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MIND MAPS – A CREATIVE THINKING TOOL IN INFORMATION TECHNOLOGY

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Abstract

The paper presents the role of information technology (IT) in educational practice. In order to emphasize the significance of visualization of the knowledge-gaining process, particular attention was paid to one of the tools of creative thinking, namely mind map. The term mind map, coined by Tony Buzan, refers to a hierarchically organized map, enabling to scan large sets of information. The paper discusses the main assumptions of the associative memory model, the double coding theory, and the principles of Gestalt psychology that were used for mind mapping. Moreover, the paper focuses on developing skills considered indispensable in the information age, achieved through incorporating into the educational program a tool that stimulates mind creativity and facilitates performing operations on information, assuring individualization of styles in the learning process.

MAPY MYŚLI – NARZĘDZIE KREATYWNEGO MYŚLENIA W TI

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Słowa kluczowe: mapy myśli, Mind Mapping, technologia informacyjna (TI).

Streszczenie

Przedstawiono znaczenie technologii informacyjnej (TI) w praktyce pedagogicznej. Podkreślając znaczenie wizualizacji procesu zdobywania wiedzy, zwrócono szczególną uwagę na

narzędzie kreatywnego myślenia, jakimi są mapy myśli – Mind Mapping. Mind Mapping wprowadzony przez Tony Buzana jest hierarchicznie zorganizowaną mapą, dającą możliwość przeglądu zbiorów dużej ilości informacji. W treści zawarto główne założenia modelu pamięci skojarzeniowej, teorii podwójnego kodowania, zasady psychologii postaci (Gestalt), które zostały wykorzystane w mapach myśli. Artykuł jest próbą zwrócenia uwagi na kształtowanie umiejętności, które są niezbędne w dobie cywilizacji informacyjnej przez wprowadzenie do programu edukacji narzędzia pobudzającego kreatywność umysłu i ułatwiającego przeprowadzenie operacji na informacji, zapewniając indywidualizację stylów procesu uczenia się.

The educational goals to be attained by contemporary schools are formulated assuming that the pupil or student is prepared for active and creative participation in life. In the information age special attention should be paid to such skills as information management, creative thinking and problem solving, as well as communication and interpersonal skills.

The information age is the time when the amount of information is rapidly growing as a result of dynamic technological development observed in many scientific disciplines. It follows that the educational system is not always able to fully satisfy expectations and face challenges resulting from "information explosion". McCarthy (1991)states in his book "Mastering the Information Age" that we do not possess skills indispensable to survive under rapidly changing conditions in the 21st century. In the educational system dominated by behavioral elements, the education that we receive is based on outdated concepts of the 19th century, since the three main skills, i.e. reading, writing and counting are definitely insufficient to meet the complexity of contemporary life (McCarthy 1991).

On the other hand, an excess of information may be stressful and lead to the so called Information Fatigue Syndrome. In the cognitive process, particular attention should be placed on developing a certain attitude, as well as a system of values, on the way towards one of the highest forms of information, that is knowledge. The skills characteristic of information society, indispensable for information processing, will be necessary for knowledge processing and assimilation in the future.

IT in educational practice

In the process of knowledge acquisition, the question: "What to learn and how to learn in order to know", and not only "learn to know" becomes very important and is expected to enforce the need of "adjusting the educational system and school to the purposes of the scientific and technological revolution" (Kupisiewicz 2000). Information technology, encompassing information, computers, computer science and communication (Gurbiel et al. 1997), when adequately integrated with the syllabus, can create a diversified environment supporting the teaching-learning process. The role of information technology in educational practice has been changing, depending on teaching methods and theories. When the assumptions of behavioral psycho-

logy dominate, it is treated as a transfer tool. In the case of the predomination of constructivism, it constitutes a set of the so called mindtools. In behaviorism, where the whole complexity of behaviors can be explained through establishing relationships between stimuli and reactions, or between reactions and rewards (STRELAU 2000), IT serves as a transporter of information used by the learner. Information is gathered by means of technology, and made available to the learner via e.g. web pages, databases, FTP. The test functions of technology enable to compare own answers with the correct ones, introduced earlier.

If the teaching-learning process does not consist in information transmission, but in dynamic interactions between the learner and the world, the decisive role is played by elements of constructivism, according to which "in perception man creates reality through differentiated stimulation organization" (STRELAU 2000). Knowledge is a result of creative perception allowing to construct a subjective understanding of the world, and not a reflection of objective reality. In the educational process, the learner enters into an intellectual partnership with IT (e.g. mindtools) and improves his own higher cognitive processes (analysis, synthesis, evaluation). It follows that such a person acquires the ability of critical thinking, and becomes part of the learning process while assimilating new experiences with previous knowledge, then defines own educational goals and chooses a strategy for their realization.

The term "mindtools" encompasses an improvement in memorizing methods and introduction to problem-solving and analytical techniques. This is an integrated environment of computer technology and psychology of education, aimed at improving the efficiency of the teaching-learning process, comprising such tools as databases, spreadsheets, semantic networks, expert systems, computer-based conference systems, multimedia, hypermedia development platforms, and programming environments (JONASSEN 2000).

A modern, creation-promoting school, achieves the set educational goals through teaching techniques and methods of creative thinking, and proposes solutions aimed at developing creative attitudes and innovative behaviors. In the process of creative thinking a key role is played by adopting a technique or method adequate to a given problem, as well as by developing motivation. The skill of effective and prompt information retrieval affects creative problem solving. Informative civilization creates the need for individuals capable of performing operations on information (KOZIELECKI 1994).

Information versus the learning process

Learning is an unobservable process based upon individual experience, leading to changes in behavior. It is possible due to the existence of memory, i.e. power of keeping past experience in the conscious mind (WŁODARSKI 1998). There are about 100 trillion possible connections between milliards of

neurons in the brain, and each of these connections is a potential fragment of memory. Thus, it may be concluded that the memory capacity of the brain is practically unlimited (CARTER 1999).

An internally motivated individual usually does not have problems with introducing a given piece of information into the brain, but with its retrieval. If the information is not placed in the brain in an organized and arranged way, it may be difficult to retrieve or reproduce. That is why a great mental effort is devoted to storing information in a way enabling the creation of internal connections between particular elements of the memorized material (STERLAU 2000).

According to MCCARTHY (1991), in order to survive, maintain "peak performance" and live our life on a "higher plane", we must become masters of information (as the opposite of slaves of information) and develop one of the most important skills, i.e. mind mapping.

The flood of information observed in all areas included in the learning process results in an undesirable phenomenon of disproportion between the amount of information contained in the material to be taught/learned and time devoted to teaching/learning. This disproportion enforces searching for, selection and application of adequate teaching methods. Such methods should take into account the correlation between the amount of new information presented to students and their potential learning ability. Psychologists believe that effective learning is one of fundamental skills in the contemporary world. People of average talent, but ambitions and persistent, have a better chance for success (BUZAN, BUZAN 1999). The brain can be trained, similarly as muscles: the more frequently it is used, the more efficient it becomes. Results of research (BUZAN 1999) show that the processes of learning and memorizing are related primarily to the existing connections between neurons and the creation of new brain cells. Intellectual stimulation affects both of these processes, so our brain and mental abilities may develop throughout life. Among numerous methods of knowledge presentation employed in the educational process, those referring to associations are considered more effective.

Mind Mapping

The method was developed by Tony Buzan, who formulated the principles of mind mapping in the 1970s, searching for new note-taking techniques. The assumptions of this method are based on results of studies on the functions of the human brain. Since that time this technique, also known as "brain map" or "mental map", has evolved, and the range of its applications increased considerably and currently comprises many more areas than just interactive note-taking.

"A mind map is an expression of multidirectional thinking, as well as a natural function of the human mind. It is also a powerful graphic technique which provides a universal key to unlock the potential of the brain" (BUZAN, BUZAN 1999).

The main principles of making mind maps are as follows:

1) first the central theme (i.e. the main idea) is defined and put in the center,
2) key ideas radiate out from the center, like the branches of a tree,
3) the branches contain key drawing or words written in capitals over the line. Each basic idea sprouts a further set of ideas, connected by arrows, like twigs at the end of a branch,
4) the branches for a network of nodes.

You can use colors, drawings, lines and your own codes or some other ways of showing connections, to make your mind maps more interesting, original and attractive, and to stimulate your creativity and memory. In this way you can construct visual and meaningful relationships between ideas, which will assist you in recall, review and understanding (BUZAN, BUZAN 1999).

The assumption of mind mapping are based on the associative memory model. The human brain is equipped with structures enabling the storage of various information (STRELAU 2000). Each piece of information reaching the brain is connected to other information by means of associations, forming a network of interconnected elements. This model reflects a system of connections between neurons observed during information processing.

The mind mapping method refers to the concept of functional differentiation of cerebral hemispheres. Results of recent studies (BUZAN 1999) on memory indicate that both hemispheres of the brain are biologically similar and may be treated as two separate brains operating at higher physiological levels, each of which is characterized by different mental functions than one brain divided into two halves. The left hemisphere processes new information at the level of: logics, works, sets, numbers, sequence, linearity, analysis. The right hemisphere is associated with colors, dimensions, imagination, rhythm, music, spatial relations, dreams and daydreaming. Both hemispheres complement each other and work best in harmonious cooperation. The investigations conducted by ORNSTEIN (1972) showed that persons using one of cerebral hemispheres to a higher degree than the other were relatively unable to use the other one (ORNSTEIN 1986). The next stage of research, completed in the 1980s, revealed (BUZAN 1999) that both hemispheres can independently take the functions of the whole brain. Prof. Roger Sperry, Prof. Eran Zaidel and other demonstrated that the more frequently both hemispheres work simultaneously, the more beneficial their cooperation becomes.

The assumptions of the mind mapping technique include also elements of the double coding theory. We use two different types of codes while creating mental representations and processing information, namely non-verbal (imaginary) and verbal, specialized in processing information of a given kind

(PAIVIO 1971). Imagens are responsible for generating image representations, whereas logogens – for generating verbal representations. Both groups independently form sequences of associations with new elements of a given coding system. Direct relationships between the imaginary system and the verbal system decide about the possibility of strict double coding. If the information recorded in one of the codes gets lost, it can be retrieved on the basis of data recorded in the other code (STRELAU 2000).

Tony Buzan also incorporated the principles of Gestalt psychology into his method. According to him, mind maps enable to use the natural innate tendency of the human brain to complete wholes and effect the closure of "open" or unfinished parts of wholes. Mind mapping joins various elements typical of both cerebral hemispheres and meets the needs of the brain as a whole, using words, numbers, order, sequences, colors, images, dimensions, symbols, visual rhythms, etc. This technique reflects natural thinking processes (BUZAN, BUZAN 1999). Our thoughts are spontaneous, unexpected and unordered. Mind maps allow to extract knowledge that we are not even conscious of possessing, because they can reach the areas of memory that cannot be easily explored using other methods.

Attempts at solving a given problem by a traditional method, thought creating lists of words or phases (sequential, linear processing) may lead to the so called "mental block", difficult to omit, that often appears at the end of such a data stream. The conscious mind is absorbed in searching for the next element of this linear data stream. This procedure is both time-consuming and irritating, and our motivation to perform a given task decreases rapidly, which may lead to the formulations of negative answers line "I cannot" or "I do not know".

The mind mapping technique uses the possibility of information processing at various levels. The work upon finding multiconnective thoughts, ideas or solutions is performed at the subconscious level, where the brain is able to concentrate on many tasks simultaneously. Mind mapping makes the thinking process visible. According to Robert Ornstein, "we are often unaware of the way in which we make decisions and formulate judgments, so they can be incorrect, erroneous or false" (ORNSTEIN 1986).

In mind maps important ideas are expressed by key words. "Our mind usually does not refer to sentences, but to key words and images. Of all words that we hear, utter or see, only one to ten percent are significant key words" (BUZAN 1988). Properly selected key words improve our creativity and memory.

The mind mapping technique substantially supports the strategies of organization and elaboration applied while learning or memorizing complex material and generating knowledge structures. Organization is aimed at distinguishing crucial elements in the material, and at finding relationships between them, whereas elaboration serves to connect the assimilated material to the already acquired knowledge (STRELAU 2000).

Mind mapping orders information, in this way facilitating both their retrieval and recall. It enables to generate great numbers of impressions, as well as to group thoughts via assigning them to respective motions.

Computer-aided mind maps

Dynamic technological development made it possible to use computers for mind mapping. The distinct characteristics of computerized mind maps are as follows:

Data acquisition

In computer-aided mind maps, positions of all categories can be easily placed, organized, recovered and retrieved.

Easy reorganization

Mind mapping encourages us to express thoughts spontaneously and naturally, so care for structure precision or ordered arrangement of ideas is of secondary importance. In computerized mind maps branches can be shifted and copied, their colors can be changed, and even the whole structure can be reorganized, if necessary.

Ready for presentation

Concepts and ideas presented in the form of a traditional mind map have their individual character. When presented in front of a large audience, they can be incorrectly interpreted due to their personal features. Computer-aided mind maps help solve this problem, since they enable to present the material in the form of any document. You can personalize your map, introducing various attractive symbols and designs, and at the same time preserve its official character and clarity of message.

Comments

Key words form the basis for mind maps. However, sometimes it is necessary to add some explanatory notes. Computerized mind maps allow to do that, but supplementary information remains hidden until needed. It is even possible to create text files and connect them to respective branches.

Export

Computer-aided mind maps can be exported to other formats in the form of a text file or a text document, a graphic presentation in PowerPoint, or a graphic file of an interactive web page.

Mind Mapping – IT

The possibilities and tools offered by information technology can be fully used when we possess the skills indispensable to apply them, access to sources of data for information analysis, processing and presentation, as well as modeling, measurement and control over devices and events (GURBIEL et al. 1997). Information technology can be employed in various areas of education, as a means or tool for expanding and enriching the learning-teaching process, as well as for supporting the cognitive process and knowledge gaining. IT should serve primarily as a tool for knowledge "generation", assuring individualization of the learning process. Visualization, especially the graphic method of knowledge "organization', applied at different levels of education, facilitates the processes of learning, understanding and memorizing.

The incorporation into the educational program of a creativity-stimulating tool that makes it easier to perform operations on information would promote creative attitudes and innovative behaviors. It would also prepare pupils and students for meeting the challenges of the information age. Pupils and students usually acquire knowledge about information technology and the range of its applications during computer science classes. Getting acquainted with such tools as text editors, databases, spreadsheets, software for sound and image processing, computer simulations and modeling, makes it possible to use IT in other fields and disciplines of science. It seems that the computer science study course should also include information on tools employed for problem visualization. Tools which use visual representation to capture relationships between notions, concepts or problems, enable to perform operations on large datasets, and – in consequence – to solve some problems.

In the contemporary world we are overwhelmed with the flood of information. Information overload leads to problems with finding and generating metadata. Numerous IT methods and techniques support the development of our skills. They include visualization techniques, such as mind mapping. The mind mapping technique permits a comprehensive presentation of a problem, and offers the possibility of its further development in any direction. Graphic representation of a problem enables its detailed analysis.

Many applications are based on the principles of mind mapping, e.g. MindManager 4.0, MindMan v.2.1, MindManager Smart, Mind Mapper or Ygnius. The majority of these programs are integrated with such applications as: MS Word, MS PowerPoint, MS Project. Computer programs belonging to the group of the so called creative software stimulate user's creativity. Using software for solving problems that require conceptual analysis based on mind mapping, we can avoid negative emotions which might appear while making traditional mind maps. In the case of such maps, imperfect graphic representation or layout, the use of inadequate words or the lack of connections between concepts may disturb or block creative or analytical

thinking. Creative software is a tool which – when applied properly – may be both powerful and inspiring, promoting new ideas and multidirectional information processing by the human brain.

Selected problems of computer science, presented using the mind mapping technique and suitable software, may be much more interesting to students, as well as easier to understand and assimilate. Let us look at an example of a practical application of the mind mapping technique and a computer program in the realization of a project "Computer memory". A mind map was created in MindManager 2002 and then converted into graphic format. A mind map printed in the form of a flash card can be a valuable teaching aid during subject presentation (Figure 1).

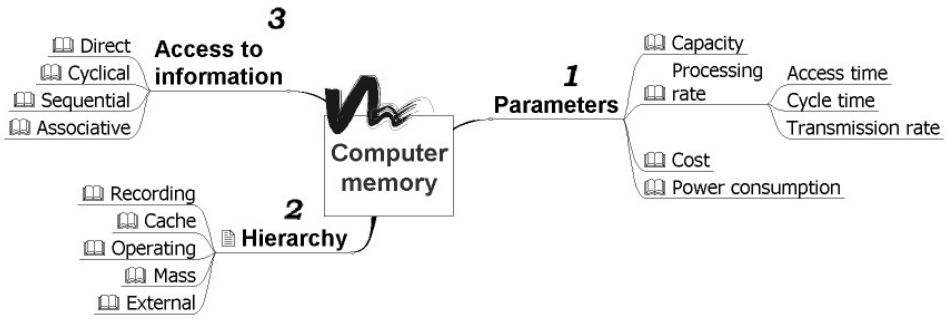

Fig. 1. Project "Computer memory". A mind map created in MindManager 2002

In order to obtain a more complex teaching aid, a mind map can be exported to interactive web page format. This enables to present a given problem in the form of a map (a single flash card) or a map combined with a traditional linear description (Figure 2).

Moving around a web page allows to discuss a given topic in an organized and ordered manner, as well as to choose the way of content presentation. We can easily present the problem, paying particular attention to key words, displaying attached notes (Figure 3), diagrams or illustrations (Figure 4).

Activating a link to another map or a connection with information resources on the Internet changes the material presented within the framework of an interactive web page into a visually interesting representation of the problem discussed.

A visual presentation of a given problem makes it easier for pupils or student to see relationships between main ideas, and correct potential mistakes. In consequence, linear information is converted into structural, and the educational process becomes more holistic. MindManager 2002 provides also hyperlinks to animation and sonic files, spreadsheets and presentations, which makes mind maps more diversified.

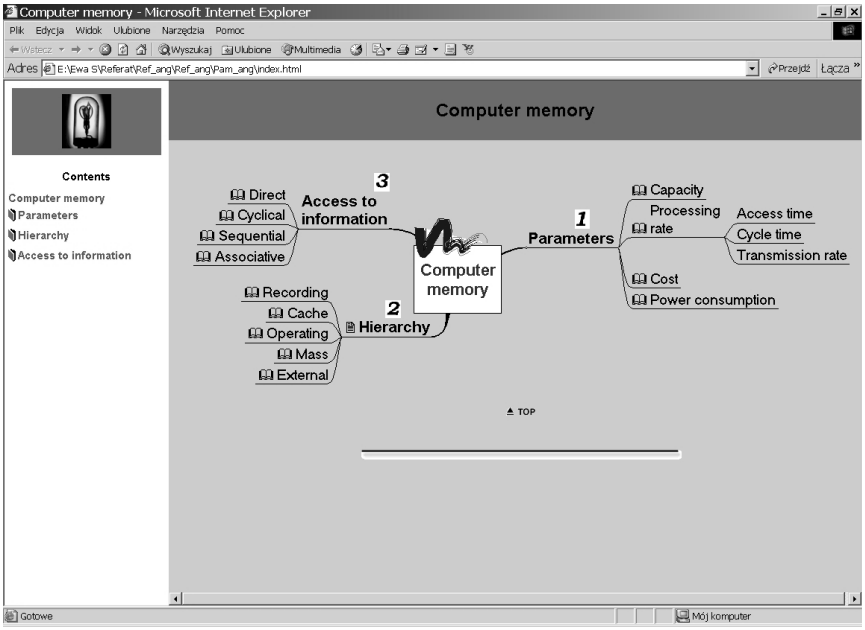

Fig. 2. Project "Computer memory". An interactive web page created in MindManager 2002

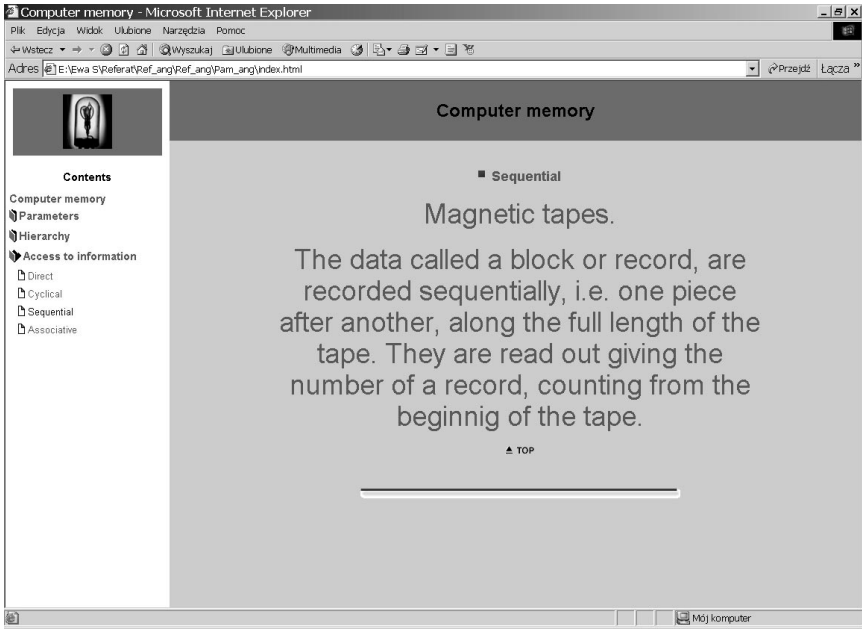

Fig. 3. Project "Computer memory". A note on an interactive web page

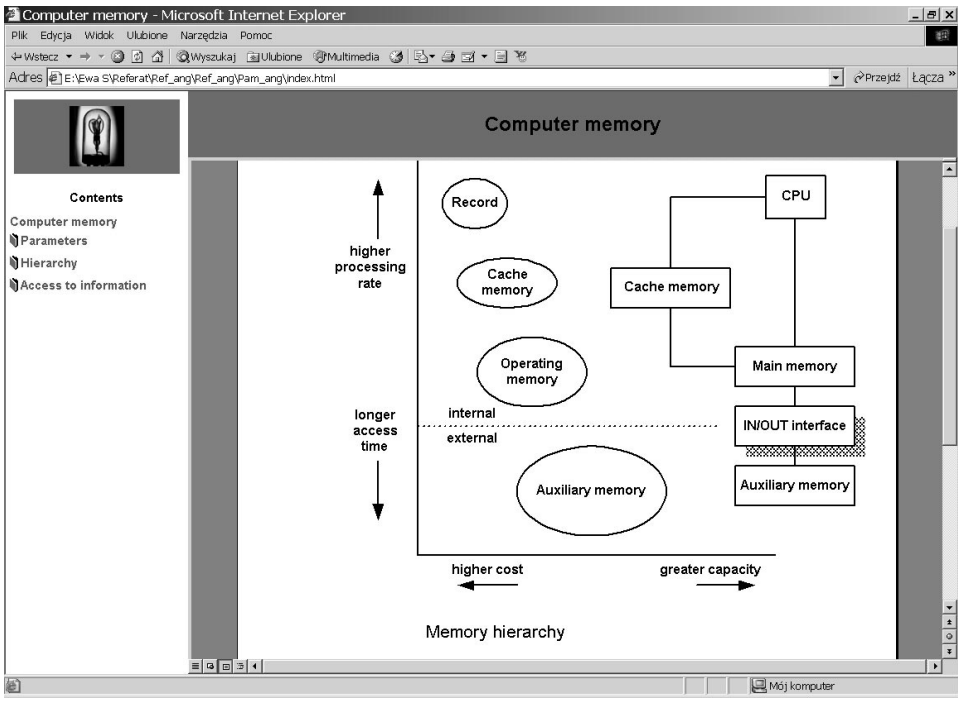

Fig. 4. Project "Computer memory". An illustration on an interactive web page

Particular pupils and students have their own individual styles of learning. Some of them prefer linguistic learning, others turn to spatial (visual) techniques. Graphic representation of knowledge is a tool supporting the processes of learning, thinking, reasoning, analysis of drawing conclusions from verbal information. Visualization of concepts and ideas helps combine information fragments into structures, which are then incorporated into the already acquired knowledge by means of associations.

According to the classification proposed by Bruner, some fields of knowledge are represented by action, others by images, still others – by symbols (PAPERT 1996). The human mind gains knowledge in many different ways. It follows that in the educational process teaching aids and forms of message conveyance should correspond with the content to be learned, and that special emphasis should be placed on methods stimulating involvement, independent thinking and cognitive activity on the side of students.

Creative thinking tool

The mind mapping technique makes us pay special attention to cognitive components of the creative process, such as "distracted attention, scattered thoughts, visualization, thinking through images, creation and usage of untypical concepts and notions, specific operations on a long-term memory" (STRELAU 2000). Visualization offers the possibility of "thinking" through images. Visual experiences, notions, conceptions and processed impressions provide a basis for developing new concepts and ideas. Physiologists and psychologists representing different schools share the opinion that visual perception is the main pathway to cognition. The sense of sight provides about eighty percent of information about the surrounding world. A well-planned application of visualization in the teaching/learning process allows to avoid over-verbalization, phenomena modeling and process simulation. Information supplied in a visual form requires 50% less time to be assimilated, and is stored for about 60% longer (TANAŚ 1997). Images help to solve problems, since visual representation enables to notice relationships between them. They also activate creative processing of information, followed by the development of novel, creative ideas. Visualization gives rise to many more associations than verbal codes. It increases memory capacity and intellectual potential, which results in more effective memorizing of verbal material.

Mind maps are a powerful tool of creative thinking, since they use all capabilities of the human brain related to creativity, especially imagination, associations and cognitive flexibility. Due to the observations made subconsciously during incubation, a new perspective of looking at a given problem, its interpretation and understanding, can be examined in a new reference system, which leads to the development of further creative ideas (BUZAN, BUZAN 1999). The mind mapping technique affects creative activity, which improves creativity understood as "an individual feature involving the ability to produce new, fresh ideas" (STRELAU 2000).

Summary

Mind maps may be applied to the majority of situations in life, based upon cognitive and thinking processes. They are used for note-taking, writing reports, papers (Figure 5) or essays, giving presentations, preparing for exams, drawing up projects and designs, organizing meetings, solving problems, self-analysis, family studies and teaching; they are also helpful while making choices, planning, etc.

Software enabling to apply the mind mapping technique contributes to the development of creative thinking, or – to be more precise – its instrumental features, which according to TALEJKO (1973) encompass logical reaso-

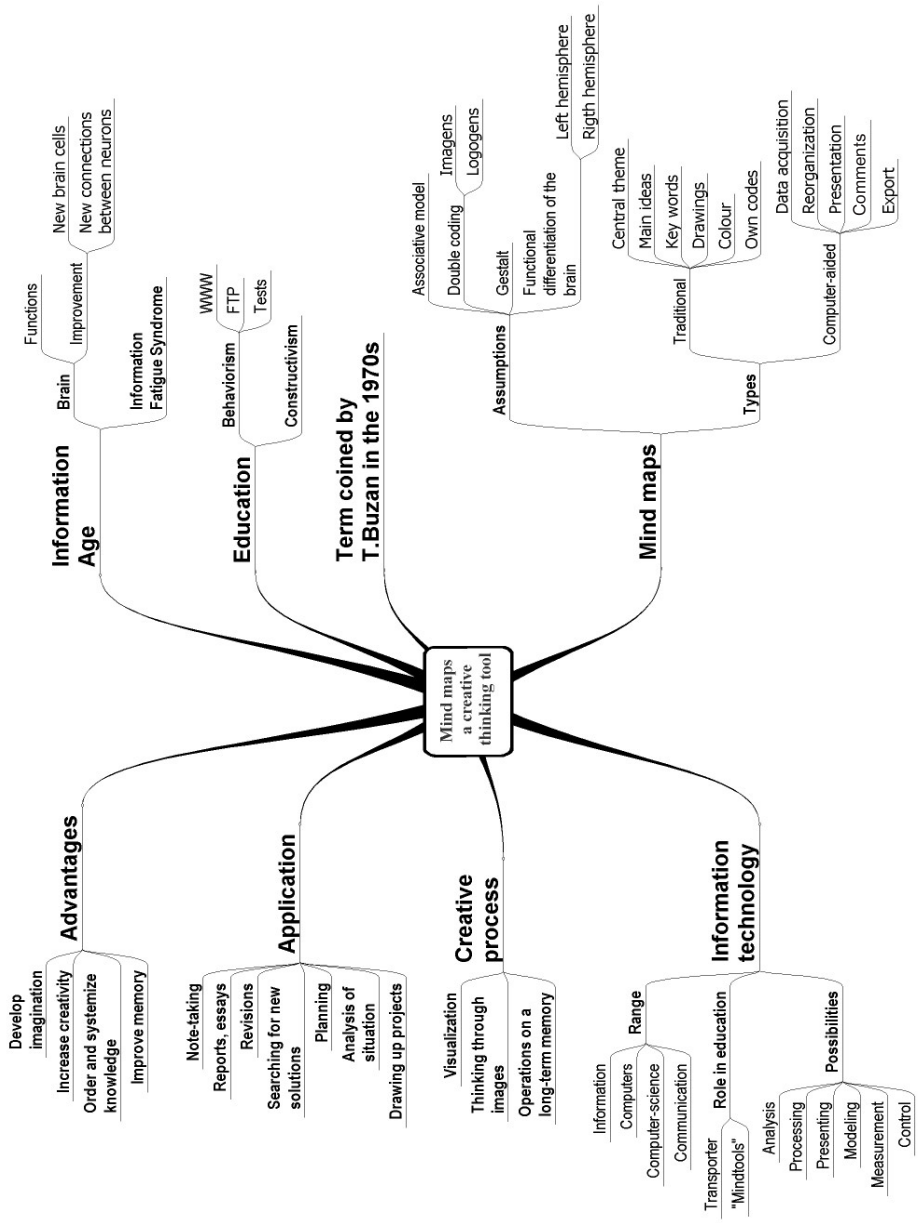

Fig. 5. A mind map created in MindManager 2002, which provided a basis for writing this paper

ning, imagination, intuition, and originality of thought. Mental literacy, based upon the mechanisms of learning, memorizing and creativity, can be developed through the implementation of the principles and recommendations of mind mapping. It enables proper use of multidimensional synergic thinking, as well as the creation of an infinite number of new patterns and paradigms of reasoning.

Ming mapping is inextricably linked with the functions of the human brain. As a creative thinking tool, it contributes to the development of the functions of the cerebral cortex. It is a visual representation of knowledge, promoting active education when adapted to individual styles of learning. Mind mapping can be practically applied to all expressions of metal activity and all aspects of life, where improved learning efficiency and clarity of thought allow to fully use brain capabilities.

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