is also appealed to the idea of constructivism philosophy which says that pupils learn incorporating new knowledge to the old one and thus, because of visual thinking pupils are able to decode visual codes, to form the right mental models and to realize the information. According to this, it is possible, that there will no education vacancies remain. The methods of the research – analysis of scientific literature, structural analysis and modulation.

Results of Research

Three parts make the structure of visual thinking (McKim, 1982). They are: visual perception, imagery and drawing. The concept of drawing is changed into the concept of visualization in this article, because the last mentioned concept is current in terminology of natural science education. The data about features of visual perception, which were distinguished during the scientific analysis process, are shown in the first table.

Table 1. The features of visual perception.

Author	Propositions	Feature
Arnheim R. (1997)	Perception is purposeful and selective.	Selectivity
	The human learns to notice what is the biggest and the brightest thing.	Comparison
	Recognition of the object is the main interaction between memory and perception.	Recognition
Gilroy (2004)	Visual perception can contort when the optical information is ambiguous.	Variation

Selectivity (Table 1) shows itself as an internal and conscious action of human perception excepting information by selective way. It is possible, that human perception selects what to percept. Such actions enable perception not to except the information which is not necessary. Thus, conscious is protected from over load and avoid huge mistakes. This explains why visual thinking is important – pupils seeing the view because of visual perception select the information which they are able to perceive. In this way, the view registers in the conscious and the difficult concepts are easily comprehensible. For example, pupils perceive the essential details of internal organs in biology lesson while seeing visualization. Transmitting information in verbal way it would be more difficult to perceive because perception could select the verbal concepts not images. It would determine the concepts formed by verbal expression to which perception would hardly find visual analogues.

It is possible that the huge part of information stays unconscious because perception selects. Perception processes its actions for particular time. Perception performs its functions during essential moment dependently on difficulty of an object, information way, content, time and etc., and in speed for which human conscious is ready. Each function of perception is adapted to organism work and flow of information.

Maturity level of mental state and conscious determines the perception speed and selective information.

It means that it is necessary to educate visual thinking because pupils' perception must be habituated to process the images. The more visual images pupil will see the more visual perception will be developed. For example, pupils will be able to understand the visualization of meteorology processes if they are used to such visual images and if there is visual net stored in longtime memory.

Recognition (Table 1) shows that visual perception acts dependently on earlier mentioned experience. The objects recognized during perception are mostly seen in similar situation. The objects can be comprehended according to principle of similarity when human perceived objects required similar functions in the past. The analogy acts, the person identifies detail, form and color which had already been perceived earlier. Recognition of the images seen in the lesson requires memory and experience because if pupil has not seen these images, he will not be able to recognize them.

Perception can compare details and features of an object (Table 1). The human notices the brightest, the strangest and the biggest object. This way pupils perceive the dimensions and colors which are close to their perception. It is possible that motivation and personal features act in this situation. Pupil who seeks to satisfy his cognitive needs is being activated by environment and perceives the details attaching the most significance.

Variation (Table 1) means that perception goes from one perceiving part to another part. If the object creates several meanings, perception "jumps"from one meaning to another. Jones R. (2003) notices that when we look at ambiguous figures our perception spontaneously varies from one perception to another. It has to be emphasized that the objects of scientific visualization distinguish for data visualization having one meaning, thus, it is likely that perception varies between size of the object, location in space, color and etc.

To sum up analyzed processes of visual perception, it can be emphasized that visual perception helps to perceive images, to decode and remember them in science education with the help of memory.

The second part of visual thinking structure is visual imagery. According to Kosslyn S.M. (2001) imagery is the collection of abilities which can be used independently from each other. In Marks D.F.

(1999) estimation imagery is the main block of conscious creation, it works in selection, repeat, planning and perfecting of adopted activity. This definition shows that imagery has clear and close contacts with perception because during the process of selection visual imagery helps to see, change, combine and distinguish the details in the mind according to essential criterion. The visual perception connects all these things: the conscious creation of view, conducting ideas, recalling and planning in the minds.

Teaching science disciplines visual imagery can help imagining the phenomenon of nature when they are recalled by perception in memory. Imagination is very important in spatial images, for example, perceiving the map and imagining the position of an object in reality.

Pupil decodes visual symbolic information and imagines it in the minds so it is easier to understand the information from the map. According to Blajenkova O., Kozhevnikov M., Motes M.A. (2006) the imagination of the objects includes parameters of form, size, shape, color and brightness. Spatial imagery contains spatial relations of the parts of the object and position in space. Visual imagery is essential not only because of viewing visual images but also when teacher is speaking or reading verbal information and pupil is imagining the object. It is very important because lots of science education concepts are directly dependable from view (molecules and their structures in chemistry, images of plants and animals, the peculiarities and functions of organism structure in biology; relief of nature, structure of the Earth in geography and etc.). Grandgenett, N., Clark, P., Topp, N. (2000) accentuate the importance of imagery in science education because of imagining of spatial phenomenon. Visual imagery is substantial because the position of objects in space has to be imagined.

Visualization is the third part of visual thinking structure. Visualization is an action or the result of the action during which the phenomena or objects are visualized in some arbitrary signs and comprehensible forms. It is the most accentuated part in science education. A great variety of scientific works show it to be true: Herráe, 2006; Kohorst, Cox, 2007; Meyer, Sargent, 2007; Roy, Luck, 2007; Mason, 2006), etc. in chemistry; Oller, 2006; Wilder, Brinkerhoff, 2007; Podowski, etc. 2006; Toga, 2006; Tychinsky, etc. 2005; Finnan, etc. 2004) and etc., in biology; Kozhevnikov, 2007; Blanton, 2006; Drevermann, Travis, 1998) and etc., in physics. All these works show that the rendering of visual images is important and useful in science education process. Better visualization possibilities are being searched for – 3D and 4D visualization programs are being created.

The right mental models are formatting because of visualization (Bilbokaitė, 2007). The last mentioned models help to make oneself a master of visual images. It is possible that it determines better knowledge. Moses B. (1982) argues that teaching visualization is grounded on visual thinking. Being aware that visualization is the part of visual thinking the argument of Moses B. (1982) is reasoned.

Analogically, it can be said that if visualization, being so broadly researched, is very important in science education, it means that visual thinking is essential too.

To sum up the data of the analysis, the model of visual thinking for successful education can be constructed. It explains working of view, visual thinking and conscious efforts.

The figure 1 shows that visual thinking must act when there is any connection with the view. During visual thinking visual perception, imagination and visualization are interdependent. Visual thinking components act together or in some order dependently from the seen object and the present situation. The processes go on while seeing the object and trying to perceive it and do some actions with these internal images. The model shows that perception transmits the actions to imagination and last mentioned gives to visualization. Analogically, all goes in this order among these three components of visual thinking.

It is possible that after activity of visual thinking the clear mental models form. They are influenced by visual and verbal memory because a lot of images are decoded only because they have been seen once. After the right mental models are created the pupil is able to understand information. If the pupil wants to make himself the master of knowledge, he must study by himself because comprehension guarantees that the conscious of human is able to except such kind of information and is able to learn but there is no guarantee that information got during comprehension will stay in long-time memory. In order that knowledge could be soaked up, there must be efforts to learn. The best way to remember is to repeat information in minds. When it is possible to repeat the knowledge after some time it shows that the learning process was successful. It means that knowledge was soaked

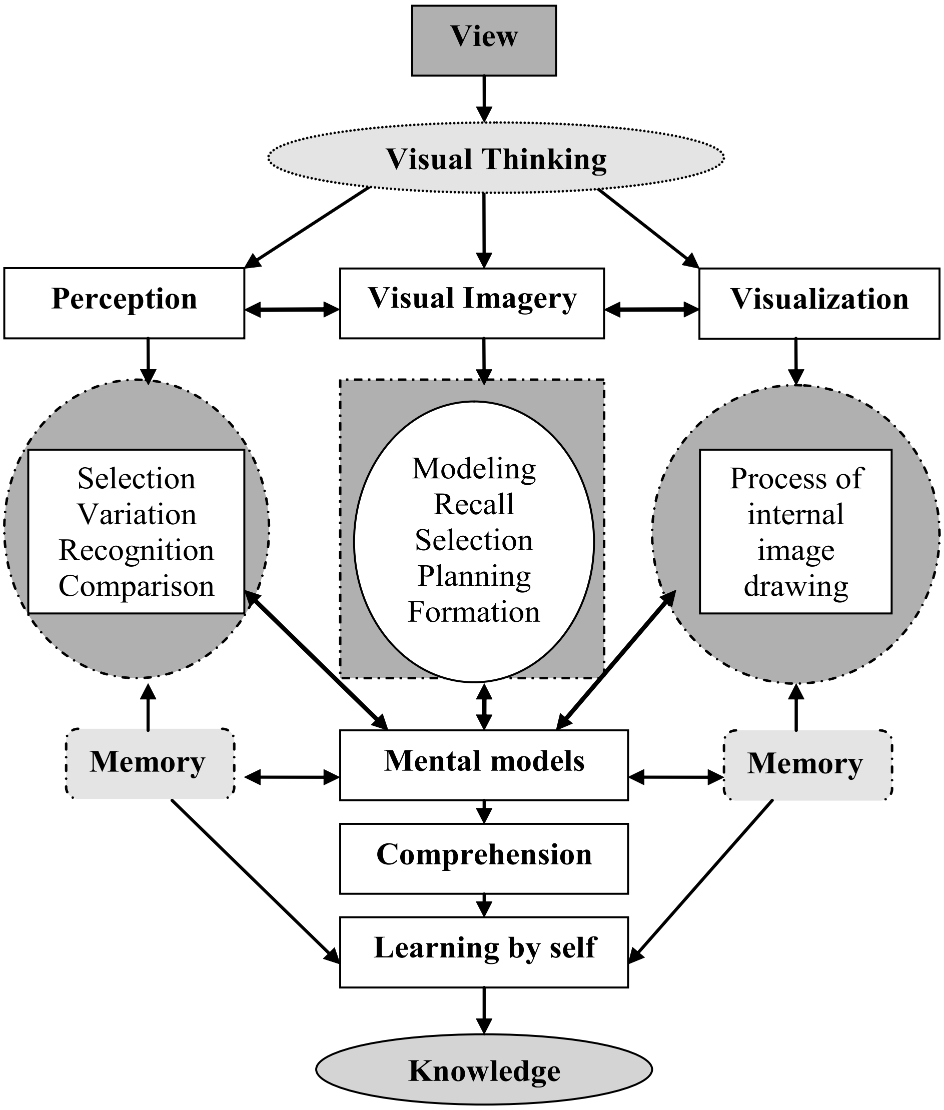

Figure 1. The model of the meaning of visual thinking processes.

up qualitatively. It is possible that the importance of visual thinking highlights as an investment into qualitative knowledge of science education because accumulation of images in conscious will let to decode difficult visualizations, to understand and soak up the knowledge easier.

Conclusions

- Visual perceptions help to perceive, decode and memorize images with the help of memory.
- Visual imagery helps to imagine the location of the objects in space and to reconstruct the images from information encoded in the symbols.
- Visualization helps to form the right visual mental model because the view is decoded and presented in mind or in real manifestation. The information is quicker comprehended because of the mental models.
- The constructed meaning model of visual thinking processes shows that all the parts of visual thinking are closely interconnected. Visual thinking helps to perceive, decode and imagine visual information, to build the mental models with the help of memory. The comprehended information is learned so that it could stay in long-term memory, it is possible, that knowledge will be soaked up.

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