

**UNIVERSITY OF LJUBLJANA
FACULTY OF EDUCATION**

ANITA RONČEVIĆ M.Sc.

MULTIMEDIA IN PRIMARY SCHOOL

DOCTORAL THESIS

Ljubljana, 2009

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1. INTRODUCTION

The choice and use of multimedia in teaching represents a relatively more recent problem-oriented area of research in media didactics; therefore this was one of the reasons for opting for the theme of multimedia in teaching, more precisely, the use of multimedia in primary school from first to fourth grade. Scientists paid greater attention to exploring the media in the second half of the twentieth century while multimedia was researched in a more systematic manner with the appearance of computers and multimedia educational tools, in an IT context, beginning in the 80s of the 20th century. «A *million* years had to pass to go from cave graffiti to first written symbols; *thousands* of years until invention of the printing press; *three centuries* passed in order to get from the printing press with large print to flat print i.e. recessed print (lithography); *one more century* until the invention of the rotational printing press and *60 years* until the first computer, which was so huge that it occupied a whole room. *30 years* later, the first personal computers appeared, and *10 years* after that the first *laptop* (portable computer) arrived. *Today*, a hand-size computer can be kept in the pocket or linked with a mobile telephone. It can send an e-mail (electronic mail), photograph or fax. Maybe this device will soon make it possible to heat up a plate of pasta for us in the microwave oven before we arrive home...» (Laniado, 2005, page 7) These new technologies are an integral part of many human activities and have implications both in pedagogy and education from pre-school to institutions of higher education. Technological progress in the economy, after having passed efficacy tests, is reflected on work in the classroom, imperatively changing it. Unfortunately, these changes in the schooling system are very often slow as a result of inertia at all levels of education. However, the teaching process is slowly being updated; both in training personnel for teaching as well as in using media and multimedia, where technically more modern teaching devices and aids supplant outdated methods. If a school is equipped with more state-of-the-art multimedia, this is no guarantee that they will be practically used in the classroom. The personal and qualified-professional competence of the teacher who will decide how and to what extent multimedia will be used in the classroom is important. The basic aim is to use media and multimedia for the emancipation of development of pupil's rights and in order to have a more humanistic approach in teaching. Therefore, a teaching strategy which strives towards development of the pupil should be created.

New age pupils i.e. pupils of the 21st century, differ from previous generations in their lifestyle and activities. Every day they are surrounded by multimedia, the flow of information is faster than before and so the children of today are more informed than previous generations. Every day they seek information and use it. Pupils are skilled at using the computer, mobile telephones, play-stations, DVDs and other multimedia. Thus their needs transcend the level of traditional teaching which „fill children's heads with mechanical information“: „That's how curricula are drawn up and that's how school textbooks are written. Those textbooks are full of unimportant information and, unfortunately, the majority of teachers consider that whatever is written in the textbooks should be memorised.... The textbook is very important but it is not the only medium in teaching“ (Matijević, 1999, page 679).

Consideration is focused on theories which explain the essence and significance of using multimedia in the classroom. Constructivism and theoretical cognitive approaches are significant for the study of developmental changes in pupils. It is important to have classes which transcend verbal or mostly verbal communication. Because of this the use of multimedia provides the opportunity for various types of communication i.e. transfer of information which stimulates the pupil's senses. Way back in 1983, Bezić (1983, page 170) assumed „...that teaching technology in the future would have a multimedia character.“ Through multimedia, we motivate pupils to learn by using their different senses, and through audio-visual presentation of information, the pupils obtain clearer and more complete knowledge of the outside world and themselves. With use of multimedia, teaching is rationalised and more effective energy-wise because with less energy expended, it is possible to achieve better and better results with the pupils in learning.

Contemporary teaching technology does not negate the traditional teaching methods, but is based on them, expanding the number and significance of didactic teaching elements, observing through new relations. „It could be said that contemporary teaching technology contains all positive achievements attained by mankind over the long historical development of teaching. In brief, it is a creative synthesis of certain elements which appeared in the past independent of each other and today they exist in a dialectic unity“. (Bezić, 1983, page 171). Each developmental level of teaching does not exclude the previous, as they contributed to new developmental levels of teaching i.e. they demonstrate its evolutionary flow. The teacher's work in contemporary teaching, focused on pupil development, is based on strategic activity: careful planning and organisation of teaching, the role of the supervisor who

stimulates the pupils in all types of development as well as a systematic evaluation of work done. The teachers play the main role in devising teaching strategies that provide conditions for development of all children's real and potential abilities as well as being sensitive to the needs of the pupils. The didactic-methodical competencies of the teacher play a decisive role in using multimedia in teaching conclusively with the educational policies of the teacher. Therefore there is a need for ongoing upgrading of teachers in the technological area so as to be able to know when to use multimedia, which type and for what purpose. The development of film, television and computers imposes imperatively a different education in the field of media and multimedia on the teachers. „Today, when it is difficult to establish the boundaries between media, when one medium switches to another, when they interlink with one another in all possible ways, technically becoming more and more perfect, the unique difference among them disappears“. (Mikić, 2001, page 243). The same audio-visual multimedia film can be viewed by the teacher with the pupils in a cinema, on TV networks, on a TV screen with the help of a VCR or DVD player, on a computer screen from the hard drive or from the Internet. Therefore, there is a need for educating teachers in the possibilities of using multimedia. Besides these technically highly-developed multimedia, a major role in teaching is also played by multimedia that provide valuable information to the senses (e.g. an apple is a medium if it is only photographed, but if the pupils touch it, smell it and eat it, the experience of the apple provides more information, thus increasing the pupils' comprehension of it). It is interesting to find out which didactic criteria for multimedia evaluation is used by teachers when choosing a multimedia, which types and multimedia structures are used in the classroom as well as what views they have on multimedia, given the existing concept of class work in primary schools in the Republic of Croatia. In this connection, the opinion of the pupils is significant in relation to preference for the media used in learning. Through empirical studies, understanding will be gleaned on the use of multimedia in class. One of the teachers' tasks is to provide a multimedia environment for learning. A multimedia environment for learning can be rich and very stimulating. The immediate physical environment of the classroom includes teaching devices and aids with existing and new multimedia possibilities of transfer of information.

Contemporary teaching imposes the need to seek newer and better solutions of teaching and learning which lead to greater efficacy of class work. Because of this, the role of multimedia in teaching and their relationships with other elements of didactics is researched in this paper. Multimedia occupies a significant place in poly-factorial teaching models. As a carrier and

transmitter of information, it represents a source of learning as well as a tool to help in learning. Different information of perceptual qualities from which the multimedia is composed impact on the dynamics of learning and stimulate different perceptive ways of learning as well as sensory integration. At the same time multimedia is in an interdependent relationship with other elements of didactic-methodical field. Therefore, this research is geared towards development of multimedia didactic theory and pedagogic-educational practice.

2. SIGNIFICANT RESEARCH OF DIDACTIC MEDIA IN THE WORLD

The results of a certain number of researches will be singled out in this paper because they merit interpretation as a result of the valuable knowledge gleaned from them. Besides this, no one ideal theory exists. The guideline for this research is a structural-constructive theory on pedagogy. The basic view is that with the observer there is no independent understanding or knowledge. This means that knowledge should always be perceived in an interrelationship with the observer as he represents „a living system“. Therefore, the said observer determines also differences in observation, description and personal experience (König and Zedler, 1998, page 248-253).

Over the 20th century, J. Dewey anticipates the constructivists and movement for progressive education and reflects on the question of a workshop type of learning as a normal way of learning. The pupils are included in giving due consideration to meaning in such a way that they themselves apply the knowledge acquired. The techniques of learning which the pupils each use by themselves are the key to acquired experience in learning. Therefore, effective use of contemporary teaching theories are based on studying the problem of pupil learning as well as the structure and use of media and multimedia which accelerates learning. Piaget's research is corroborated by numerous levels of thinking which the pupils develop through construction processes or creation of subjective mental structures and external realities. The class environment should be stimulated by the research work of students and the development of a critical spirit. The contribution of Vygotskog who considers that pupils require a rich social environment which stimulates higher levels of cognitive functions is also significant (Norton and Wiburg, 2003, page 32).

For constructivism it could be said that it is an educational philosophy which states that there is not only one single reality; there are many realities which are experienced individually. The intellect is a primary source of knowledge and reality is built on its foundations. Such an educational philosophy also has its attitude in relation to multimedia: „Constructivists state: Let's enjoy ourselves today and be informed through the images of the media which are „the reality of another order“ and no longer from personal experience or the experience of our nearest. We are no longer interested in the background to the events whose truth, in fact, would relate to those events. If for a moment we perhaps thought that the media is a „mirror

of society“, today it is clear: television is a „social apparatus“ and society has become the reflection of that apparatus.“ (Košir, Zgrablić and Ranfl, 1999, page 27).

Constructivism is a theory which has developed in several directions. Individual constructivism advocates the idea that the pupil builds knowledge on the basis of his experiences, the results of learning come from personal interpretation of knowledge, and learning is an active process which is developed on the basis of experience. Social constructivism describes learning as collaborative, where the meaning of different perspectives are mutually exchanged. Contextualisation propagates situational learning where the thinking is the real-life context wherein it is applied. Real-life situations which are familiar and normal for the pupils are shown, i.e. authentic learning (all constructivists do not include contextualisation as part of their philosophy). Radical constructivism emphasises that every pupil is unique and the teacher does not know what the pupil needs or wishes to learn. Because of that, they do not advocate aims, prepare completed subject matter in advance, help in learning or any other restriction. Moderate constructivism emphasises that personal construction of knowledge is not immediately responsible for development of the pupil's environment and that leaving all information of teaching to pupils is an unrealistic burden in the important task of mastering the aims of the curriculum.

„A constructive view of learning propose at least five teaching principles. Norton and Wiburg (according to: Norton and Wiburg, 2003, page 33) quote J.G. Brooks and M.G. Brooks who identified these teaching principles as:

1. Problem-solving important for pupils: important problems do not have to be important earlier for the pupils. All pupils in the class are not interested in learning the construction of words, biological cycles or the historical band of time, but the majority of them can help in building understanding of significant themes.
2. Structural learning around primary terms: when the constructive teacher in the class program organises information around the conceptual framework of the problem, questions and conflicting situations as the pupils are involved the most when problems and ideas are shown holistically rather than in separate, isolated parts.
3. Seeking and evaluating the pupil's viewpoint: the pupil's viewpoint is a window into their understanding. Awareness of the pupil's viewpoint helps the educators to challenge the pupils in creating an experience of contextual and meaningful learning. Each pupil's viewpoint represents an entrance door to individual education.

4. Adaptation of subject matter to the pupil: learning is advanced when the cognitive, social and emotive needs are accessible. Some kind of relations have to exist between the requirements of the curriculum and the assumptions of what the pupils will gain.
5. Assessment of the pupil's learning within the context of teaching: the creative assessment of learning from the constructive perspective is evaluated by the pupil's cognitive functioning, his aptitude and the relation status of teacher – pupil. The pupil's understanding prior to revealing right or wrong becomes the main issue with the teachers. The pupil's understanding becomes a place of various types of intervention which lead to the pupil's constructions of new understanding and mastering new skills. Assessment is used in favour of the pupil rather than by a calculating machine.“

The pupils construct knowledge individually and socially in the classroom. Knowledge is observed as an interdependent idea. In the class of pupils, connections of personal experiences of each pupils in the group is observed. Reality is constructed rather than being revealed. Along with a holistic manner of thinking on the nature of learning, it is thought that knowledge cannot exist outside the pupil. The process of learning has to be considered with experiences and contexts which the pupil finds himself in while he is studying. Therefore: „today we all know that the class and teaching of individuals will be more successful if the pupil is less taught, if he learns more, if he is more „exposed“ to personal activities of different types and various levels of complexities. That is why planning activities personally is not the most difficult for the teacher but planning activities of the pupils by which they learn i.e. modifying the subject matter as they go along. The pupil, namely, does not acquire ready-made knowledge. However much he comes to a ready-made and final form of it, he must in his own personal way digest it, creating thus personal experience. That is why in class learning situations are of great significance.“ (Jelavić, 1998, page 38). Constructive learning is described as construction of pupils in understanding the importance triggered by their own personal experiences, accompanied by their understanding.

“Many others have identified the characteristics of a constructive learning environment. D. Jonassen, for example, sums up and gives a deeper meaning to constructivism in shaping teaching as:

1. Providing multiple representation of reality
2. Presents a natural complexity of real life

3. Focuses on the perceptual construction and not reproduction
4. Presents authentic works (contextual rather than abstract class work)
5. Reflects the real world, a learning environment through spontaneous methods rather than determining class tasks in advance
6. Stimulates the practice of reflection
7. Provides context and meaningfully dependent insights of constructs
8. Supports collaborative construction of knowledge through social practice.”
(according to: Norton and Wiburg, 2003, pages 33-34)

Multimedia is an ideal device for presenting reality to the pupils. In many media combinations, the pupils are provided with possibilities of individually experiencing the presented reality. A multimedia stimulating environment in which the pupils find themselves encourages the pupil's individual experience of the world and freedom of CHOICE of the media by which he/she most effectively learns. For example: if the teaching aim is acquisition of new knowledge about a butterfly, then the teacher will create external motivation for learning and give the pupils opportunity to: praise, describe, draw, study from an encyclopaedia or multimedia learning tool, count all the parts of the butterfly, compare it to other animals, imitate its movements, collect stamps with butterflies on them, go into the school yard and try to spot a butterfly; they do not have to do all these activities but choose which one to do. The significance of multimedia stimulation and semantically rich transfer of information is in providing possibilities for self-actualisation i.e. affirmation of all the pupils' needs in class by which they acquire new knowledge, develop skills, habits and form their own opinions. The meaning of constructivism is to assure multiple representation of reality is that reality is a construction in an individual's brain. Each brain develops its own reality. This is why we talk about individual realities and possibilities of multiple experiences of the given reality. Observation and description of "reality" is determined by the pupils, who create unique, authentic class activities. It is more important to ask the pupils for their own opinions than to traditionally demand a mechanic reproduction of the subject matter.

When the pupil understands the purpose of learning focused on self-growth i.e. self-development, learning has a deeper meaning. The process of learning itself is based on seeking, comprehending, recognising, selecting, using i.e. applying information and interacting with already existing information. The process of learning differs from pupil to pupil and is compatible with their individual developmental possibilities. Therefore, some

pupils learn faster, others slower. Styles of learning, levels of acquiring information, abilities to apply knowledge in the same, similar and various problem-solving situations, all differ. From theories which study cognitive possibilities of learning through multimedia and theoretically establish guidelines for this research work, the following are outlined: *information processing theory, cognitive theory of multimedia learning, cognitive liability theory, multiple intelligence theory, eco systems theory, structuralism of the Berlin school, integrated model of understanding text and pictures as well as the structured model of class work*. Relevant theories, discussed in this paper, are implicated in studying multimedia in teaching. They relate to cognitive possibilities of learning, conditions under which the pupils and teachers learn as well as the effect which various multimedia create with the pupil during transfer of information.

Scientists who have studied cognitive approaches to learning, focus their research on the analogy of computer functioning as it partly explains the workings of the human mind (Vizek Vidović et al., 2003, page 168). Use of multimedia in the class until now has mostly been researched in the field of IT (Information Technology). Authors and proponents of certain theories mutually complement each other in their opinions and give their scientific contribution in various creating possibilities i.e. developing multimedia and its uses. Cognitive approaches have been chosen because they are based on the study of internal changes in the pupil in: thinking, knowledge, abilities, skills, habits and attitudes. However, the general cognitive competencies neither reflect the achievements of pupils in class nor give us an answer to the question : What are their cognitive competencies in relation to the elements of poly-factorial models of teaching (e.g. social forms of work, personal and methodical competencies of the teacher, working methods, motivational, emotional processes, media and multimedia...)? Only after reviewing all elements of teaching is it possible to gain a complete insight into learning in the classroom.

2.1. SIGNIFICANT RESEARCH OF MULTIMEDIA IN THE FIELD OF EDUCATION IN THE USA AND AUSTRALIA

Since the USA is one of the most developed countries in the world, it was the first to start with research into media application in teaching. Therefore, the paper will mention scientists who have contributed to exploring the phenomena of media in learning.

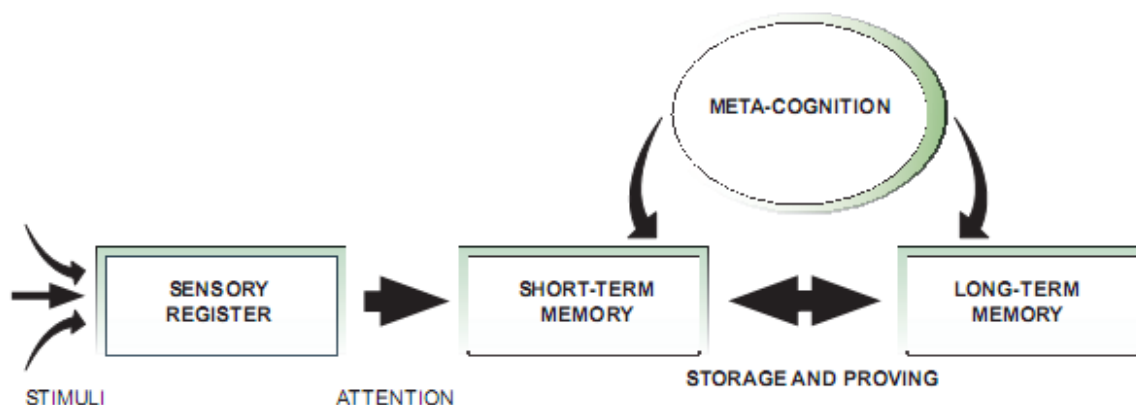
Pioneers in the research of media in America were: Lashley, Watson (1922) and McClusky (1924). The subject of their interest was the conceptualisation of research variables. The reputable scientific journal at the time AVCR (AV Communication Review) published by Allen W. H. (from 1953- 1969) contributed to the popularisation of scientific insights into the field of media didactics. A. Lumsdaine named the following thirty years a period of “comparative-evaluative research.” This type of research was based on didactic value of the emergence of new audio-visual media in relation to conventional methods of teaching. Other research directions that also surfaced e.g. research of radio schools, mass media and their commercial effects, surveying public opinion, calculation of statistical data on the population etc. did not have any connection with research on class work, nor was it researched by pedagogues; this was done by social psychologists. The next type of research studied the problem of reading skills, readability of media and printing formation of textual media. One of the leading American researchers of teaching media, W. Allen, points out the significance of earlier research of teaching media: in directing attention to the efficacy of media in transferring information, comprehensive research of the characteristics of teaching media and their diverse possibilities of use, which should be studied under controlled conditions. Following communication research, techniques and instruments for analysing the responses of subjects evolved. Research strove to create clearer pictures of convincing and motivating roles of communication. Military institutions made a valuable contribution in researching teaching media during the 1st and 2nd World Wars as well as in the inter-war period, especially in the field of film impact. The decade in which the popularity of film was taken over by television and where school TVs spread were the 50s. The efficacy of using televisions in class was highlighted as a new valuable tool in relation to the previous frontal conventional teaching methods. In the 60s the real challenge was class programming which was credited for research in the field of planning, sequencing and structuring of media as well as individual two-way communication. Towards the end of the 60s and the beginning of the 70s, Gagne (1965), Salamon and Snow (1968), Briggs (1970) and Allen (1970) left their mark on the period of

research in stimulation, assignment and pupils in a deeper sense of understanding the values of class media. Briggs (1968), Gagne and Rohwer (1969), Frase (1970) and Rothkopf (1970) contributed to researching the right way of using class media based on research in the field of class programming, especially in the field of ways of presenting subject matter and hierarchical structure of subject matter (according to Blažič, 2007, pages 25-32). The intention of “comparative-evaluative research” stimulates the principal idea of markets that each newly invented media has a superiority over the existing media with regard to the possibilities it provides, thus modernising the class work.

Lately, it has been difficult to limit ourselves to one country since, thanks to electronic technology, scientists more than ever are connected all across the world and scientific practice involves team projects whose leaders are representatives from different countries. It is obvious that the globalisation trend in the economy affects the scientific field.

Besides research in the field of media structure and the possibilities for their use in class, research of cognitive possibilities for teaching pupils is highlighted. “Today, models of human information processing are at the centre of a cognitive approach to pupils studying and memorising. Information processing is not only a term for a unique theory but includes a series of theoretical understanding about how we perceive stimuli from our surroundings, how we process the information in our short-term memory, how we connect it with our acquired knowledge, how the new knowledge is stored in our memory and how it is retrieved. These approaches are applied in analysing learning, memorising, problem-solving, visual and audio perception, cognitive development and artificial intelligence.” (Vizek Vidović et al., 2003, page 161) The cognitive theory of multimedia learning developed from the theory of information processing towards the end of the 60s of the 20th century. The theory of information processing represents a simple and general model of learning which is made up of stimuli, attention, storage and retrieval of information. The most effective model of information processing is the model of storage first proposed by Atkinson and Shiffrin (1968). That model encompasses three linked sub-systems of which each carries out its own special function: a sensory register or receiver of stimuli, short-term and long-term memory...

Fig. 1: Model of memory and learning as a way of information processing (Atkinson i Shiffrin; according to: Vizek Vidović et al., 2003, page 168).



Information processing begins when an external stimulus triggers a certain sense. Sensory register then accepts the information by stimulating the sense and holds it for a very short period in its original form. Recognition and perception follows. This is the process during which we recognise the meaning of each stimulus in accordance in the previously mentioned rules of perception. Although the information in the sensory register is held for a very short period of time, 1 to 2 seconds, in this period we decide whether to further process the information. Using multimedia in class, the pupils are exposed to audio-visual stimuli. However, whether the pupils will pick up on the stimuli depends on them paying attention in class. „The process of attention plays a major role in determining whether the information in our sensory register will be passed on. At every moment our senses are exposed to all kinds of stimuli – colours, sounds, smells etc. Most of these stimuli are superfluous i.e. we cannot pay attention to all of them. Attention is determined as the process of CHOICE of certain stimuli from all surrounding stimuli that we are constantly exposed to.“ (Vizek Vidović et al., 2003, page 168-169)

R. E. Mayer (2005, page 31-48), professor of psychology at the University of California in Santa Barbara, *develops a cognitive theory of multimedia learning* from the theory of information processing. In the cognitive theory of multimedia learning (also known as the theory of separated attention) Mayer deals with research in the field of acquiring and reorganising cognitive structures in the process of information modification and storage, the impact it has on the pupil's environment and the role of the teacher. The basic hypothesis of research of multimedia learning is that multimedia educational messages, formed in the direction of explaining the way that the human mind functions, with the aim of effective

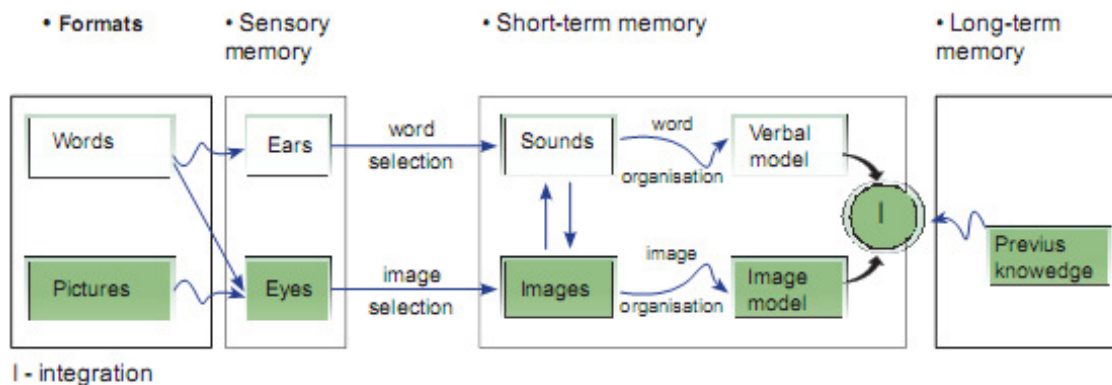
learning (compared to learning which is non-effective). In multimedia learning, we have three memory storages: sensory memory, short-term memory and long-term memory. Words and pictures from the outer world, as multimedia presentation, through the ears and eyes, enter the sensory memory. The main activity of multimedia learning occurs in the short-term memory which holds it and manages knowledge in the active consciousness. The left part of the short-term memory shows the rough material which enters the short-term memory. The arrow from the sound to the picture shows the mental conversion of sound into a visual image while the arrow from the picture to the sound represents the mental conversion of the visual image into sound. The cognitive theory of multimedia learning is based on the model which is made up of selection, organisation and interaction of information through: selection of important words for processing in the verbal short-term memory, selection of important images for processing in the visual short-term memory, organisation of selected words in the verbal thought model, organisation of thought images into the visual thought model and integration of verbal and thought presentations with previous knowledge. Cognitive theory of multimedia learning is based on the audio-visual learning model. There are three basic assumptions (Mayer, 2007, page 32-37):

1. Processing of visual and audio information occurs through different and separate „channels“
2. Each piece of information in the processing channel is limited in its possibilities of information processing
- 3 Processing of information in the channels is an active cognitive process is formed into a harmonious mental presentation.

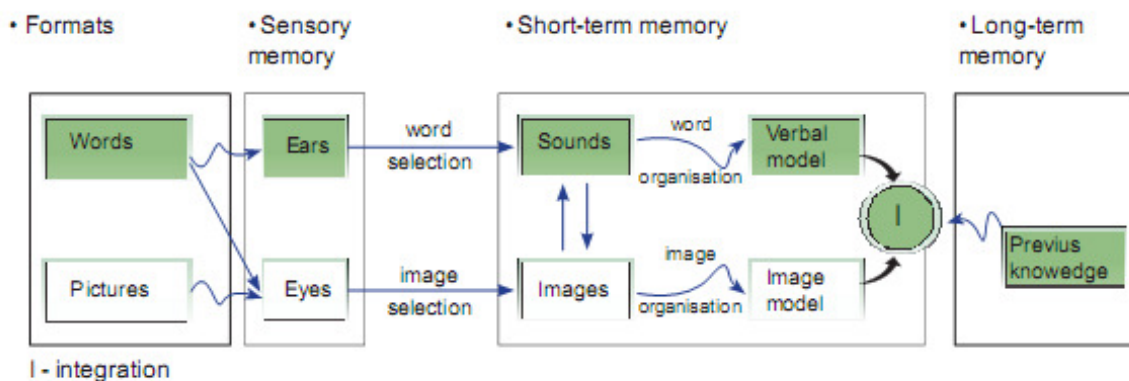
The main cognitive process of multimedia learning is shown with arrows which signify selection of words, selection of images, organisation of words, organisation of images and their integration. These five cognitive elements of the process facilitate learning through the procedure of small segments: selecting words and images from the first spoken sentence and the first few seconds of animation, organises them and integrates them thus repeating the process on the following example. By doing so, in multimedia display of words and images, audio and iconic display from the sensory memory are transformed into sounds and images in the short-term memory, thus creating a verbal and image model in the short-term memory, which connects with previously-acquired knowledge from the long-term memory. Mayer comparatively demonstrates learning in an audio, visual and audio-visual manner (fig. 2). He outlines three types of information processing: processing of pictures, processing of spoken words and processing of printed words.

Fig. 2: Processing of pictures, spoken and printed words (Mayer, 2005, page 43).

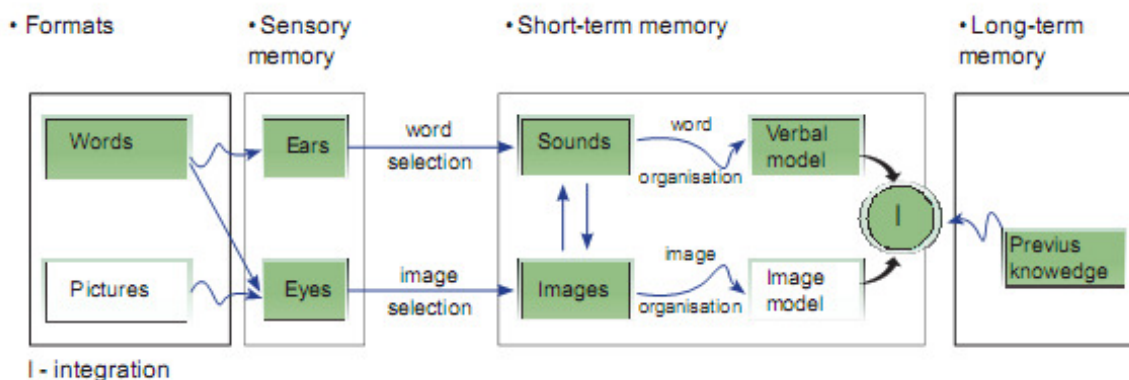
PROCESSING OF PICTURES



PROCESSING OF SPOKEN WORDS



PROCESSING OF PRINTED WORDS



The flow of *picture processing* is shown by the shaded boxes. If, for example, we show the pupils a photograph (static picture) and animation (dynamic image) which in sensory memory

without any effort, is briefly registered by the eye, then an active cognitive process follows which is consciously controlled by the pupil. If the pupil pays attention to the rapid flow of pictures registered by the eye, part of the pictures will be shown in the short-term memory. This deliberate processing makes up picture selection. Since the short-term memory is full of different pictures, the following active cognitive process includes organisation of those pictures into a coherent structure, thereby creating an image model which the pupils construct as a flash (photographs) or an organised flow of pictures (animation). Finally, active cognitive processing links new impressions with previous knowledge. *Processing of spoken words* is shown in the shaded boxes (fig. 2 example in the middle). When the computer says words in the multimedia presentation, the ears register them in the sensory memory and so that information is temporarily stored in the audio sensory memory. If a pupil pays attention to the sounds coming through the ears, some of the incoming sounds will be selected in the audio short-term memory. Such accumulated words should be organised into coherent mental structures in the verbal model of short-term memory. At that moment, words are transformed from sound into their meaning which, in connection with previous knowledge, completes the transformation. While the processing of pictures occurs through the visual channel, the processing of spoken words occurs through the audio channel and the *processing of printed words* occurs through the audio-visual channel. The arrow from pictures towards sounds in the short-term memory shows that a pupil can mentally create sound that suits a visual image and vice versa; mentally he can create a picture that corresponds to words. Printed words are shown visually so the processing of words begins with the eyes. Certain words, through selection of their pictures, are directed into the short-term memory as parts of pictures. On a mental level, they are transformed into sounds which are processed, like spoken words, into new impressions with previous knowledge (Mayer, 2005, pages 42-44).

Mayer (2005, pages 97-201) outlines several principles of multimedia teaching with which a higher quality of learning is achieved:

- *The principle of multiple presentations:* while explaining, it is better to use words and images rather than only images, e.g. multimedia effect;
- *The principle of subject matter involved:* with multimedia explanations, we create a correspondence between words and the image. Pupils master the subject matter better through simultaneous explanation with words and images rather than successively;

- *The principle of divided attention:* during multimedia explanation, it is better to use words through audio rather than visually (text on the screen);
- *The principle of individual differences:* the former principles depend on individual differences among pupils. Multimedia effect is stronger with pupils of a lower level of knowledge;
- *The principle of coherence:* is based on short summaries of explanations which should be organised as productively as possible.

The stated principles are essential for this research paper as they represent guidelines of multimedia learning. Apart from that, each stated principle of multimedia formation opens new possibilities for future research.

The theory of cognitive liability has been defined by the Australian psychologist J. Sweller (Clark, Nguyen and Sweller, 2006, page 24), professor of education at the University of New South Wales. The areas of his scientific interests are focused on cognitive processes and teaching methods. Through the theory of cognitive liability, he analyses cognitive possibilities of learning and defines it as a universal precept of the learning principle which demonstrates results in an effective class environment and contributes to a humane cognitive process of learning through leverage. The universality of this theory relates to its application in all curricula, all available media and all pupils as well as giving instructions on how to use basic audio-visual sources in learning. It is based on experimental research studies, advocating efficiency (faster and higher quality of learning) in learning i.e. economical quality minimises useless mental sources and instead of that places those limiting mental sources into action with the aim of maximum impact in learning (with the least expended energy to achieve better and better results), offers principles and guidelines for an enhanced formation, development and presentation of learning. Types of cognitive liability are: intrinsic liability, appropriate (purpose-serving) liability and unimportant (minor) liability. Intrinsic liability is mental work by which the complexity of curricula is imposed to primarily predetermine teaching aims. Therefore, complex class themes should not be taught all at once; they should already be broken down into several small teaching units directly. Appropriate (purpose-serving) liability is mental work by which class activities are imposed in order to carry out the aims of the curricula. During class, it is imperative to use methods which lead to better efficacy in learning. Unimportant (minor) liability is based on the competencies of the teacher. There is a lot of burdening through unimportant liability of pupils in learning which result in long-

lasting learning and poor effects of learning in pupils. (Clark, Nguyen and Sweller, 2006, pages 7 – 13). The theory of cognitive liability is based on direct reading and understanding of information processing, development of illustrative figures as well as ways in which knowledge is acquired. Sweller's theory of cognitive liability, in devising the curricula, relates to two types of short-term memories. On the one hand, these are limited possibilities for drawing up multimedia schematic content which we are presenting, and on the other hand the limits of their understanding, gaining new abilities and skills.

The basic meaning of multimedia teaching is optimal learning of pupils when the computer's working memory facilitates and provides for changes in the long-term memory of pupils. Restriction of the working memory causes difficulties in connecting several pieces of information simultaneously. When more information is in interaction, it is better to show them simultaneously than successively. A high level of interactive information can be included in showing class curricula. Subject matter which contains a high level of interactivity cannot effectively be taught with unsuitable methods of teaching. Weaker methods of presentation i.e. teaching, can result in unnecessary ineffectiveness. Simple subject matter which has several interactive elements cannot be explained by a simple method of presentation.

The theory of cognitive liability is subject to numerous teaching regulations which enable the pupils an easier understanding of the curricula. Apart from that less time is required to acquire new knowledge. The alternative teaching model highlights the importance of learning through working examples which guides them in the usual manner of doing things:

- Careful analysis of teaching requirements and needs. Problems arise in learning when a pupil must pay attention to too many elements simultaneously.
- It is necessary to use single, harmonious displays. The pupil should have focused attention rather than divided attention.
- Excess should be eliminated. An excess of information lowers success in learning.
- Provide problem-solving instead of conventional repetition practice
- In multimedia teaching, it is better to show animation and speech simultaneously rather than one after the other.

Theory of cognitive liability opposes the traditional approach of curricula presentation. The teaching demands and specific nature of information transfer encourage research where the deeper meaning combining different curricula and teaching methods are analysed. Persons who draw up curricula must be aware of the short-term (working) memory of the computer and the long-term memory of the human brain. The significance of the theory of cognitive liability for this research paper lies in the fact that it does not oppose the traditional approach of curricula presentation but seeks a deeper meaning i.e. creating developmentally set aims in different curricula combinations. Apart from curricula, in a didactic sense, methods are important i.e. ways of presentation as well as the awareness of the teacher about the given significant points, as the teacher with his personal and professional competencies influences the creation of a stimulating and effecting class environment for learning.

The Theory of Multiple Intelligence was established by the scientist, Howard Gardner, professor at Harvard University and professor of cognition and education at Harvard Graduate School of Education. Gardner (Gardner et al, 1999, page 220) defines intelligence as: “the ability to solve problems or create products which are important in certain cultural environments or communities.

The theory of multiple intelligence is based on different types of intelligence: linguistic, logical-mathematical, inner, outer, musical, visual-spatial, physiological-kinaesthetic, natural and existential, noting that the last two were added in 1999 (Gardner et al., 1999, page 222-228).

Verbal-linguistic intelligence – the ability to think with the help of spoken and written words, the ability to read, interest for written content: books, letters, Internet..., oral communication enhances memory and description.

Visual-spatial intelligence – spatial intelligence differs from visual intelligence. While visual intelligence is based on viewing and visualising, spatial intelligence encompasses three-dimensionality and relations in space. Visual-spatial intelligence most often is found in: spatial orientation, figurative and abstract visualisation abilities, thinking by using image impressions, the possibilities of thinking in 3D, redefining and reconstructing existing artistic compositions into new ones. Artistic creativity has an impact on the imagination, the ability of forming in two-dimensional and three-dimensional materials, creating diverse practical works (drawings, paintings, prints, sculptures, relief, installations...

The most frequent combination in class which supports great efficacy of learning is represented by stimulating verbal-linguistic and visual-spatial intelligence. These kinds of stimulation are supported by multimedia. Multimedia foster the development of the given two types of intelligence since by their structure they encompass the channels of the audio and visual senses. It is essential to train the pupils to listen and watch, observe, and even more important to hear and see, by using multimedia. It is also important through multimedia usage to monitor the achievements of pupils individually during class work, which directly affects the maximal increase of personal intellectual potential.

Logical-mathematical intelligence – provides for abstract thinking, creating meaningful connections and relations among subjects, elements or ideas, the ability to think numerically, counting, measuring, understanding logical mathematical operations, critical thinking and creative solving of mathematical problems, organisational and research skills.

Musical intelligence – the ability to (re)produce rhythm, height and colour of tone, the ability to recognise, produce and reproduce music by using musical instruments or vocal interpretations. When playing a musical instrument, the skill of mastering the technique of playing is acquired, and in singing, the skills of mastering vocal techniques. Through active listening, a strong connection between emotions and musical expression is created along with the habit of enjoying listening to music.

Physiological-kinaesthetic intelligence – the ability to control movements of the body and handling of objects, thinking through movement, development of motoric activities, balance, coordination of movement of the entire body and dexterity, dancing, sports, acting...

Intrapersonal intelligence – the ability to understand oneself, self-awareness of personal feelings, values, thoughts and self-esteem, the ability to regulate personal feelings, moods i.e. emotional states, mental abilities and behaviour.

Interpersonal intelligence - the ability to understand and react to other people's moods, feelings, views, wishes, motives, behaviour, development of empathy, the ability of good relationships i.e. interaction with people: family, neighbours, friends from the neighbourhood, pupils in school....., a leader in teamwork.

Natural intelligence – the ability to recognise and classify plants, animals and everything else in nature, the ability to understand the natural world and natural laws, understanding of animal behaviour, their needs and characteristics, growing and caring for plants.

Existential intelligence – the ability to think about the complexity of human existence (what does life mean to us, why do we die...), how to cope with life's problems.

Attention is focused on Gardner's work because the different types of intelligence are connected with inborn styles of learning and dominant profile styles of pupil-learning. These profiles are determined based on the dominance of the eye, ear and hand in relation to the dominant hemisphere of the brain. This type of definition tells us how to understand and acquire new information in the easiest possible way. One of many learning style divisions in relation to profile domination will be interpreted (Hannaford, 2007, page 198-201). Cross-lateral profiles are based on the opposite side of the dominant hemisphere in relation to the dominant sense. For example, if the right eye is dominant, the left hemisphere is dominant. The preferred style of learning is visual and vice versa.

Table 1: Cross-lateral profiles of domination (Hannaford, 2007, pages 198-201)

CROSS-LATERAL PROFILES		
DOMINANT SENSE	DOMINANT HEMISPHERE	PREFERRED LEARNING STYLE
Right eye	left	visual
Left eye	right	visual
Right ear	left	audio
Left ear	right	audio
Right hand	left	verbal
Left hand	right	kinaesthetic

However, if the dominant sense and dominant hemisphere are of the same side, then the information which the pupil acquires will be limited. If this occurs, it is a question of homo-lateral profiles of domination. For example, if the right eye and the right hemisphere of the brain are dominant, then sight will be less effective (Hannaford, 2007, page 198-201).

Table 2: Homo-lateral profiles of domination (Hannaford, 2007, pages 198-201)

HOMO-LATERAL PROFILES		
DOMINANT SENSE	DOMINANT HEMISPHERE	LEARNING STYLE
Right eye	right	visually limited
Left eye	left	visually limited
Right ear	right	audio limited
Left ear	left	audio limited
Right hand	right	limited communication
Left hand	left	limited communication and kinaesthesia

Therefore, by recognising intellectual composition, learning styles and dominant profiles of each pupil in the class, the teacher will have basic guidelines of choice and use of multimedia by which he will satisfy the needs of pupils in learning. Multimedia teaching and learning provides the pupils with the possibility of success as it creates a synthetic experience in pupils, meaning that it enables simultaneous experience of the curricula through audio and visual senses. By encouraging the audio and visual senses in teaching and learning, clearer and richer impressions are created compared to stimulating each pupil individually. Sensory integration impacts on heightening the pupils' capacities. By sensory integration, the following abilities are developed, e.g. organisation of use sensation, self-organisation... with which they fully experience the outer world. By doing this, conditions for greater success in learning are provided.

In the historical review of media research to date, scientists have rarely researched elements outside the class which influence the impact of media on the class. Therefore, because of the complexity of the problem, it is worthwhile describing conditions which can influence the usage of media in learning. The theory which clearly describes and defines the structure of social systems is *systems theory*. The systems theory is in spiritual and social sciences the most complex and demanding theory at the moment. Compared to previous limited observation of the child, as a communication multimedia where the attention used to be focused on communication relating to the child, in order to see the whole development, today the educational system encompasses each individual and social dimension that affects development of an individual. Its founder is Talcott Parsons, while the European scientist, Niklas Luhmann, developed a holistic theory of society. Social systems have a tendency of creating social sub-systems so the Luhmann's basic question is how does the educational system function. It is very logical through a prism of social systems to observe the pupil and teacher as systems of consciousness, which are reflections of the functioning of social systems' principles on a micro level, through mechanisms of stabilisation and differentiation. The basic constructivist premise contained by the systems theory and system of consciousness has the common theme that each pupil creates his own reality (Lenzen, 2002, pages 154-155). The place of education of an individual within the framework of the systems theory is clearly described by the *ecological systems theory*, through comparing the influence of sub-systems on the structures and mechanisms of action. Reviewing the entire context of an individual's development, the ecological systems theory explains the wider communicational and material-social context. American psychologist Urie Bronfenbrenner (according to: Berk, 2007, pages 23-25) is the author of the ecological systems theory. The ecological systems theory defines the cross-sections of the environment as a complex system in which a person lives and develops and each section has a great influence on the development of the individual, thus in the context of class work, on the achievements of the pupil in learning. These sections are: micro-system, mezzo-system, exo-system and macro-system. *Micro-system* comprises the individual and is represented in the activities and patterns of interaction of the immediate environment. *Mezzo-system* encompasses relationship between the immediate family, the individual (in this case the individual is the pupil) and the school. The greater the quality of their relationship, the greater the pupil's success is at school. Research of multimedia is thus located on the relation between the micro and mezzo-system. Multimedia are tools by which we strive to raise the effectiveness of pupils learning in school. Along with the development in school, since learning is a lifelong activity, the parents' view on multimedia is also

significant. Therefore, it is assumed that pupils will develop better in those homes in which the parents foster the development of their children with the help of all kinds of multimedia and their “right” way of usage. *Exo-system* is an even wider part of the environment structure which relates to the social structures such as: the wider family, friends and neighbours, jobs and e.g. local communities. Pupils’ achievements can be influenced by parents’ flexible working hours, paid maternity leave, parents’ sick leave for their sick children, advice and socialising with friends, neighbours and members of the wider family etc. In socially isolated families, which can be at risk of unemployment, conflicts and abuse, the pupil will rarely have the possibility of developing and achieving better school results. *The Macro-system* is the greatest system and comprises the wider social community which is made up of cultural values, laws, customs and resources. The state of the macro-system influences the development of the individual. In countries with high standards, there is a greater probability of reasonable development of the individual. Therefore, it can be concluded that the development of society as a whole impacts on the development of the individual. Along with the nature of human development, the environment is dynamic and variable, and the development of the individual is a flexible and multi-directional process, as apart from imposed, external influences, there is a possibility of conscious choice, changing and creating the desirable experiences and environments.

2.2. SIGNIFICANT RESEARCH OF MULTIMEDIA IN THE FIELD OF EDUCATION IN EUROPE

As the American state funds were depleted in the 70s of the last century, the amount of research on the effectiveness of television, computers and programmed teaching was reduced. Right at that time, the focus point of research in educational technology and didactic media was transferred to Europe e.g. England, France, Germany, Scandinavian and other countries. German research had and still has an impact on other European countries. Scientists such as: Dohmen, Peters, Dichanz, Flechsig, Zifreund, Rademacker, Glueck and Schwittmann marked the early German period of research during the 70s, while the 80s and 90s in Germany were dominated by Heidt, Hertkorn, Ambruster, Boeckmann and others (according to: Blažič, 2007, pages 33-34). W. Faulstich writes about the development of media science, about multimedia in such a way that he analyses the integration of static and dynamic media, along with the functioning and characteristics of multimedia. F.W. Kron shows the systematisation

of the media within the framework of media pedagogy, didactics of media, media education and media in class. He classifies theories of media pedagogy (e.g. media-teaching, technological, emancipation...). He points out the multiple significance of media usage in class curricula through a media – pedagogical (handling of media, aesthetic – sensory functions while handling media, ethical responsibility towards the influence of media on the individual and society as a whole, critical – analytical approach in evaluating media, ecological dimension in a balanced use of media) and media – theoretical (maintaining and storing media, informing the individual and society as a whole, technocratic management, emancipation usage, enculturation etc.) context (according to: Faulstich, 2000, pages 323-354).

During the 60s in West Germany a reaction to the formal approach to elements of teaching occurs in didactics. It was no longer important to list the elements of class strategy, but the explanation of the phenomena of their mutual relationship, i.e. connecting into a theoretical unit was insisted on. This kind of theoretical approach is known under the name of structuralism of the Berlin school. Its main representatives were Paul Heimann and Wolfgang Schulz. Their significance lies in the fact that they freed didactics from traditional methodism and formal descriptions. Heimann presented the theory in a form of classical German academism only towards the end of his life. Schulz (according to: Knežević, 1986, pages 15-36) popularised it by adapting it to teachers. The basis of the structuralism theory of the Berlin school is holistic and comprehensive teaching, which answers the six basic questions: what, why, how, with what, whom and where. The question *what* refers to the content of learning, *why* defines intention and the aim of learning, *how* explains ways i.e. methods, *with what* encompasses objects, tools i.e. media, *whom* refers to subjects learning, and those are pupils, and *where* explains the place, environment in which the learning is done. Therefore, Heimann developed a structural model of teaching by which he clearly and visually presented class structures with the help of six elements, four of which (aim, method, media and content) represent the area of decision-making, and two (anthropological-psychological and socio-cultural) areas of conditions. The structural model of teaching is described in the chapter: the place of multimedia in various teaching models within the framework of poly-factorial understanding of class.

The meaning of the structural model of teaching and structuralism of the Berlin school is in the reconstruction of classical didactic triangle into a didactic hexagon, in which the

connection between media and other elements of structure are defined. The teacher is the external creator and organiser of the process. In this way, structural elements are defined and the quality of the teaching process, to a great extent, depends on the didactic competencies and the intuition of the teacher. The model represents a general manner in which a class is carried out, but in practice it provides a wide range of creative authentic class activities. Furthermore, inter-dependency between the elements is established and their roles in class. This means that the activity of one element is in an interactive relationship with all other elements, and that the activity and change of one causes the activity and change of all others. This type of synchronicity is manifested in the operational part of the class work. That is why Schulz (according to: Knežević, 1986, page 21) interpreted five viewpoints of media connection with other elements of the model. The intentional view describes the stipulation of choice of media in relation to class aims and assignments. The content view stipulates adaptability and measurability of media with teaching subject matter. The methodical viewpoint highlights the connection of media with methodical procedures and the dual methodical roles: for individual learning with the teacher in class. Anthropological-psychological viewpoint determines the dependency of choice and usage of media in relation to anthropological-psychological structure of the pupil, while the socio-cultural viewpoint causes a connection between the media and the immediate and wider environment.

Newer significant research of multimedia in the field of education which is also connected with our research, relate to an integral model of text understanding and image. The integral model of understanding text and image (fig. 4), by the author, Wolfgang Schnotz from the University of Koblenz-Landau, Germany, serves the pupils when they use during learning several sensory modalities. The model encompasses understanding of reading, listening, visual imagery and sound. (Schnotz; according to: Mayer, 2005, pages 49-69). The cognitive architecture contains a sensory register, short-term and long-term memory. The model also contains a cognitive and perceptive level. The cognitive level is made up of two channels: verbal and imagery, while the perceptual level is made up of several sensory channels. On a perceptual level, information of spoken text and sound is received by the ear, while information of written text and visual imagery is received by the eye. The received information from the sensory register passes through a separate audio and visual channel into the audio and visual short-term memory. The audio and visual channel has a limited capacity of processing and storing information. From this point, one part of the audio information goes directly through the verbal channel into impressions, one part of the visual information goes

directly through the visual channel into mental models, while the second part of the audio and visual information cross each other, the audio information is stored in mental models and part of the visual information in suggested impressions. Newly-processed information in the short-term memory is connected with the existing knowledge which is fed to the long-term memory.

The author gives suggestions for class formation of multimedia that has common precepts with Mayer's (2005, pages 49-69) research of cognitive theory of multimedia learning, thus they both agree that multimedia learning can be successful only if human perception and cognitive processes based on empirical research is understood:

- The principle of multimedia: we combine text with images which are connected with the content of the text while pupils have poor previous knowledge, but sufficient cognitive abilities to process both text and image.
- The principle of spatial proximity: if written text is used it is interpreted in close proximity to an image.
- The principle of time proximity: if a text is used it is interpreted with an image in a time proximity.
- The principle of modality: if animation is used, it is better to use spoken text instead of written.
- The principle of specific redundancy: we do not add written text to oral while we are combining it with an image because a duplication is unnecessary.
- The principle of coherence: We do not use unimportant or incomprehensible (foreign) words and images. We do not add unnecessary sounds or music.
- The principle of sequencing images-text: if written text and images cannot be interpreted simultaneously, then it is better to interpret the image before the text rather than vice versa.
- The principle of structural presentation: if the contents can be visualised with different images in various ways so that they are information equivalent, we use image with visualisation which best corresponds to master new subject matter.
- The principle of general overcrowding: we do not combine text and image if a pupil has greater previous knowledge and cognitive abilities of creating mental models from one source of information.

- The principle of information process control: if the static image is combined with text, if the text is difficult to understand and learning time is not limited, we use written text rather than spoken text.

Future research should be geared towards a more precise display of conditions and circumstances in which the combination of text and image is useful and harmonious for learning, diversities of effectiveness of multimedia, and explanation of the pupil's scope of learning principles through image and text.

In the Republic of Slovenia, M. Blažič and I Gerlič are known as scientists in the field of multimedia.

Blažič, a professor at the Faculty of Pedagogy in Ljubljana, writes scientific papers in the field of media didactics. In his research, he gives a historical review of media development, as well as media taxonomy through the more important classifications of media, considers the problem of terminological and systematic expansion of media, the importance and role of media in the class-communication process and the choice and use of media in a didactic context. The scientific contribution of Blažič in the field of multimedia is based on his term definition, didactic qualities of multimedia, defining multimedia characteristics and the significance of multimedia programs and computer teaching strategies.

Blažič (2007, page 109) states that audio-visual media have several functions: presenting, motivating, informing, individualising and reproducing. With the help of multimedia, we show inaccessible reality, subjects, events etc. Their role is easier memorising and more effective learning. With listening, the pupil remembers more than 10%, while with observing more than 80% of all comprehension. With short-term memory (up to three hours), the individual remembers up to 70% through listening, 75% through observing and with a combination of both modalities, even more. With long-term memory (up to three days), the individual stores 20% of that heard, 30% of that seen and about 50% of simultaneously heard and seen. More effective learning with the help of audio-visual multimedia is manifested in a higher percentage than learning with one sensory channel, whether it is only auditory or only visual. Audio-visual multimedia represent basic and sensory dual information. Blažič points out that multimedia is often used instead of primary sources. Observation should monitor and guide their attention to concrete events. Didactic material is transformed through audio-visual information. Suitable reshaping of information which impacts stimulative on learning is

desirable. Thinking should be connected with observing. Multimedia provide for a dynamic presentation of information and create a useful external motivation and successful experience in an educative environment. The author mentions four basic rules in creating a motivational environment which emphasises that: motivation is more effective with the help of multimedia use, the intensity of motivation is subordinate to individual criteria, motivation is a very variable category in the process of learning and that with multimedia pupils should, as often as possible, be given feedback of information on the success of learning. Therefore, the professional competencies of the teacher in didactic-methodical choice and use of multimedia (in harmony with the development of the pupil) are extremely important and a commitment of evaluating multimedia effectiveness is imposed at the end of class activities. In using multimedia, the teacher should pay attention to: the possibilities of the pupil as a recipient, individual differences of the pupils and their previous knowledge, the specific qualities of multimedia which provides for intervention of professionally lucid, clear and complete information, multimedia encouragement of creative thinking and a heuristic approach to problem-solving situation as well as training the pupil with multimedia to distinguish between statement of facts from their interpretation. Contemporary teaching emphasises the importance of individualisation and differentiation of teaching as it provides for respect towards differences of pupils (their previous knowledge, their interests, learning styles, the amount and importance of the subject matter which can be acquired during class etc.).

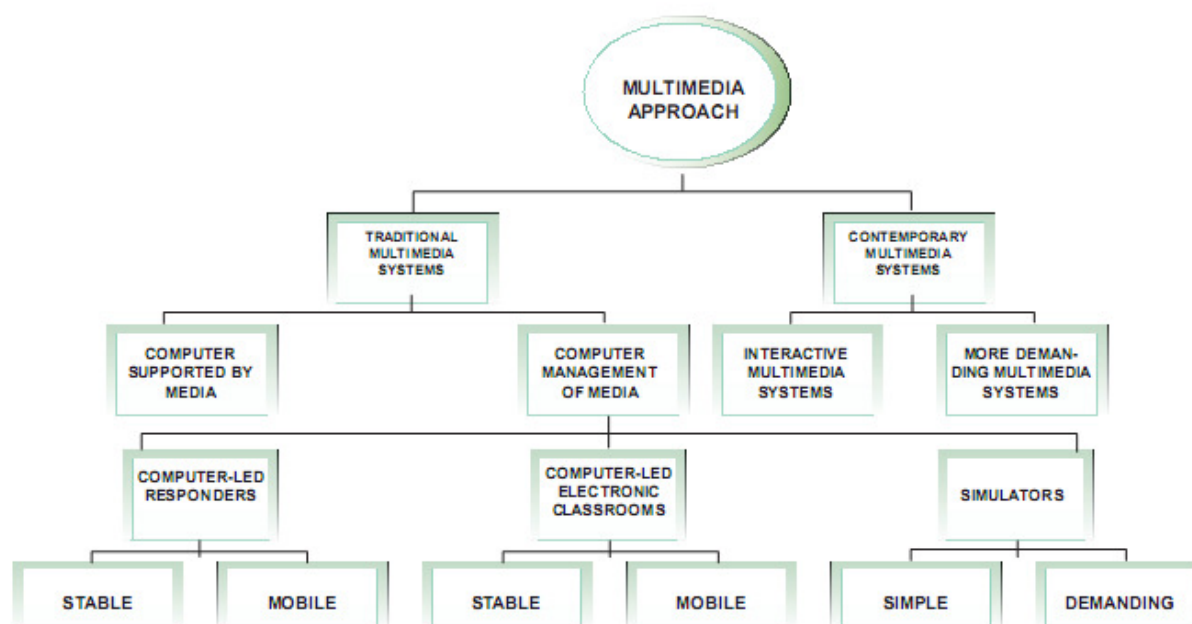
Blažič (Strmčnik et al, 2003, page 312) emphasises simplicity and technical perfectibility of audio-visual media which can be made, stored and reproduced, and often create a multiplicative effect in learning efficacy (numerous pupils in various classes, in various places, with different upbringings). In this division, along with the reproduction function, we should add the production function, where pupils are given the possibility, on one side, of creating multimedia, and on the other side, of creating productive knowledge . Multimedia have the ability of repeating information, which means that we can use them whenever we want over and over again, whether it is a question of selective approaches to information, repetition for the purpose of better understanding or repetition of content.

Gerlič, professor at the Faculty of Pedagogy in Maribor, is researching multimedia in the field of contemporary IT in education, computer didactics and didactics of physics.

Gerlič (2000. pages 200-218) mentions the pedagogical and technical importance of using computers. The pedagogical significance relates to all activities which provides for more

effective learning while the technical importance in using computers is directed towards the technical possibilities of content interpretation. A multimedia approach itself in education is made up of traditional and contemporary multimedia systems (fig. 3). The traditional multimedia systems can be observed from two viewpoints when: the computer is supported by other media or the computer manages other media. When the computer is supported by other media, it is connected with one or more elements of traditional educational technology, e.g. tape, cassette recorder, earphones, slide projector, VCR etc. The computer supported by other media represents the oldest form of traditional multimedia system. The other viewpoint relates to the computer's task in the teaching process to connect, include and exclude different media in the appropriate order. The managerial functions of the computer are applied in computer-led responding systems, computer management of electronic classrooms and simulators.

Fig. 3: Multimedia approach in education (Gerlič, 2000, page 199)

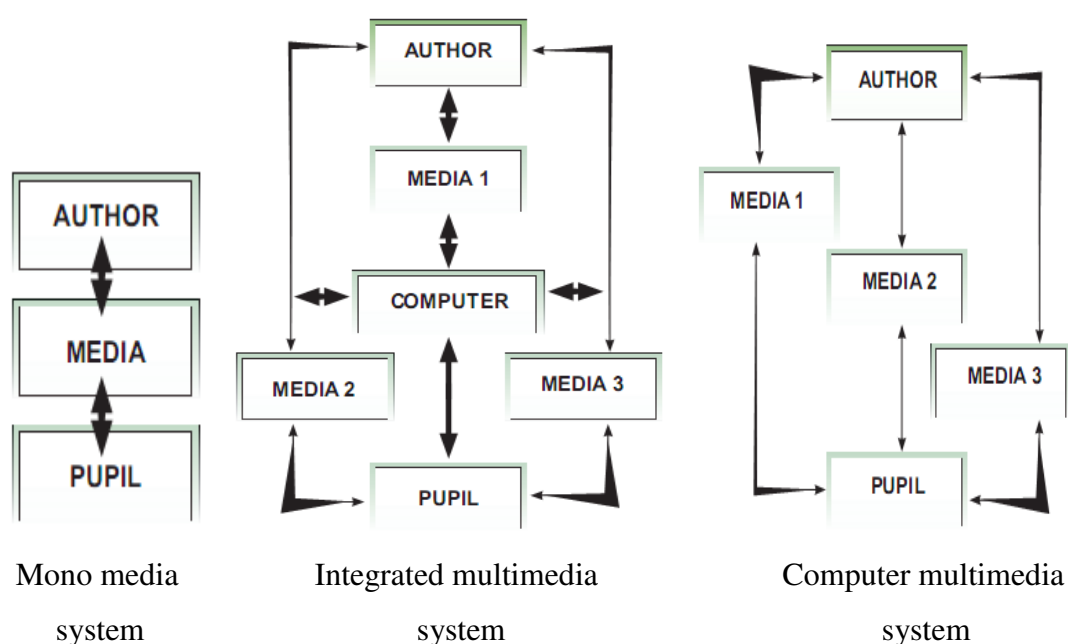


Computer-led responding systems enable communication of all pupils in the class and the teacher through feedback information. The basic condition for a computer-led electronic classroom is having a suitable program and machine equipment, while simulators are a combination of electronic classrooms and computer simulation strategy. Given the level of technological equipment, Gerlič divides interactive multimedia systems into three significant groups: professional, semi-professional and non-professional or traditional multimedia systems. Contemporary computer systems differ from traditional in their level of

technological development of media and computer equipment as well as the level of interaction among elements of the system and user, so they are divided into interactive and more demanding multimedia systems. The origins of interactive multimedia systems represented *Videodiscs*, which had the possibility of showing individual images, moving forward-back, seeking images and their sequence, stopping, repeating, skipping images etc. *Optic discs* allow a digital record of great amount of data of: text, images and sounds, while *interactive CDs* at the beginning were external and connected to the computer and TV, and later as an important part of every multimedia computer with the help of a CD-ROM drive. More demanding multimedia systems such as hypermedia are highly interactive as access to information in the form of text, static images, dynamic images, film sequences, video and sound and their connection are displayed through the features of hypertext. Scientific-technological progress influences further improvement of interactive and hypermedia systems.

Gerlič mentions an interesting approach of the authors: Philip Barker and Harry Yeates in defining a multimedia approach. They distinguish a mono media and a multimedia system in relation to one-directional or multi-directional communication. In a mono media system, the communication is a two-way street, whereas in an integrated multimedia system there are several communication channels, since there are more media in use simultaneously or successively, and finally a multimedia system with a computer, which is the broadest and has the greatest possibilities of multi-directional communication (Fig. 4).

Fig. 4: Mono media and multimedia systems in education (Gerlič, 2000, page 198)



Analysing the viewpoint of Philip Barker and Harry Yeates in defining a multimedia approach, it can be said that in didactic thinking a computer multimedia system is also an integrated multimedia system, if under integration we consider the “process of indefinitely adding small sizes within certain limits”. (Anić and Goldstein, 1999, page 598) Multimedia systems, as opposed to mono media system, are made up of at least two or more media components. What differentiates the integrated multimedia system and the computer multimedia system is the computer itself as an example of multimedia. This means that there are many different examples of multimedia systems that we could (which in practice are created by teachers) further create and develop on the basis of various combinations of media and multimedia. From the above-mentioned, it can be concluded that there are three basic types of combining in multimedia systems, and those are: multimedia systems exclusively made up of media, multimedia systems that are made up exclusively of multimedia, and multimedia systems which are made up of media and multimedia. Of course, each one of these three listed multimedia systems can be made up of numerous combinations of media and multimedia.

In his research, Gerlič observes the importance of multimedia usage in learning within the process of learning. Research done by I. Gerlič and N. Jaušovec (1998, pages 197 – 206) in which they study the cognitive processes present in multimedia mediating programs, has confirmed that the learning processes of verbal content differ from the content interpreted by multimedia. Furthermore, multimedia presentation has been more successful with average pupils as opposed to the gifted pupils. Apart from differences in the impact levels of multimedia on pupils, Gerlič also mentions three basic conditions, and those are: suitable apparatus, suitable program equipment and qualifications of staff.

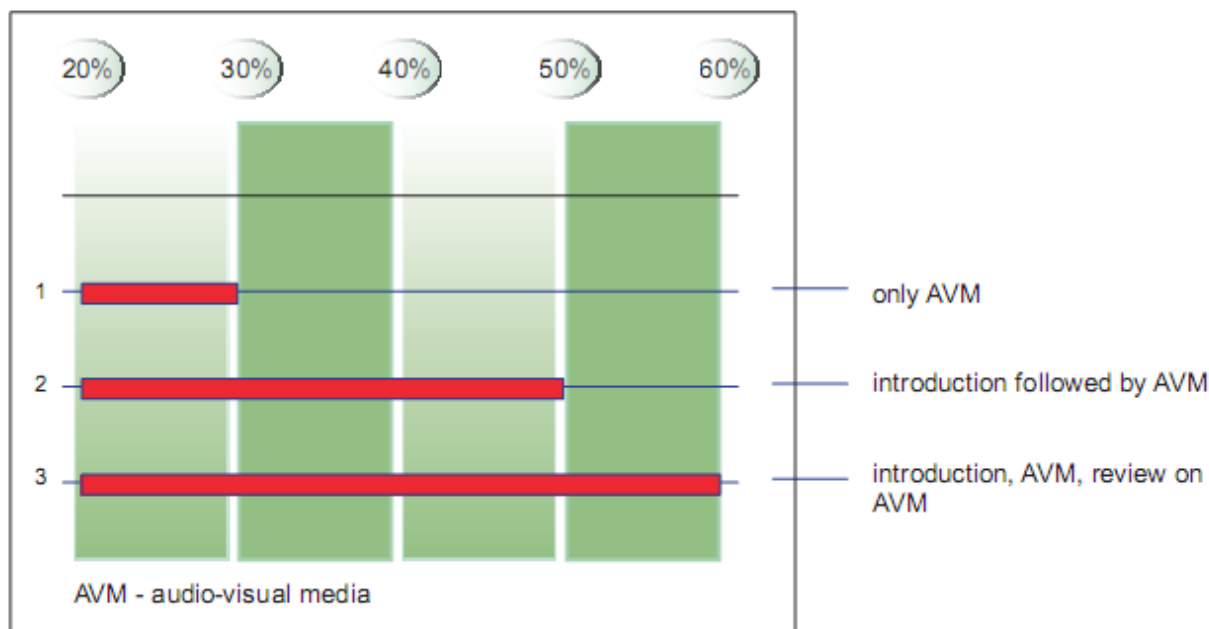
2.3. SIGNIFICANT RESEARCH OF MULTIMEDIA IN THE FIELD OF EDUCATION IN COUNTRIES OF EX-YUGOSLAVIA

Significant research of multimedia in the field of didactics in the countries of ex-Yugoslavia lagged behind American research. In the period between 1920 – 1960, discussions on film in class dominated, surveys on the efficacy of audio-visual tools in class and learning were carried out as well as written articles on use of projectors. In Serbia *J. Đorđević* with his doctoral thesis “Contribution to experimental research on didactic values of films in class” made the first post-war empirical research in which he strove to answer the questions regarding general values of film in class and the influence of film on remembering facts, understanding processes and using the knowledge acquired. Through research, he came to the conclusion that film in class positively impacts on acquisition of knowledge, enhances results in the use of knowledge, stimulates permanent memory of class contents, guides and contributes to concentration in learning, triggers anxiety and aesthetic feelings (according to: Blažič, 2007, pages 33-34). Apart from his doctoral dissertation, in the book “Contemporary Teaching” 1981, he points out the significance of using complex tools i.e. the connection between class objects with other objects. “It was proven that a group of media which mutually complement each other, act more effectively in the process of learning. Apart from that, there is a need to stimulate more sensory areas i.e. include a greater number of receptors in the learning process, thus contributing to accomplishing educational assignments. A wider and broader approach through the use of the eye, ear, and touch can make understanding more complete (according to research, perception of the outer world through the sensory organs is in the following proportions: through the sense of sight – 83%, sense of hearing – 11%, sense of smell 3.5%, sense of touch 1.5% and sense of taste – 1%)” (Đorđević, 1981, page 222). Đorđević states that use of media in class depends more on their attitude towards them rather than physical level of equipment of the classroom and that by using different educational media working style and quality of knowledge changes. Knowledge is more diverse, dynamic and complex.

In Vojvodina D. Soleša and Đ. Nadrljanski are prominent with their scientific work. *Soleša* terminologically explains the meaning of the term “educational technology”, classifies teaching materials and mentions the characteristics and application of teaching materials. He pays special attention to multimedia, designing multimedia presentations and multimedia on

the Internet. Soleša (2006, pages 68-70) visually shows the influence of teacher's preparation on the pupils' amount of knowledge during usage of audio-visual media in class.

Table 3: Influence of teacher's preparation on pupils' amount of knowledge (Soleša, 2006, page 79)



The table shown demonstrates the efficacy of applying audio-visual media in acquiring knowledge in three situations: 1. When pupils only watch audio-visual media, the level of acquired knowledge is the least; 2. When the teacher gives an introduction and then pupils watch audio-visual media, the level of acquired knowledge is significantly increased; 3. When besides an introduction and watching audio-visual media there is a review on the audio-visual media, accomplishment is the highest. Therefore, Soleša mentions a couple of phases during usage of multimedia through which the greatest effect in learning is achieved, and those are: preparing pupils, watching the program, analysis, synthesis and homework. In the introductory part, the pupils are motivated to watch audio-visual media. Since the pupils are ready to watch audio-visual media, during the presentation they create their own experience, especially if their task is to pay attention to certain significant details. After watching, the teacher checks the level of information gained through analysis and synthesis. Explaining and summing up of information is subsequently directed and confirmed through homework.

Nadrljanski analyzes the IT context of multimedia through: educational aids and their multimedia architecture, types of hypermedia educational aids and the role of the pupils in

multimedia systems. IT criteria for classification of educational aids comprise: “1. The computer as teacher; 2. The computer as a user tool for work; 3. The computer as a tool which the user avails of to teach himself and others”. (Nadrljanski, 2000, page 110) The computer as a teacher contains various techniques of teaching that are classified in the following categories: drill and practising, tutorial programs, simulations and model creation, problem solving and educational games. The possibilities of the computer as a user tool for work that can be carried out in the class are: data searching, text processing, applied programs, computer-led learning and the computer as an instrument or laboratory. Research and discovery is a special type of programmed product in the cases of using the computer as a tool which the user avails of to teach himself and others (Nadrljanski, 2000, pages 110 – 121).

Research done on multimedia teaching and learning in the Republic of Croatia is more and more common, which confirms the reality of their significance in class work. Multimedia-themed papers are published in books, collection of papers, and in other sources in which the emphasis is mostly on IT orientation formation of content and their interpretation in class subjects. The published materials mostly mention the importance of using computers in education, lack of IT equipment in our schools, insufficient education of our teachers in primary schools etc. There are very few interpretations of multimedia teaching at class level, especially in the field of multimedia educational aids. Scientists who have made a valuable contribution in the field of didactics of media and the study of multimedia in education are: V. Švajcer, I. Lavrnja and M. Matijević. Along with them: K. Bezića and N. Šoljana, who write about educational technology.

V. Švajcer was a didactician at the Faculty of Pedagogy in Rijeka. In his work “Organisation of Class” (1994, page 176), he mentions the term *multimedia classrooms* which are equipped with standard audio-visual tools (film projector, slide projector, epiprojector, overhead projector (OHP), radio, tape, gramophone, TV) as well as with a responding (communication) system which enables quick reaction by the pupils and the control of pupils’ reactions. Furthermore, he mentions *multimedia technique* by which he implies sound-based projection that is made up of synchronised sets of audio and visual materials e.g. slide film + gramophone record; written text + slides + tape (Švajcer, 1994, page 142). The author also mentions *multimedia sets* which he describes through connection of element-film with gramophone records, tapes etc. (Švajcer, 1994, page 163) Most of the media mentioned are out-of-date in comparison with today’s media and multimedia, but the significance of his

thinking lies in his vision, at the time, of a rich multimedia environment that can be stimulating in the learning process.

I. Lavrnja was a professor of Didactics at the Faculty of Philosophy who write about personal and impersonal media (Lavrnja, 1998, page 127). Personal media have several didactic functions (cognitive, affective and psycho-motor) i.e. they relate to verbal and non-verbal tools of the teacher in the process of communication. Impersonal media (material tools) are replacing parts of the didactic-methodical functions carried out mostly or exclusively by teachers (higher quality and more efficient) and thus simplifying and speeding up the process of learning and communication in these processes. But impersonal media under no circumstances (these tendencies exist) replace the teacher, as a significant personal medium, mediator and organiser of class work and learning.

M. Matijević, didactician at the Teacher Training Faculty in Zagreb also studies the problem of media and multimedia. His scientific interests are, among others: didactics, educational technology, Internet in education and remote learning. He participates in the following projects: Internet in Education, Multi-Didactics of Media, New Educational Technologies and Long-life Learning.

His opinion is that “every media reaches its full potential in a complementary application with other media.” (Matijević, 1985, page 76) Therefore, he defines multimedia in the following manner: “When two or more media are used in class or in the whole educational program, and when they mutually complement and enrich one another, we can talk about multimedia i.e. multimedia education. Therefore, not any kind of combination of two or more media, but a didactical and communicational well through combination, in which the media complement each other during their work.” (Matijević, 2000, pages 27-28)

Matijević analyzes all types of communication in certain teaching media. He connects intrapersonal, interpersonal, mass, one-way, two-way, impersonal, personal, non-verbal, verbal, direct and indirect communication with audio, visual and audio-visual media (Table 4)

Table 4: The connection between forms of communication with teaching media (Matijević, 1984, page 161)

TYPES OF COMMUNICATION	AUDIO						VISUAL						AUDIO VISUAL						
	verbal speech	tape record	gramophone record	radio program	musical instrument	telephone	drawing, image	maps	slide film	silent film	microfilm	text	models	audio film	TV programs	video tapes	videodisc	computers (time sharing)	micro-computers
intrapersonal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
interpersonal	+					+													
mass			+											+					+
one-way	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+			
two-way	+					+												+	+
impersonal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
personal	+					+													
non-verbal	+																		
verbal	+	+	+	+		+				+	+	+		+	+	+	+	+	+
direct	+	+	+		+		+	+	+	+	+	+	+	+		+	+	+	+
telecommunication				+		+									+			+	

Matijević mentions the multimedia characteristics that are important in the process of teaching and learning. These characteristics are: modality of information with regard to sensory characteristics, modality of information with regard to children’s development, duration of presentation of program, manipulation with multimedia, level of information credibility, level of pupils’ involvement in the process of learning and level of teacher’s professional work.

K. Bezić and N. Šoljan write about educational technology. Šoljan (1976, pages 101-109) analyzes the application of computers in class, development of computer application in education and teaching strategies. He classified the educational computer tools and formed them into a taxonomy of teaching strategies in class with the help of computers, these are: problem-solving, using computers as calculation tools, practising or rehearsing, guiding and teaching, linear strategy, intarsia strategy, adaptive strategy, Socrates’ dialogue, seeking information, simulations, games, control of pupils, testing, artistic design and composition as well as Dean Brown’s strategy. Classification gives an assessment and insight into types of educational computer tools.

Bezić (1983, pages 127-199) broke up the development of teaching technology into several periods: period of the spoken word, period of the written word, period of observation in class, period of manipulative and operative technique, period of audio-visual technique and mass media (period of teledidactics), period of computerisation of class and period of multimedia techniques and the role of the teacher in every given period. The last two periods refer to use of multimedia in class. Technical inventions of film and television in class represent a revolutionary step forward in the development of multimedia. Their advantage lay in the fact that they became available to a great number of pupils and provided the possibility of presenting inaccessible information. The flaw was manifested in a one-way flow of information. However, Bezić emphasises the importance of the surrounding context which provides or hinders use of multimedia in class, of which the most important is the competence of the teacher in class. The competencies of the teacher imply long-life learning of highly-qualified experts in applying the latest technical-technological products and ideas.

3. MULTIMEDIA IN TEACHING

Multimedia in teaching have an educative role in that they stimulate developmental changes in the pupil. In this section, attention is focused on determination of the term, structure and taxonomy of multimedia. The structure of multimedia is made up of two or more different media. Therefore, as a starting point, media are interpreted in the paper.

Media in teaching are classified with regard to the senses they stimulate, thus broadening the existing classification of media. The most common classification of media: audio, visual and audio-visual, is extended to: audio, visual, kinaesthetic, olfactory and taste, thereby focusing more attention to sensory class work. The historical development of mass media is shown: film, television and computers.

With the arrival of the multimedia computer (twenty years ago), the term multimedia is more frequently referred to computer multimedia, since the research based on cognitive psychology is often focused on studying the phenomena of learning with the help of computerised verbal-image sources, because of the analogy of the learning process. Mayer (2007, page 3) more precisely calls this type of multimedia learning *dual-channel* or *dual-code learning*. Therefore, the possibilities of multimedia usage of computers in class is interpreted in this paper. Apart from the possibilities of usage, elements of teaching strategies specific for multimedia usage are listed, algorithm on multimedia usage in class and their characteristics. The necessities of using multimedia computers are appropriate computer equipment that works and computer literacy of the teacher and pupils. Use of the computers in different class work is described. A brief display of the IT literacy curricula for pupils in class is mentioned, through the elective subject of IT literacy. There is also mention of conditions which should be respected in multimedia formation of educational subject matter. The relationship of multiple presentation of information and multimedia is discussed.

Teacher training for skilful usage of multimedia is an important field of teacher development, in which the quality of his class strategic work is directly influenced.

Multimedia in teaching shows the numerous possibilities of combining different media and multimedia in class work, successively and simultaneously, based on the existing needs for developmental achievements of pupils.

3.1. DEFINITION OF TERMS WHICH COMPRISE THE CONTEXT OF MULTIMEDIA

In using professional and scientific literature, a lack of term definition standardisation is noticed, e.g. explanations of the term multimedia. *Multimedia is an extremely popular word and is multi-meaning which may lead to confusion in its interpretation, more so because for different people multimedia has a different meaning and different interpretation.*

Multimedia is a word which nowadays is often used in different human activities. Mayer (2007, page 2) lists several different interpretations of the word multimedia within different contexts: “For some people, multimedia is a presentation of information by the computer of: text, graphics, animation and sound. For others, multimedia means a “live” presentation in which a group of people sit in a room watching images on one or more screens and listening to music or an orator. Watching television, VCR or DVD can also be called a multimedia experience. The following example of multimedia is a PowerPoint in which a person presents slides off the computer onto a wider screen and talks about each slide. Even a technically simpler environment facilitates multimedia such as “chalk and speech” where somebody writes or draws on a blackboard, verbally explaining the lesson. Finally, the most common basic type of multimedia is a textbook since it consists of printed text and illustrations.” Communication “in one or more ways” refers to audio and visual sense by which the information is acquired. “Multimedia” is a clearly based phenomena which has its applicability and impact in business, education, entertainment and personal creativity.” (Jerram and Gosney, 1955, page 5)

Multimedia in *librarianship* is a “term for a construction unit which contains two or more different media or different forms of the same media, where neither one can be credited with primary significance. It is usually used as an entity and is called a multi-purpose and multimedia construction.” (Kovačec, 2005, page 513) This type of definition is based in the prefix multi i.e. several, which means multimedia as a component of two or more mediums, where it is not important whether the components are of the same or different sensory compartment.

Interpretation of multimedia in *art* is defined as “An artistic form in which several different artistic expressions are fused and connected: visual, musical, theatrical and dance, where modern technical media are used: photograph, film, VCR, sound recording etc.” (Kovačec, 2005, page 513) Multimedia in art represents a synthesis of expressions of various artistic fields. Multimedia “represents information to more than one medium...” (William et al, 1995, page 370) Similarly, Lockard and Abrams (2000, page 230) describe multimedia as: “Each system that unites two or more media into one product or presentation.” The last two definitions open the possibility for a multi-meaning understanding of multimedia.

Apart from the stated definitions of the wide field of human activities in which multimedia is used, the starting point in this paper will be IT definitions of multimedia, which are based on computerised, synthetic displays of audio and visual media: images, text, sound, video and animation, and thus will be explained after the individual determination of the words multi and media.

Terminological definition of the word multimedia finds its roots in Latin origin and is composed of two words: multi and media.

Multi is a prefix in a compound word multimedia and comes from the Latin word *multus*, which means many (Klaić, 1990, page 914). Multi is a “suffix in the compound word, and means many, more”, meaning “that which is composed of more or many things.” (Anić, 2003, page 787)

The basic cause of the problem in understanding the word multimedia is in the diverse, non-standardised and multi-meaning interpretation and definition of the term medium. Observing the term media in a wider context, the same word has different meaning in different human activities. In spirituality it can mean the person – energy channel of spiritual messages through the dimension of time, healer, a person who is or will be hypnotised etc. Media in journalism refers to *media of public communication or mass, mass media* (radio, newspaper, TV etc.). In the field of economics, the term *commercial media* (billboard ads, TV, flyers, brochures, key chains, clothing materials with imprinted advertisement, logo etc...). In criminology, media are used as persons who help to solve problems and mysteries of criminal cases. Media is also used for explaining various physical and chemical processes (SSKJ, 1995, page 533) The well-known statement by McLuhan (2008, pages 17-18) that medium is

a message: „Before the arrival of electric speed and the entire field, it was not obvious that medium was a message. It was thought that a message was a „content“ since people used to ask *what does the picture say*. Nevertheless, they never wondered what a certain melody said or what does a house say or a dress. In those kinds of situations, to a certain extent, they kept the feeling of an entire sample, form and function of some kind of unity. But, in the electronic era, this whole idea of structure and configuration was so dominant that the theory of education took things into its own hands. Instead of dealing with specialised arithmetic „problems“, the structural approach today follows the forced direction in the field of numbers, thus forcing children to think in terms of number theories and „sequences.““

Medium has several similar explanations: “1. An environment in which there is something, an environment and way in which something is said; 2.a) A means and way of saying something, means of communication; 2.b) Modern tool for transfer of information (newspapers, radio etc.)” (Anić, 2003, page 738) *Medium* in English means middle, one that is in the middle. „*Medium* – 1. middle; 2. mediator, guide; 3. means, mediation.“ (Filipović et al, 1998, page 683). In the mini English dictionary, *medium* means „in the middle between extremes.“ (Mini dictionary, 2001, page 345) and the word *multi* is a „combinational form for more.“ (Mini dictionary, 2001, page 363). *Medium* in Latin *medius* means middle, environment in which someone moves (Klaić, 1995, page 798). This means that *media* are in the middle i.e. between people and information. In the English-Croatian and Croatian-English Computer Science dictionary a *medium* is described as: „...means for storing data and information...“ (Kiš, 2002, page 603), but besides containing information, it is important to point out that its role is in transferring information. A *medium* is „every means of communication by which a message can be transmitted, information from the communicator to the recipient, regardless of the fact whether the communicators or recipients are individuals or groups, as actors of communicational practice. Every means which enables a transfer of messages through space and time from source to the recipient, is considered a *medium* of communication.“ (Srdić et al, 1979, page 58)

Medium is a word which is similarly used in different languages e.g. English: *media*, German: *das Medium* (plural: *die Medien*), Italian: *il medio*, Spanish: *medio* (*medio de comunicacion*), French: *media* (Brozović, 2000, page 316).

In this paper, the term *medium* will be used exclusively in a didactic sense. Therefore, in the following text, a few definitions of *medium* in the field of didactics will be used.

Media are all means which take on a mediating role between “man and information”. (Lavrnja, 1998, page 127) In the focus of research in this paper, media intervene between the pupils and information. It can be said that media are “carriers and/or transmitters of information” (G. Dohmen, according to: Blažič, 2007, page 38) i.e. media contain and/or transmit information. In that connection, media have the role of a teaching aid and/or teaching tool. As a teaching aid, media represent carriers of information and as a teaching tool they play the role of transmitters of information. The distinction of the didactic term medium from media is in the teaching purpose i.e. the aim of its usage. While media generally carry and transmit information, in class they are used for stimulating developmental changes in pupils. This is supported by the quote of a German didactician, G. Dohmen (according to: Bognar and Matijević, 2005, page 326) who gave the following definition of media: “The specific didactic term medium signifies the carrier/mediator of information in didactically functional connections. This means that here the emphasis is geared towards a medium that is perceived as a carrier of different individual functions within the framework of basic functions of all media – transmitting and mediating information – in a specific didactic reflexive i.e. intentional connection. The didactic term media is not identical with the term “hardware” (here we mean tools, objects, materials) nor with the term “Software” (contents, notifications). Only when reproductive means and material carriers become in a didactic connection carriers and mediators of information, i.e. when tools and information are connected in the service of a some didactic function, do we talk about medium in a didactic sense.” It is precisely Dohmen’s definition of media that will be the leading definition in this paper.

There are several definitions of media, of which a few more, used by Blažič, are mentioned: “Media as treasure and carriers of ideology...(Kinter, Maspfuhl)...Media as different elements of the educational environment, which create stimuli in pupils...(Gagne), Media as a system which mediates messages in space and time. In the system it includes integral parts which are necessary to record signals, significant for media, for archiving and transmission of messages as well as for mediating signals to the transmitter...(Handal), Media as a teacher’s tool for work...(Diel), Media as inter-didactic elements (Von Cube), Media as a tool for pupils, as a means for self-education...(Knigge-Ilnner).” (according to Blažič, 2007, pages 37-38).

In the encyclopaedic dictionary of pedagogy, teaching tools are defined as: “various objects, images, models, devices, machines, collections and other graphic materials which in class serve as sources for immediate acquisition of knowledge or simply as auxiliary aids for indirect acquiring of knowledge.” (Franković et al, 1963, page 525) Đorđević says for the media: “Teaching tools are didactic working instruments which bring specific elements into the teaching process and contribute to a more effective creation of class and pedagogical-educational tasks of the school.” (Đorđević, 1981, page 222) Media is named differently in the teaching practice: *teaching tools and aids, classroom devices, graphic devices, working devices, technical devices, tools for learning, teaching technique...*

Furthermore, Blažič’s (2007, page 38) reflection on media in class is interesting because he mentions its effectiveness in the process of learning, in harmony with the aims of usage: “Recognising mass media such as magazines, radio, television and special teaching or educational media e.g. book, programmed textbook, transparency, slide, sound tape, gramophone record, CD, DVD, school television, video, computer etc. enables a distinction between different levels of media usage that are significant in determining definition fields “didactics of mass media” and “didactics of teaching media”.

Distinguishing between media which relate to the general definition of media and technical teaching media does not say anything about the fact that technical teaching media are rated a higher quality.

Consequently, in class it is usually not good to give advantage to teaching media over mass media. With others it is possible to achieve an even greater teaching impact and organise the teaching process which is more suitable and more motivating than what teaching media can be since they are usually filled with exaggerated pedagogical connotations. On the other hand, teaching media do not require an equal aesthetic value and quality as e.g. a television program, which because of its graphic and aesthetic form, in a teaching context, it acts disturbingly. The intellectual level of a newspaper article can also be unsuitable for a certain pupil. In determining whether to use a certain medium in class, it is always questioned whether the chosen medium is suitable from an understanding point of view and does it make the process of learning and teaching easier, and to what extent can it further motivate the pupil, does it enter into any curricula and to what extent does the technical form of mediating help in presenting the given class subject.” From the above statement, it can be concluded that

the use of media and multimedia is determined by the situation dynamics during class and that usage depends on elements of the didactic-methodical field, which means that uniform rules on when media can be used during class do not exist, but didactics criteria do, which form the basis enabling easier choice of media in class.

After having listed the definitions of the term medium, it is easier to notice and accept different interpretations of the term multimedia. All over the world there is the same word for multimedia. In English, German, French, Italian and Spanish (called medios multiples) the same word exists – *multimedia* (Brozović, 2000, page 530).

Multimedia in the Croatian encyclopaedia is defined as “A synchronous display of a content in several forms, mostly in word and image, i.e. in a verbal form (printed or spoken text) and image form (static pictures, illustrations, graphs, photographs, charts, maps, dynamic images, animation, video). The term began to be used at the beginning of the 80s in connection with computers, and since then has been used in a wider context to describe anything involving the senses of sight and hearing in a computer environment. In a restricted sense, the term is used in three meanings, i.e. for signifying devices through which a message is carried, the format of the display of a message, and the senses that the recipient uses for receiving a message. The possibility of enriching displays of certain information or content e.g. audio or video record influences its comprehensibility, and so the encyclopaedias or textbooks are nowadays frequently made multimedia. M. provides the user with the possibility of interacting with the content, which is a characteristic which makes it unique. Interactivity gives this medium an important psychological dimension which engages the user and gives him the power to act.” (Kovačec (ur), 2005, page 513).

Through the following definitions, multimedia is explained in the field of Information Technology (IT) and is based on computer, audio-visual display of contents.

Mele (1993, page 23) defines multimedia as an original name for computer, in which he unites the modules for recording, processing and reproducing of sound, images (static and dynamic), text and other numerical information.

Jerram and Gosney (1995, page 3) state that multimedia is often referred to the enhanced possibilities of personal computers in processing not only text, but all kinds of visual and audio information.

Williams, Sawyer and Hutchinson define multimedia as presenting information on more than one medium, including text, graphics, animation, video, sound and voice. (1995, page 332)

Multimedia is a “combination of sounds, graphics, animation and video. In the world of computers, multimedia is part of hypermedia, which connects the elements of multimedia with hypertext for creating links between information.” (Štiglić (ur), 1995, page 177)

McFarlane (1997, page 160) also defines multimedia as a combination of high resolution images, digital stereo sound, text, video and animation.

Lavrič (1999, page 163) in his research on use of multimedia computer programs points out the significance of multimedia in connecting and displaying: video, sound, text and animation with the help of computers.

In the English-Croatian and Croatian-English Computer Science dictionary, multimedia is used as software and as a computerised way of displaying information: “1. Program equipment which is constructed in such a way that it can simultaneously send various types of data (e.g. text, graphics, computer animation, television and sound) to different output devices (e.g. speakers, screens); 2. Computer type of displaying information by connecting audio and video components i.e. through the use of text, graphically displayed data, television, sound (voice), computer animation or digital film image; provides for versatile usage of computers.” (Kiš, 2002, page 637)

In the English-Croatian Computer Science encyclopaedia dictionary, multimedia is shown as: “Using computers for the display of text, graphics, video, animation and sound all of which are connected, i.e. integrated into a whole unit. Multimedia applications, which were long announced as a revolution in the IT industry, were not common because the required hardware was too expensive. With an increase in its effectiveness and the drop in the usage price, multimedia has become accepted all round and is frequently used. Almost all personal computers today are capable of displaying video material, although the resolution depends on

the power of the video adapter cards of the computer and its general processor.” (Panijan (ur) ,2005, page 42) Collin (1995, page 8) states that the appearance of multimedia triggered a revolution in education, more precisely a new world of education, through the combination of various media such as sound and image, assisted by the personal computer.

Matijević (2000, page 124) uses the term multimedia “for multimedia software which can be found on a compact disc (CD) or is available to users on the Internet.” There are *linear* and *interactive multimedia programs*. Linear multimedia programs guide the user onto the following or previous page while providing interactive users with the freedom of choice of content whose sequence is created by the users themselves. “Interactive multimedia gives you the freedom to investigate the unknown with the light-speed connections to the linked titles. This type of interactivity with dynamic elements such as video and music makes multimedia a suitable tool for learning – especially for children, since multimedia is similar to TV or video games, thus becoming part of the youth culture.” (Jerram and Gosney, 1995, page 17) In a similar way, Collin (1995, page 9) explains interactive multimedia as „the possibility of managing and allows you to freely navigate through a labyrinth of images, sounds and video. Clicking the mouse on the formerly defined area known as *the hot spot*, displays the other directory in the program; the connected directory can be made up of images, sound directory, video or a window filled with new information. There are several ways of defining hot spots in multimedia titles. Sometimes the cursor changes into the form of a hand when it is placed on a hot spot. Hot spots in the text are usually highlighted through the use of colour, underlining or capital letters.”

The common characteristics of the given definitions of multimedia in an IT context have their base in the structure of multimedia, as audio-visual components, program equipment and computer way of displaying information.

Elements needed for multimedia research are: monitor, hard disc, processor, memory, sound card, PC speaker, speakers, microphone and CD-ROM drive. There are several multimedia CD-ROMs. In class, educative ones are recommended, relating to learning foreign languages, new developments in science and art (e.g. multimedia encyclopaedia Microsoft Encarta, Microsoft Musical Instruments, virtual museums...), learning and adopting new techniques of reading as well as those intended for personal expression of users or examining their knowledge and abilities. Pupils can create even their own multimedia, draw, choose ready-

made pictures, change their appearance, connect two or more into one (recompose), scan, print, make various video sequences, photographs, photo albums, web pages and animation. The computer in a teaching context is viewed as a means for teaching and learning. The first computers were mono-media. They served exclusively for input of text.

Today, computers provide multimedia possibilities of expression (sound, image, text, video clips and animation). The usage of computers provides for hypermedia educational technology whose components are hypertext, hypermedia, computer educational back-up and Internet. *Hypertext* is a textual display of information which comprises a non-sequential network of associations and gives the user a view of connected objects. The user himself determines the sequence of reading the information. *Hypermedia* is a medium which has a specially designed text i.e. it is made up of software connections between text, image, sound and orders. „Hypermedia – interactive programs in which information is stored in several different media. All is arranged so that the information can be used and presented in several different ways.“ (Matijević, 2000, page 118) Hypermedia ie geared towards training the pupil for independent learning (searching, selecting, comparing information etc.). The *Internet* is „1. A group of computer networks connected so as to send and transform messages. 2. Global group of networks and accesses with joint protocols for entering the network, millions of users worldwide log onto it.“ (Anić and Goldstein, 1999, page 602) “Internet is a new way of communicating, compatible with the times in which we live; it is quick, obvious and far-reaching; the Internet connects computer literate people into a community without states, natural or cultural boundaries; the Internet is a way of thinking, promotes business and socialising, making it effective and fast.” (Raič, 2000, page 114) The Internet is made up of many services, one of them being the World Wide Web (www), which contains great amounts of textual, imagery and video information, as well as email i.e. electronic mail which is used for exchanging letters and documents. The exchange of written messages is a form of communication called *chat*. “While talking on the phone the communication is done verbally, through *chat*, the communication is done through the exchange of written messages which are immediately displayed on a computer screen of the person or persons that we are connected to. For this purpose, it is necessary to install a special program on one’s own personal computer or have access to *web-chat*, an Internet page intended for that function. A web camera can also be used which enables the co-speakers to see each other, but most *chatters* prefer to remain anonymous. Because of the possibility for the individual to hide behind an imaginary identity, *chat* is more of a social rather than a technical phenomenon. Even

different lives, more exciting, intense and illusory than any dream, can be formed. The Internet, *www*, universal network, covers the whole planet like a spider's web of endless messages, silliness, feelings and conversations. This is a paradox of the digital age. Virtual reality takes on a special consistency: it is *mediating* less and less real, but paradoxically more realistic, direct, more exciting and receptive than dull everyday life. “ (Laniado and Pietra, 2005, pages 66 – 67) Simulation of reality with the computer is achieved with the help of virtual reality. *Cyberspace* is an electronic world. “1. 3-Dimensional space created with the help of a computer. 2. The World occupied by the power of cybernetics, a life environment satiated with information on facts and technical achievements.” (Anić and Golstein, 1999, page 240) Virtual reality is common in films and television, various games, shows and spectacles etc., and it is a sub-category of a virtual environment since it relates to a group of technologies through which the user's images of reality are more credibly altered by the image of the virtual environment (Pandžić, 2004, pages 3 – 7). It directly connects the user to a computer through various input-output devices. Elements of a virtual environment are various simulations: visual, audio, haptic and physical. Drawn or image displays represent visual simulation. Audio simulation includes reproduction or generating of sounds. Haptic simulation includes simulation of touch and/or force. Physical simulation of virtual objects gives physical attributes e.g. simulation of a car crash.

Informatics (IT) is the science on information. The term itself “was coined in France in 1957 as a derivative of the terms information and automatique (information and automation). Informatics (IT) can be defined as a science on gathering, processing, storing, transmitting and using information with the help of electronic computers.” (Strugar, 2003, page 8) *Information* or notification is the content of communication. “Information is a human understanding of this or that thing, this or that phenomenon which is as a product of symbolic human action reflected into another system (speech, letter, signs). As an understanding, of course, information is also linked to the category of power since real knowledge is always a sure form of human power over what is known.

Multimedia, in a didactic sense, Soleša (2006, page 183) explains as a multimedia educational material which must use the possibilities of multimedia through optimal usage of multimedia elements. “Multimedia elements are various forms of mono-media records. They have their place in many areas of computer application from web sites to program intentioned games and children learning. The development of content with multimedia elements today has a much

greater significance from a series of colourful images, various audio and video effects. Besides a better and more effective way of presenting content, multimedia elements must be able to effectively be searched for and separated according to the user's query." (Soleša, 2006, page 183) Dohmen's definition (according to: Bognar and Matijević, 2005, page 326) of media in class analogously also has its applicability in defining multimedia in class. Multimedia, defined in an IT context, has its usage value in class, when besides carrying and transmitting content it accomplishes its didactic function i.e. functions.

Mayer (2007, page 3) states that the word multimedia can be used as a noun or adjective. The noun multimedia represents material in combined visual and verbal forms, while as an adjective, it is used in the context of *multimedia learning*, *multimedia messages* or *multimedia presentations* as well as *multimedia teaching*.

Teaching technology is a term used in many languages across the world. English sources use the phrases: instructional technology, technology of education, educational technology, technology of teaching. In the German language, the term Unterrichtstechnologie (medien) is used, and in the Italian language la tecnologia d'insegnamento is used. In the Slovenian sources, authors use the phrase izobraževalna tehnologija, while in Croatia there are several terms: nastavna tehnologija, tehnologija nastave, obrazovna tehnologija, tehnologija nastavnog rada, tehnologija suvremene nastave, etc. „Technology is the science which teaches us how to create useful things and objects from the substances which nature provides us with (natural resources) through changing the shape (mechanically) or changing the substance (chemically)...The subject of technology is only those methods and procedures which can assure an economical production of a certain product.“ (Supek, 1971, page 1) Technology of teaching can be explained in a stricter and wider sense: „Educational technology in a stricter sense relates to technical devices and organisational procedures which serve rationalisation and optimisation of teaching and learning processes. Educational technology in the wider sense includes, besides procedures necessary for the accomplishment of inner educational goals, understood as adopting content of education and upbringing, as well as procedures that serve in connecting educational activities with the needs of man and economic and social needs of the environment.“ (Andrilović et al., 1985, page 103) Since the quote states that the restricted meaning of teaching technology refers to technical resources, they represent “tools” being used in class. This thought is spread onto all media and multimedia, and not only technical, due to a more comprehensive approach to teaching strategies which answer the

question *with what* do we hold the class. There are many phrases being used in didactics which refer to media and multimedia: teaching tools and aids, teaching technique, technical tools in class...Media and multimedia are part of the teaching technology. In teaching, technology is considered the all inclusiveness of the activities which influence the development changes in pupils. Through comparison of production technology and teaching technology, production technology is based on processes of manufacturing resources to the final product, while in teaching, the pupil is not a resource, but a living being, not being manufactured, but technology signifies the activities in the processes of the changes in pupils i.e. procedures that lead pupils to higher developmental achievements and levels. It is important to point out that among other elements of strategic activity, here it means using media and multimedia in a wider dimension than simply using technical equipment i.e. teaching tools. The example of comparison between production technology and teaching technology is interesting: "In the first communities, production technology was at the same time the technology of upbringing and education, if it can be called that. Teaching technology, which is based on the teacher's lecture (verbal teaching) corresponds to trade technology (although they cannot be identified). Industrial production of books and their application in class introduced elements of industrial technology. Industrialisation of teaching technology has been increased even more so through the introduction of various technical devices, all through to machines for learning. The highest extent in teaching technology development has been achieved with the introduction of automated elements in teaching. Modern teaching technology more and more aspires towards industrialisation and automation of the teaching process. In this sense, it is possible that the pedagogical phenomena will be created and developed in the future. Industrialisation of the teaching process is manifested in its mechanisation. There are various technical devices are applied, from the simplest to the very complex (machines for learning and computers). It can be said that even now a high level of specialisation of these technical devices has been achieved. Moreover, there is a greater and greater breakdown of work.. In programming, preparing and printing books, producing teaching tools and aids, as well as other work on creating material conditions for class work where a great number of people from different specialities and levels of education participate." (Bezić, 1983, page 178) Just as production technology throughout history had its developmental stages, so was the teaching technology changed and perfected. The changes in production influenced changes in teaching. Teaching is being constantly changed since it follows the development of science and technical-technological changes in production. It is being gradually changed, modified, through the introduction of teaching-technological

innovations. In doing so it creates diligent individuals in society who enhance the quality of work in all human occupations. Because of this, the time intervals between new invention to their application in class are more frequent and shorter. The changes are going towards reducing the teacher's activities in class and increasing the activity of pupils during class, improving material working conditions, a higher quality of communicational transactions, training teachers for the use of modern teaching strategies... "With the evolution of science and society, the original meaning of the word technology is being broadened. Here we shall determine educational technology as an integration of scientific understanding of didactics (and media didactics), cybernetics, psychology, as well as theory of curriculum, theory of system, theory of information and other sciences, in order for the educational process (teaching and learning) to become easier, faster, more rational, more economic, more productive and more objective." (Matijević, 2000, pages 24-25) Teaching technology today can be viewed through the prism of an interdisciplinary basis with the aim of completing its structure. Teaching technology is a subordinate term to didactics, while teaching strategies are components of teaching technology.

Multimedia is an adjective "which is made up of several media which act as a unit in the same project or purpose." (Anić, 2003, page 787) In a teaching interpretation of media, multimedia is understood as usage of various media and multimedia in the process of learning. *Multimedia* "lat. multi-media, which is simultaneously served with several techniques of reproduction and transmitting communication." (Klaić, 1986, page 914) Along with the stated definitions, multimedia in class signifies successive or simultaneous usage of several different media and multimedia, whose purpose is to stimulate developmental changes in pupils. In regard to the relations which are created, the term *intermediary* can be used. Multimedia in class, Matijević (2000, page 125) defines as "mutual complementation and enrichment in the operation of two or more media, e.g. textual and audio-visual, or teacher's lecture, supplemented by an overhead projector and text; can be an illustration of multimedia."

Media Didactics is a branch of didactics in which the role and usage of media in class is studied. "It deals with questions of defining and classifying teaching media, didactical forming of teaching media as well as criteria for choosing teaching media." (Matijević, 2000, pages 114-115) In certain scientists' papers, a term called *multimedia didactics* arises, as a branch of didactics which studies the role and usage of multimedia in teaching. Matijević (2000, page 124) defines multimedia didactics as a "branch of didactics which deals with laws

of learning and teaching carried out by an enhanced role of multimedia and multimedia communication.” This paper advocates the viewpoint that the phenomena of multimedia can be studied in the framework of media didactics.

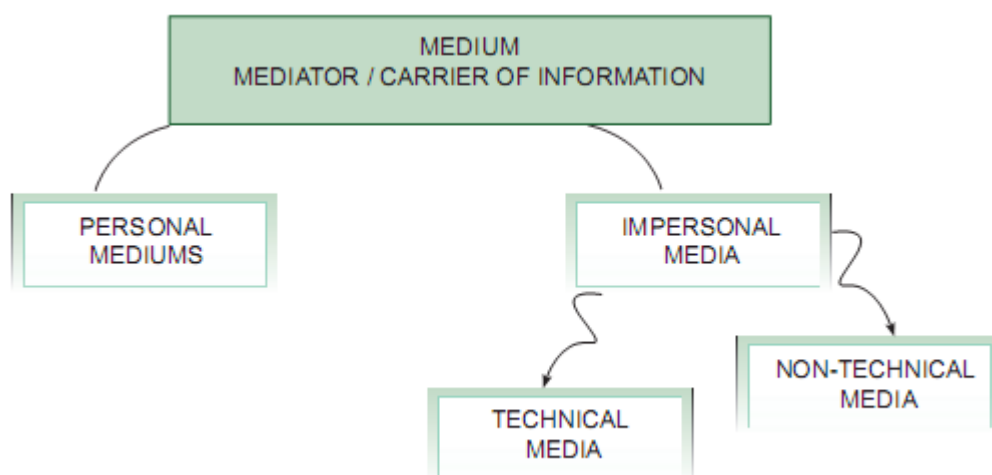
Teaching resources are a didactically formed original reality (Poljak, 1985, page 55). Teaching resources represent sources of knowledge i.e. carriers of information. Teaching aids are tools for work. Teaching aids are transmitters of information. “Special didactic reasons for forming teaching resources as sources of knowledge in teaching exist. Moreover, objective original reality, natural and social, which pupils study in class, is the primary and adequate source of knowledge in human understanding. However, because of spatial and time distance, cognitive complexity and inaccessibility, as well as many other cognitive and psychological barriers, the original reality is not always suitable for direct study by pupils, so as to compensate for that especially constructed teaching resources are being used. This is why teaching resources are didactically transformed, i.e. a didactically formed original reality...disorderly sources make it difficult for pupils to acquire knowledge. This is why in forming teaching resources as sources of knowledge for teaching purposes there is a need for didactic intervention, in that they be in a cognitive sense complete, adequate, accessible, cognitively clear, well laid out, and that directly state facts and generalisations as relevant cognitive guidelines in acquiring knowledge.” (Potkonjak et al, 1989, pages 94-95) It can be concluded that media and multimedia are teaching resources and aids in the process of teaching and learning. From teaching resources, video and DVD recordings are mentioned. Video is a “technique of noting in which the optical signals are transformed into electrical impulses and are recorded on a magnetic tape. The tape can be erased, recorded over and over again, and it can be copied.” (Mikić, 2001, page 179) In the 80s the VCR is used in homes as well as school classrooms. Nowadays video tapes are being replaced by DVD because of multiple advantages. “The advantages of a digital recording onto a disc are: over eight hours of video recordings of high quality, the possibility of subtitling films in up to 32 languages simultaneously....numerous options accompanying each film (quizzes, games, film reviews, conversations etc.), automatic instant searching for the desired place on disc, durability, it does not wear out with time, if we add to that a likely possibility of erasing and rerecording (as with VCR), the advantage of DVD is obvious.” (Mikić, 2001, page 179)

3.2. CLASSIFICATION OF MEDIA IN TEACHING

Media in teaching are an element of the methodical-didactical field, and represent carriers and transmitters of information. As carriers of information, they signify a teaching resource, while as transmitters have the role of a teaching aid. There are many classifications of media in teaching. A few basic ones that are of a high-quality structure for acquiring experiences of various sensory areas will be mentioned.

In the historical origins of teaching, it was considered that the teacher was the only source of information. Gagne mentions a directed communication in the model function of learning through various media (fig. 8) as one of the media. Edling, also in his own classification of media with regard to sensory modality and strength of stimuli (fig. 10) highlights the human factor through direct experiences with people. Therefore, in didactics, persons who are carriers of information and mediate them for the purpose of learning processes, are called personal mediums. Gradually, the spectre of sources was expanded to: various teaching resources and aids (subjects, objects, phenomena and symbols from the real world, didactically formed media...) and pupils' experiences. Fig. 5 describes types of teaching media.

Fig. 5: Types of teaching media (Blažič, 2007, page 39)



In the given classification, apart from personal mediums, there are also impersonal media, which are further broken down into technical and non-technical media. From the given classification, in which the media are shown in a didactic function, it can be concluded that multimedia are components of impersonal, technical media.

With the development of technology and teaching technology, different media are introduced. Today there are endless ways of self-expression of pupils through media as well as many different ways in acquiring knowledge and understanding the world. Media contain and transmit information which is acquired. Although media are all around us, they take on a didactic role in the moment when information they contain and forward serve for learning and teaching of pupils. This is what we mean by media in teaching.

For easier reviewing, fig. 6 shows classification of media in teaching with regard to acquiring of experiences i.e. understanding different sensory areas. Apart from this, this classification aims to underline the significance of media usage which is represented by all sensory areas in which pupils receive the necessary information, and not just individual, which is often the case in existing classifications listed in this chapter. A deeper meaning of this kind of classification and usage of teaching media is to stimulate a richer sensorial integration that enhances the process of learning. All media are not listed because it is impossible to list them all, and that is not the goal here. Media of each sensory area comprise various subjects, objects, materials, machines, devices, animals, plants and people. The basic role of media is creating developmental changes in pupils. Through media, pupils gain new knowledge, working habits, develop abilities, skills and develop personal viewpoints.

Audio media produce and/or transmit hum, sounds, voices, animal sounds, tones. They influence the development of hearing, development of rhythm, ability to remember music, mastering musical language, musical notes, musical pieces and forms, musical taste, national and international musical cultural heritage... They influence the mastering of content of other school subjects.

Visual media demonstrate various visual displays of different artistic areas. They influence the development of artistic-visual communication, visual observation, application of artistic tools, materials and techniques, influence mastering the content of other school subjects, aesthetic evaluation as well as national and international artistic cultural heritage. Pupils

master the relations: big-small, empty-full, right-angled-curved, light-dark, hot-cold, tone-colouristic, fat-thin, short-long, contour-constructive, shiny-matt, striking-dimmed...By observing objects, the pupils can notice the attributes of surfaces, which are also listed in kinaesthetic media: smooth-rough., soft-hard...

Kinaesthetic media help in successful mastering of motoric knowledge (biotic and specific) and developing motoric and functional abilities i.e. raising the entire anthropological status of the pupil to a higher level. In doing so, kinaesthetic media also serve in the development of motoric skills such as: speed, coordination, flexibility, strength and precision.

In media classification, the kinaesthetic and tactile fields are merged into the kinaesthetic field.

Fig. 6: Classification of media in teaching with regard to the senses

MEDIA IN TEACHING					
AUDITORY	VISUAL	KINAESTHETIC		OLFACTORY	TASTE
magnetophone tape, magnetophone, Gramophone record, Gramophone, Radio, Audio cassette, Cassette player, CD with sound recording, CD player for sound recording, Dictaphone, Mini disc, Mini disc recorder, Musical instruments (classic, electronic, improvised), Microphone, Mobile (cell) phone and a computer in the role of audio stimuli, Musicians.	Art techniques Tools and materials Drawing, Sketch Croquis, Caricature Comic, Picture Poster, Billboard Imprint, Sculpture, Photograph Relief, Stereograph Artistic reproduction Applications for flanelographs and magnetographs (Micro, macro) model Simulator, Scale model Relief, Stereograph Signs (letters – books, magazines, newspapers, commercial... numbers, musical notes, scouts, military, traffic, map, measurement, seal, crest, flag, rebus, emblem, logo) Scheme, Pictogram Collections and samples Stick on pictures Stamps, Globe Toys (dolls, constructive...) Maps (historical, geographical...) Tables, Charts Holograms, Books (encyclopaedias, textbooks, picture-books) Magazines Wall newspapers Letter, Art tools Technical tools and materials Rulers, French curve Film (silent, element-film, microfilm) Apparatus for element film Camera (classic, digital), Slides, Slide projector, Slide film Epi-projector Overhead projector Transparency School blackboard Photocopying machine TV TV program Mobile (cell) phone Computer and internet in the role of visual stimuli Video games Visual artists...	Various sports appliances and equipment Sneakers, Sports outfits, Shields, Protective caps, Helmets, Goggles, Fins, Surfboard, Pad for non-swimmers, Ropes, Sailor ladders, Swedish ladders, Trampoline, Board for the spring, Bar, Buck, Rings, Mat, Crossbar, Parallel bar, Volleyball net, Basketball net, Goal, Cones, Ring, Hula hop, Ball, Medicine ball, Frisbee, Ribbons, Jumping rope, Bike, Room bike, Racket, Skateboards, Skates, Skate, Skis, Treadmill, Device for rowing, Other simulators, Professional sportsmen Coaches, Judges,	Leather, Fur, Feathers, Stone, Plastic, Metal, Sponge, Paper, Concrete, Brick, Clay, Glass, Water, Needles, Fabrics, Wood, Art tools and materials, Different samples by which we stimulate the sense of touch.	Scented items, Soaps, Rubbers, Perfumes, Stickers, Fragrant plants, Sandalwood, Lavender. Flowers. Leaves. Smells of food and beverages, Goulash, Fish, Cheese, Juice, Tea, Animal smells, Rabbit, Dog, Bird, Horse, Human smells, Sweat, Mouth odour, Baby smell, Various samples by which we activate the sense of smell.	Semi-processed and processed foods of plant and animal origin, Fruit, Vegetables, Seeds, Meat, Cheese, Bread, Confectionary, Medicinal herbs, Herbs, Spices, Various samples by which we activate the sense of taste.

Part of the kinaesthetic media refers to those that stimulate the sense of touch: hot, cold, sharp, rough, smooth, spiky, soft, hard, wet, tiny, huge...

Olfactory media provide information that stimulates the sense of smell. With the help of these media, pupils experience: pleasant, unpleasant, harsh, sweet, fresh, intensive, natural, artificial smells etc.

Taste media stimulate the sense of taste. With the help of taste media, pupils experience various tastes: sour, spicy, salty, tasty, tasteless, cold, hot, exotic...

This classification can be conditionally understood, since certain media regardless of them being listed under one category in the table, can provide information of various sensory areas. Besides that, media are more and more in an interactive relationship. "Today, when it is difficult to establish the boundaries between media, when one medium switches to another, when they interlink with one another in all possible ways, technically becoming more and more perfect, the unique difference among them disappears". (Mikić, 2001, page 243). Whether in class a media or multimedia will be chosen depends on didactic criteria, of which the primary are: developmental possibilities of the pupil, views and competencies of the teacher, level of equipment of the school as well as anticipated educational achievements of pupils. High quality learning is based on skilful combining of all types of meaning (personal, technical, non-technical), with the aim of creating a rich, material environment in the classroom which is stimulating for learning and in which, besides the teacher, pupils will have the possibility of choice of media in their class activities. This is substantiated by the research Efficiency of active and passive verbalization methods of learning of gymnastic exercises in pre-school age (Hamza and Bala, 2001, page 55), which emphasises a more effective role of combining media of various sensory areas in relation to the usage of media of one sensory area, as well as the levels of involvement in the process of learning: „According to the results of univariant analyses of variant and canonical discriminatory analyses, the authors conclude that applying the method of active verbalisation enabled a higher quality of performance of gymnastic exercises and ground compositions, from the method of passive verbalisation, and more so from the classic method of learning motoric assignments.“ This means that the greatest achievements were made by kids who first learned a song off by heart, then saw a demonstration of gymnastic programs and during a later independent exercise chanted parts of the text (active verbalisation) which was linked to a certain gymnastic element. The second group of children performed the same exercise as the first group, but the last five minutes of class simply listened to the song (passive verbalisation) and a description of the exercise, thus achieving weaker results. The weakest results were achieved by the control group which

performed the same exercises the former two groups did, but without song, standard method of motoric learning: explaining, demonstration and exercising.

A one-sided choice of media (e.g. just personal or exclusively electronic, digital), distances the pupils from the natural context. The natural context is extremely close to the pupils in class because of its specific developmental age and original reality.

With regard to the diversity and numerousness of media, several classification of media is listed in the Encyclopaedia dictionary of pedagogy: "...with regard to the character of work in class, they are divided into: a) demonstrational (pictures, maps, drawings, schemes, graphs, charts, applications, relief, models, slides, slide shows, movies); b) teaching-working (textbooks, manuals, dictionaries, lexicons, encyclopaedias, notebooks, working maps, journals); c) laboratory-experimental (refer to different apparatus and devices used for studying the laws of nature, material properties, carry out various measuring); d) manipulative (tools, equipment, mechanisms, devices); e) operative (machines and equipment for studying the process of production); f) production (machines and tools for production work). Other classifications also exist such as e.g. with regard to the origin of teaching devices: manufactured teaching devices, teaching devices made in school, teaching devices collected from various sources, either by teachers or pupils; with regard to the level of didactic process: natural objects, manufactured natural objects and teaching devices of a symbolic character (geographical maps, charts, musical notes); with regard to place: teaching aids in nature, in production and in other facilities, in schools; with regard to perception: visual, auditory and audio-visual; with regard to function of cognition: teaching resources as a direct source of knowledge, teaching resources as aids in indirect acquisition of knowledge. A classification into static and dynamic teaching resources, natural and artificial, standard and modern, teachers and pupils, for studying, learning, exercising etc. also exists." (Franković et al, 1963, page 525)

Various authors support various classification of media. Research has been done in classifying media with regard to sensory types. Poljak (1985, pages 55-58) classifies teaching resources into: visual (with regard to the didactic function – static and dynamic, with regard to dimension – two-dimensional and three-dimensional), auditory, audio-visual (sound films and TV programs) and textual. Filipović's (1988, pages 124-147) classification of media with regard to the senses is based on: textbook, visual teaching devices, auditory teaching devices,

audio-visual teaching devices, manual teaching devices and auxiliary teaching devices. Pletenac (Bežen et al, 1991, pages 105-110) classifies media into: auditory teaching devices and aids, visual teaching devices and aids, audio-visual teaching devices and aids and computer. Matijević's (Bognar and Matijević, 2005, page 331) classification of media is based on: visual, auditory, audio-visual, textual, simulations and computer technology. Classification of teaching resources by Soleši (2006, pages 52-53) comprises classic and modern teaching resources. Classic teaching resources are: verbal, textual, visual, auditory, audio-visual, manual, experimental and auxiliary technical educational resources, while in modern teaching resources he includes educational program back-ups, multimedia electronic communication, expert systems, teaching bases of knowledge, intelligent tutorial systems etc. It can be concluded that all listed classifications contain several types of teaching media which belong to the same sense e.g. textbook is part of visual teaching resources, like all other textual media, computer is a type of audio-visual teaching resource etc. Didacticians, who frequently classify media with regard to perception, support the classification with regard to dominant senses: auditory, visual and audio-visual media. Such a classification of media is considered traditional and incomplete because it does not contain other types of perception such as: kinaesthetic, taste and olfactory, even more so because including all senses intensifies class work. In the listed classifications, elements that are not linked to sensory types, but belong to other typologies, interfere.

The aim of using media in class is not to determine the percentage of its representation, but its diversity, suitability and effectiveness of usage, by which it directly influences pupils' experiences. Therefore, it is more precise, with regard to the type of sense (attachment 1), to classify media into:

1. Auditory – sources of knowledge which provide information by listening
2. Visual – sources of knowledge which provide information by watching
3. Kinaesthetic – sources of knowledge which provide information by movement
4. Olfactory – sources of knowledge which provide information by smelling
5. Taste – sources of knowledge which provide information by tasting

Using technical media can have negative connotations in teaching. Then we speak about technicality in didactics. Technicality in didactics raises the cult of technology “to such an extent that educational values of concrete teaching curricula are neglected. Such neglect and

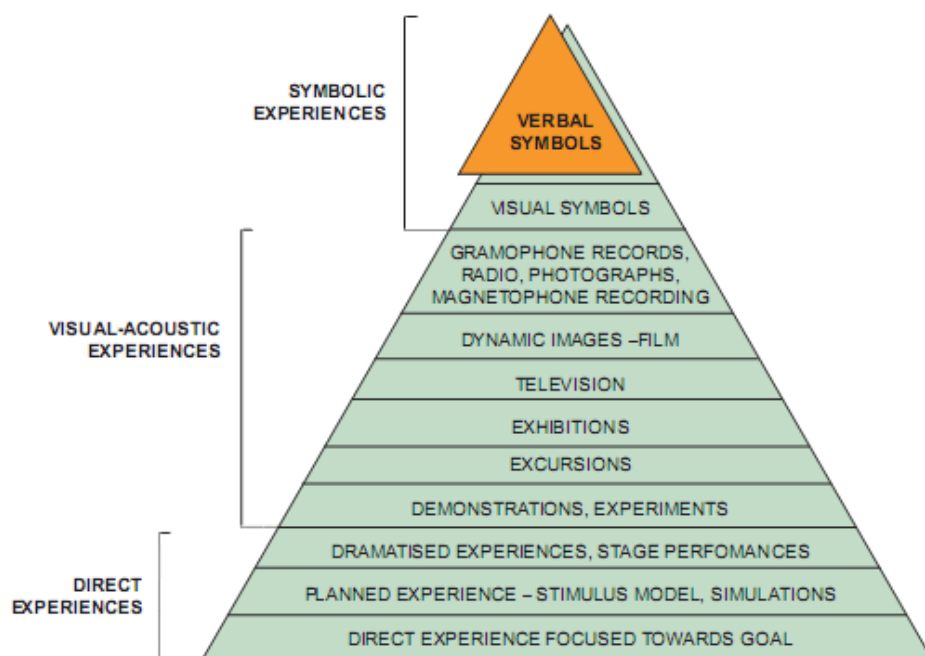
hypertrophying of teaching techniques reduces the class work to “useless spent time” – to the detriment of subject matter and economics of time.” (Franković et al, 1963, page 1017) If the stated aim is not respected, one of the mistakes of using media in class can be technicality. Pupils bear the greatest harmful effects. Therefore, it is important to have and respect criteria of media and multimedia selection, in order to avoid eventual harmful effects for all.

3.3. MEDIA TAXONOMY

The evolutionary flow of teaching, by the usage of various media which are also changing, stimulated many practitioners and theoreticians to devise a classification of media by which their general specific qualities would be defined. We will mention a few examples of media taxonomy of scientists who gave their scientific contribution to systematisation of media. Graphic examples of classification can be found in the attachments of the paper.

Dale’s cone (Dale; according to: Blažič, 2007, page 77) displays three types of experience:

Fig 7: Dale’s cone of experience (Dale; according to Blažič, 2007, page 77)



- Direct experiences (direct experiences, simulations, dramatised experiences, stage performance)

- Visual experiences (demonstrational experiments, excursions, exhibitions, television, film, photograph)
- Symbolic experiences (visual symbols, verbal symbols)

According to Dale, direct experiences have the greatest influence on learning, visual experiences less influence and the least influence symbolic experiences. Learning in original situations is focused towards abstract learning, and abstract symbols are connected with concrete examples of original reality. Between the original contact and abstract symbols are auditory and visual media as well as audio-visual multimedia. They comprise a link of experiences and their interpretation i.e. sensory experiences and thinking activities. In the classification mentioned, the author included media, multimedia, methods and techniques of teaching.

Gagne’s Model of Didactic Functions of Different Media (Gagne: according to Blažič, 2007, page 79) is based on the display of different media (objects-demonstrations, verbal communication, printed media, still image, moving image, sound film and machines for learning) which stimulate eight functions of learning: presenting stimuli, focusing attention and other activities, presenting the model – example, accepting outside help, focusing opinions, transfer of knowledge, checking results, mediating with answers.

Fig 8: Gagne’s Model of learning functions through various media (Gagne; according to Blažič, 2007, page 79)

1. FUNCTIONS	2. MEDIA						
	Object and demos	Directed communication	Printed media	Static images	Moving images	Sound film	Machines for learning
Stimulation of stimuli	yes	ltd.	ltd.	yes	yes	yes	yes
Directing attention and other activities	no	yes	yes	no	no	yes	yes
Preparing a model of an expected effect	ltd.	yes	yes	no	ltd.	yes	yes
Providing help from outside	ltd..	yes	yes	ltd.	ltd.	yes	yes
Directing opinion	no	yes	yes	no	no	yes	yes
Stimulation of transfer	ltd.	yes	ltd.	ltd.	ltd.	ltd.	ltd.
Testing of knowledge	no	yes	yes	no	no	yes	yes
Securing feedback information	ltd.	yes	yes	no	ltd.	yes	yes

The most suitable media which stimulate functions of learning are machines for learning, sound film and directed communication. From that mentioned, it can be seen that choice of media is not systematic since the individual categories are ambiguous or not listed. The focus of Gagne’s research is on intellectual characteristics of learning. The table clearly shows that the same media can have various roles, and different media can have identical roles in the process of learning.

Briggs’ Matrix of Media (Briggs; according to Blažič, 1992, page 84) is more complex than the previous two models. The author analyses the relationship of media (objects, model objects, natural voices-sounds, sound recording on tape, print, program material, record, transparency, slide show, slide, film, television, photograph, image) and four features: characteristics of teaching, demands of pedagogy, materials and transmission.

Fig. 9: Briggs’ Matrix of Media (Briggs; according to: Blažič. 1992, page 84)

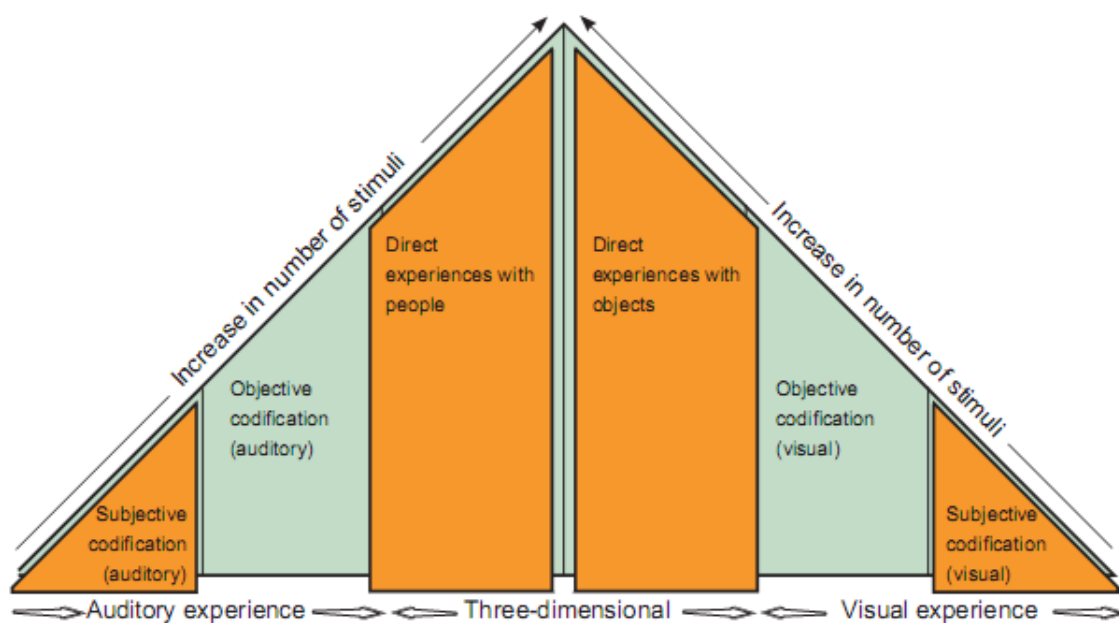
AFTER	IF	TEACHING CHARACTERISTIC										DEMANDS OF PEDAGOGY					MATERIALS		TRANSMISSION								
		Large group (above 100)	Medium group (30-100)	Small group (2-30)	Individual work	Visual stimulus	Auditory stimulus	Teaching steps	Response	Self-education	Movement	Class hour (work standardization)	Defined consecutiveness	Flexibility consecutiveness	Consecutiveness of discovery	Creativity in context	Effectiveness	Possibility for acquisition	Class hour for repeated usage	Price (for 4 copies)	Clarity (permanent)	Suitability (permanent)	Possibility of control	Independence of distance	Sharing not required		
OBJECTS																											
MODEL OBJECTS																											
NATURAL VOICES (SOUNDS)																											
SOUND RECORDING ON TAPE																											
PRINT																											
PROGRAM MATERIALS																											
RECORD																											
TRANSPARENCY																											
SLIDE SHOW																											
SLIDE																											
FILM																											
TELEVISION																											
PHOTOGRAPHS,IMAGES																											

In the table display, each media is connected with its sub-category of each feature. White squares represent suitability, black ones unsuitability, while triangles represent partial suitability. It is exactly here that the problems arise since there are flaws in determining “suitable” and “unsuitable” squares (e.g. why is printed text suitable for large groups (above 100) and a photograph and image are not suitable?), as well as the ambiguity of determining

each category (e.g. is television an object? In the characteristics of learning, social forms of learning and various sensory stimuli are combined, while the learning phases fall under the category of demands of pedagogy?...).

Edling's classification of media with regard to intensity of stimuli of learning experience (Edling; according to Blažič, 2007, page 84) has similarities with Dale's, since direct experiences with people and objects are the strongest. Edling classifies learning experience into four basic ones: acoustic, direct experiences with people, direct experiences with objects and visual experiences.

Fig. 10: Edling's classification of media with regard to sensory modalities and strengthening stimulus (Edling; according to: Blažič, 2007, page 84)



Direct experiences with people and direct experiences with objects provide for the strongest intensity of stimulus in learning with people through: authentic situations, role-playing, socio-drama, pantomime etc., while we stimulate direct experiences with objects by the use of samples, models and recordings. Edling classifies learning experiences with regard to sensory modalities and the strength of stimuli, but again does not move further from acoustic or visual experiences. According to the theory of multiple intelligence, different pupils experience the same media differently because of various learning styles, various previous knowledge etc. Therefore, determining the amount of stimuli for each media is a sensitive area.

In the taxonomies mentioned, scientists strove to devise a model of media usage with the help of some learning techniques, numerosness of pupil groups, transmission of information, levels of experiences etc. easing the teachers' choice of media in teaching. The disadvantages of those models are often based on: subjective evaluation where empirical testing has been omitted, in listing a restricted framework of sensory areas of learning (auditory, visual and audio-visual), ambiguity in determining certain categories as well as unclear criteria in determining certain media. The complexity of the process of learning is based on many elements, beginning with the pupil and teacher, followed by media and multimedia usage, curriculum, educational achievements, methods and learning techniques, social forms of work, types of class activities, spatial-material conditions, marking systems. Therefore, in devising a media taxonomy, by including all teaching elements, a comprehensive classification is obtained.

3.4. MASS MEDIA: FILM, TELEVISION AND COMPUTER – FROM INFORMING THE PUBLIC TO USAGE IN TEACHING

Film, television and computer all have individual historical dimensions of development based on numerous inventions significant for mankind. The primary role of mass media was in promoting certain ideologies for military and political purposes. “The appearance of film, radio, television and other means of mass communication brought a new situation and atmosphere into the educational domain. Education more and more is becoming a significant aspect of the function of communication in society.” (Itković, 1997, page 305) It is precisely their role of informing the public which classifies them into mass i.e. mass media. They are available to people all over the world and promote various kinds of information. “Ideological misconception and divisions of the world tried to use film (and television) as a messenger of ideology, during the era of media popularity growth, revealing an Orwellian world of dehumanised, strictly controlled media, while the modern era of rapid development and thrust of electronic media is breaking down all artificial boundaries, and non-verbal communication channels shift from film and television images, firstly controlled by technical possibilities of transmission, to satellite connections crossing over into the world of computer networks that provide a direct, individual access to information in integrated world informational networks.” (Majcen, 2001, page 244)

Over time mass media are being modified and perfected. Old-fashioned mass media are being replaced by new, which have greater comparative advantages: quality of reproduction, dimensions, price, capacity, handling etc. “Today, in the abundance of audio-visual media, film has a different function. Television partially absorbed the film, but the prevailing opinion is that each media has its own advantages and disadvantages. Returning to Marshall McLuhan and his claim that each media has its own message, it can be said that maybe television and film share some messages of comparative action, but obviously among them differences also exist. Educational film is no longer viewed in the cinema, nor can it be seen there any more (except on special projections). Neither in school, besides suitable multimedia devices, nobody uses a film projector. For example, the fond element of the film Filmoteque 16 was fully recorded onto a video tape and is used with the help of a VCR. It is obvious that even in that field specialisation is occurring, in which the film is freed from responsibility of direct social usefulness and didactics, allowing it to develop in a freer way and discover different characteristics and qualities which other audio-visual media have not yet reached, or satisfy the needs of viewers which other media cannot provide.” (Majcen, 2001, page 244) In households today, video tapes are rarely used. DVDs are replacing them more and more with their comparative advantages. These changes, of replacing older models of mass media with new ones, are much slower in schools. One of the reasons for this is of a financial nature. “Entering into the modern multimedia, post-industrial world, visual communications are gaining a special place, and their forms (television, computers) are becoming strong formative elements of the educational process, elements of gaining real-life experience and are the best way of linking the school with life. While the aim of the educational film in the past was, to a greater or lesser extent, impact on people’s social consciousness and changing people and the world, today the educational function of multimedia sources of knowledge is reduced to providing information and ensuring its accessibility. Information technology (IT) is becoming a more and more relevant field to people working in the film industry, as well as pedagogues and teachers who are helpers and stimulators in accepting a multimedia path of discovering the world, which as a result of an old aspiration for registering and storing spatial and time-passing reality, after various photo-optic experiments, was brought to light in the first Lumiere’s film projections.” (Majcen, 2001, page 244)

The flow of information through mass media is becoming faster and faster and far-reaching. To the pupils today, television and computer do not represent only machines for games.

Pupils of the new age are representatives of the “button-generation” and electronic media. “According to statistical data collected by Henry J. Kaiser from Family Foundation - an institute in the USA that carries out research on family - children in the developed world every day spend an average of 6 hours and 32 minutes in front of some kind of screen, whether it be television, cinema, videogames, computer or internet. At first glance, it can be thought that the results of the research are exaggerated. However, let us try to think how long our children are exposed to the influence of electronic media: they spend two hours in front of the television, the following two hours they spend online (email, chat, videogames) and, in the best possible scenario, an additional two hours in front of a screen because of school activities. If we also include film in the form of video tape or DVD, which represents a tele-overdose at the end of the week, our calculation becomes even more than obvious.” (according to: Laniado and Pietra, 2005, page 11). It is easy to recognise such children: they have ear phones for MP3 in their ears, skilfully use various possibilities that the internet provides: they have their own blogs, they chat, send and receive emails, copy and burn CDs and DVDs, enjoy the pleasures of home cinema, download interesting images and videos from the internet and store them in their mobile (cell) phones, USB sticks..., write and print work material for school, skilfully use the options their mobile (cell) phones provide. Through these activities, usually by the system of trial and error (outside of class context) they research new possibilities provided for them in their family environments. In this way, they train themselves for active learning, and their style of learning, in itself, is imposed in class. In cases of a traditional approach to teaching, the archaic methods emphasise out-of-date-ness to children, i.e. stereotypes in class, since as the technology becomes old fashioned so do the teachers if they do not follow the accelerated appearance of new achievements, in the field of media and multimedia as well as in all other methodological components. Modern educational definition of work with pupils form an interactive relationship of learning in the family home and school, which is necessarily modified in a pro-social community. Therefore, the contemporary trends of transformation of mass media and multimedia should be followed more quickly by schools in relation to equipment and computerization of school classrooms. For example, in England, for equipping a school with computer technology, 25 million pounds is spent annually (McFarlane, 1997, page 175). Film, television and computers make the work easier for teachers. The teacher previously used to carry out many activities the hard way, while today has mitigating possibilities e.g. twenty years ago, in order to watch a film with the pupils, they all depended on the TV program. “The first step forward was the separation of television program from the scheduled time of broadcasting and enabling their

dissemination independently of the program, with the help of video tapes and video recorders.” (Majcen, 2001, page 237) Today there is a greater choice of films on the market and they can be viewed with pupils at a suitable time. It is important to view film, television and computers as means that serve teaching, and not the other way round.

In this chapter inventors who have been a turning point in the evolutionary genesis and development, world known and most widespread mass media: film, television and computers. Besides the historical development of film, television and computers, attention is paid to their significance and influence they had on a population of users. These mass media are daily being perfected so they will always be creating new forms of learning in teaching. Just as there are interesting multimedia presentations in various world entertainment centres and museums, these same are soon entering the school premises. “Thanks to the marriage of television and computers, we will be equipped with glasses and gloves that will provide us with the feeling that we are moving and touching objects in a three-dimensional reality. Together with the main heroine, we will participate in her adventure, experience the same visual and tactile stimuli, and be able even to sense the intoxicating fragrances or disgusting smells.” (Laniado and Pietra, 2005, page 19)

With the daily perfection of film, television and computers, there is a need to educate pupils on their possibilities and significance of usage through various activities: through talk, writing, learning about them, productive creativity with their help, critical viewpoint and analysis of messages they transmit. Mass media in pupils create an illusion of reality, but also an escape from the “real” reality, an illusion of proximity and a feeling of participation. Their advantages are gradually supplanting obsolete media in class. “The process of reciprocity, unity between written and verbal, typographical and audio-visual, is already in full swing so, for example, classic school textbooks are being replaced by multimedia aids that also contain written texts, visual material, gramophone records and tapes, and already in this connection, video tapes, films and God knows what other invented devices that might appear.” (Plemenčič, 1982, page 114). Teachers have the possibility of writing prep work with the help of computers. It is possible that soon there will be on-line consultations with parents, where parents will have entry codes for their children and be able to regularly have insight into their children’s marks. However, regardless of the possibilities of film, television and computer usage, to what extent and in which way the teacher will use them in class depends on personal convictions and professional competencies of the teacher.

3.4.1. Film

Film is one of the oldest audio-visual technical products used in teaching. The development of film was based on the synchronisation of the auditory and visual component. It provides a greater number of pupils simultaneous usage and furnishes information that is difficult to access. J. Đorđević defined film in class as: “dynamic, visual or audio-visual teaching device, didactic instrument of work, which introduces specific elements into the teaching process and contributes to a more effective execution of teaching and educational assignments of the school; it is constructed according to the age specification of pupils, didactic requirements, specifications of class work, curricula, teaching disciplines and themes.” (Đorđević. 1962, page 40) The significance of his definition lies in the fact that apart from a description of film, he also points out didactic criteria which dictate the film structure. V. Švajcer mentions the didactic characteristics of film: “1. Educational film enables discovering reality in its *dynamism...*, 2. Only educational film allows vivid and clearly direct *connecting of spatial and time determination* of objects and occurrences..., 2. Education film enables *optimal time condensation* of shown developments for the needs of teaching... and finally, 4. Through educational film, the registration of an insert from the flow of events can pedagogically focus onto those moments which are in line with teaching goals.”(Švajcer, 1994, pages 154-155) These didactic characteristics of film create possibilities for more effective learning, with regard to the possibilities they provide.

The first days of film (according to: Mikić, 2001, pages 128-183) date back to China, which was famous for shadow theatre based on the principles of current day projections (light passed through transparent material creating shadows). In 1500, L. Da Vinci described and sketched camera obscura – a portable box which through a hole for the passage of light was able to reflect on the opposite side whatever was on the front side. In the 19th century, on the basis of the discovery of sluggishness of the eye, “stroboscopic effects” display themselves with various invented machines (e.g. Phenacistiscope). The era of chrono-photography (photography in time) represents the forerunner of cinematography from 1874 to 1894. In 1874 P. Janssen, a French astronomer, constructed a photographic revolver with which he recorded 48 shots in a row on one photographic plate. E. Muybridge carried out experiments with photographs in which he analysed the movements of animals and people (the most famous experiment was when a horse recorded itself in motion, pulling the ropes and switches

of 24 cameras). In 1888 T. A. Edison patented a kinoscope suitable for one viewer, and seven years later, M. Skladanowsky constructed a bioscope which enabled public projection for an audience. The first film-makers are considered to be the Lumiere brothers (Auguste, 1862-1954; Louis, 1864-1948) and G. Melies (1861-1938). The Lumiere brothers are the creators of documentary film while Melies is the creator of feature film. During the further development of film, various authentic influences of different countries arise: film d'art, Brighton school, Italian historical spectacle, Nordic film school, USA – development of film language, silent comedy, film and realism, film in Sweden, German expressionism, the golden age of Soviet revolutionary film. In Europe and Hollywood during the 30s of the 20th century until the end of the 2nd World War, the following were developed: French poetic realism, British documentary school, classic Hollywood. Various film genres were developed. In the 50s, an interest in the Asian cinematography (Japan, India) arose. Besides the listed European countries, film was also developed in former socialistic countries. During the 90s, American film takes over the world markets, and the basic role of film in consumer society was relaxation and entertainment. Technical possibilities of showing film were more and more perfected. “This is not science fiction. China with screens the size of eight floors of a building already exist. In Sony Imax Theatre on Manhattan, New York, the audience equipped with mentioned glasses, stare at a screen the size of 24x30 m and it appears to them that they are in the sea watching fish swimming by. In Poitiers in France, in the Cinema du Tapis Magique, scenes are projected on all sides of the cinema including the floor. The audience have the impression that they are flying, observing the landscape from above and they experience fear of a crash in the air.” (Laniado and Pietra, 2005, page 19)

Educational films in Croatia were produced by Zora Film and Filmoteka 16. Until 1991, Filmoteka 16 had shot around 400 films. “In this period, educational film renounced many film expressivity resources and possibilities that a film camera provided so as to use to the maximum some other possibilities of visual communication to achieve conciseness and clarity of information. Perhaps it is the most important that it abandoned an imitative-narrative character and began communicating with the audience through visual expressions; which went from displaying concrete reality to expressional communication, showing in that final phase its power of developing visual abstract language and creating mental maps with the help of images.” (Majcen, 2001, pages 232-233) These elements of film cover the area of Croatian language, mathematics, nature, society and art. The high marks from world experts for films in mathematics and art education at the 9th International Week of Educational and

Teaching Film in Bruxelles bear witness to the quality of these educational multimedia made by D. Vunak in cooperation with V. Brkić-Devčić, V. Benčić and R. Ivančević.. (Majcen, 2001, page 227).

3.4.2. Television

The first days of television date back to the end of the 19th century. In 1884, P. Nipkow patented the transformation of image into an electric signal with the help of an “electrical telescope.” Thirteen years later, K. F. Braun constructed a cathode tube which was a basis for television. In 1895 in Great Britain G. Marconi invented equipment for wireless communication. In 1926 K. Takayanagi constructed a TV receiver with a cathode tube. A year later Bell Telephone Laboratories demonstrated a wired and wireless transmission of television signal. In the following four years experimental emission of television signal in the USA, Germany, Great Britain, France and USSR began. In 1940 the American CBS presented a television system in colour. The first television news in the USA was introduced by CBS in 1948, while in Europe it was the BBC in 1952. In Croatia television was introduced in 1956, and in the same year in the USA a remote control was invented. An intercontinental television link between American and Europe was made possible by the launching of the satellite Telestar in 1962. In 1969 six hundred million people throughout the world watched man’s landing on the moon. Teletext was introduced by BBC in 1974, and in 1975 the company Sony produced the first home video-recorder. The 80s were characterised by specialised television stations. In 1996 in Europe the analogue system was replaced by a digital system. (Galić et al, 2006, pages 529-541) Television, as an audio-visual device is being more and more perfected. LCD TV screens, which occupy less space and can be assembled on a wall (as a painting) are becoming more and more affordable. “With the invention of a laser screen, which will soon appear on the market, the screen itself will no longer physical: the scene will appear in the middle of the living room without any mediator, made up only of electrons. The viewer will more and more feel as if he is “entering the scene”, that he is becoming an integral part of the protagonist or story, forgetting that he is in his own home.” (Laniado and Pietra, 2005, page 19)

Broadcasting of school TV programs in the Republic of Croatia, in the morning hours, began in 1960. The programs were compatible with the teaching curricula. The editorial board of School Television stored a valuable amount of image heritage and provided for a parallel

process of learning: at home and in school. “Television is becoming the dominant multimedia source of information in organised education forms as well as in private life. Entering the family homes, it changes the education habits and the relationship of people towards education. So although it is true that the television programs are viewed without any mental input or strain, they hypnopedically act on forming mental maps and knowledge pools of great populations.” (Majcen, 2001, page 236)

“It will be interesting, in that context, to observe the origin of television. While film, in its first days, was a socially popularised technologically photographed theatre, so it was slow and difficult in resolving its theatrical scene and mise-en-scene, acting theatrical expression, television, in a technological sense, as an electronic media emerged from the radio; in doing so – as a visual media – it found itself overloaded, just like its older brother the radio, with its verbal-auditory component, and at the same time, in gaining scene experience had to fall back on its old visual relatives: theatre and (especially) film. Television is in fact – as highlighted up until now – gained an immediacy of live theatre, spatial mobility of film and broadness of radio... Without entering deeper here into a rather complex problem of relationship between theatre, film and television, we could nevertheless mention the immediacy of theatrical effect, in which the viewers are constantly conscious that they are distanced from the stage; film is a “photograph that moves” and creates the illusion of motion; television on the other hand provides an image made up of electrical impulses that create an image in our eye, drawing us in a certain way in a sensory way to the screen, which thus becomes as opposed to the wide screen, an active factor in the process of imagery, and in this activity our eye joins it as a receiver of the image.” (Plemenčič, 1982, page 20)

Television addiction is a proportional magnitude with the degree of blindness by television. There are several ways in which children watch television: TV as a passion, TV as a patch and TV as wallpaper (Laniado and Pietra, 2005, pages 31-32) If TV is viewed as a passion, then the child becomes completely hypnotised while sitting in front of the screen. It is excluded from the happenings around him since he does not care for other members of the family, his duties, friends etc. He chose a certain program which he does not miss. Watching TV as a patch boils down to viewing it because the child is bored and does not have an idea what else to do in his free time. He constantly “switches” through channels and carries out other activities: writes homework, speaks on the phone, eats. When TV is viewed as wallpaper, then this signifies a habit of chronic inclusion of TV, regarding of what is being

viewed, it is heard in the background while other activities are being carried out. On arriving home, the TV is switched on without any conscious thought.

Today there are so-called audio-visual archives “where AV documents are collected, chosen, catalogued, permanently stored and given for usage. These are films of various forms (8, super 8, 9.5, 16, 35 mm) as well as video-documents (tapes of 1 and 2 inches, U-matic cassettes, Betacam cassettes) or new digital AV media, CD-ROM, DVD. These types of archives are mostly within the framework of public television, whereas film archives (film libraries) are independent institutions or within the state’s archives.” (Galić et al, 2006, pages 29-30) Educational programs broadcasted by television can be used in class. The broadcasting program of HTV (Croatian Television) offers: scientific-educational programs, documentaries, programs for children and youth, foreign programs... The programming department of HTV programs for children and youth “prepares programs for an audience of an age group from the youngest children to an adolescent age. In the department an ex-school program has been incorporated so most of the production is of an educational character. The daily program *Žutokljunac* (yellow bird) is intended for children of a preschool age and preparation for school (*Čarobna ploča – Magic blackboard*). For children of a school-going age, “Nulti sat” is prepared (programs *Na glasu, Kratki spoj, Navrh jezika, Športerica, Kako nastaje..., Iznad crte, Glazbeceda, Platno-boje-kist, Strani jezici, 10 minuta, Kokice i Učilica*).» (Galić et al., 2006, pages 337-338)

3.4.3. Computer

The development of the computer dates back 5,000 years B.C. when people used a tool with little balls: abak, abacus for calculating. The Scottish mathematician and politician J. Napier (1550-1617) in around 1600 developed a calculating device made of wood or bones, with which larger numbers could be multiplied and divided. In 1614 he published his first logarithmic tables, by which he simplified the operations of multiplying and dividing. B. Pascal, as a nineteen year old, developed in 1642 a mechanical calculating machine since he was bored by manually adding numbers in his father’s office for tax collections. Somewhat later, G. W. Leibnitz (1646 – 1716), the founder of the binary numerical system, made Leibnitz’s binary calculating machine which was first to enable direct multiplication and division (Strugar, 2003, pages 11-13). It is interesting to also mention the German professor, W. Schickard (1592 – 1635) who was in the shadow of the French scientist, Pascal, and in

1623 developed the first mechanical calculator. Through the automated production process of weaving, invention of the weaving loom, a program was invented which determined activities for the weaving loom, where with the help of 20,000 pierced cards it was able to weave a portrait. The French inventor, J. M. Jacquard (1752 – 1834) made it possible for the same machine to weave different samples of material. It was this idea that Babbage analogically used for his differential machine, where the purpose of pierced cards was used for the input of program and data. The appearance of the English scientist C. Babbage (1792 – 1871) demonstrates the great progress in the development of computers, since he was the first to construct a computer that was steam fuelled, but due to a lack of financial resources the construction of the differential machine was completed only on the 200th anniversary of Babbage's birth, in the London Museum. The machine worked flawlessly and thus confirmed the validity of Babbage's invention. Following these inventions, a real expansion of scientific discoveries in the further development of computers took place in the USA. In Europe the German scientist, K. Zuse (1919 – 1996) during the 30s of the 20th century on his own initiative constructed a programmable computer for solving linear equations, but due to the war and lack of support of the German government the final result was limited. (Grundler, 2003, pages 2-7).

From the end of the 19th century up until today, the USA has stimulated research in the field of computer technology. In 1884 a son of a poor German immigrant, H. Holerith (1860 – 1929) in the USA registered his first of many patents, the so called sorting machine, which is also known as the first modern machine for data processing. Holerith's firm Tabulating Machine Company, established in 1896, merged with several other companies in 1924 and changed its name into IBM (International Business Machines) thus becoming one of the greatest companies for production and application of computers. Scientists from Harvard University in the USA, H. Howard Aiken along with a couple of engineers from IBM in 1943 completed and set in operation an electronic-mechanical computer under the name of: Harvard IBM Automatic Sequence Controlled Calculator or in short Harvard Mark I. The Second World War influenced the rapid development of electronic computers since there was a lot of calculation needed for the military industry. Therefore the USA invested an unlimited amount of resources in order to achieve that aim. The outcome was the first electronic computer ENIAC (electronic numeral integrator and computer), constructed by the scientists J.P. Eckert and J.W. Mauchly from Pennsylvania State University. The computer was of a huge dimension. It weighed 30 tons, used electric energy equivalent to 100 households

(around 174 kWh) as well as being made up of 17,468 electronic tubes (Grundler, 2003, pages 4-6). Following ENIAC the development of computers went through various phases i.e. generations of computers marked with significant specifications.

The first generation of computers (1951 – 1957) is known for the product called UNIVAC 1 – Universal Automated Computer, whose purpose was to carry out the census of the population in the USA in 1951. The basic element of these computers was an electronic tube, and the computers were programmed in a binary machine language.

The second generation of computers (1957 – 1963) was characterized by a replacement of the electronic tube with a transistor, as well as binary language being replaced by program languages: Assembler, ALGOL 60, COBOL and FORTRAN. In 1948 J. Bardeen, W. Shockley and W. Brattain invented the transistor thus becoming winners of the Nobel Prize in 1956. As a result, computers of the second generation became smaller, with less breakdowns, reduced the consumption of electricity, increased the volume of processing of information and were cheaper than previous models.

The third generation of computers (1964 – 1971) was characterized by the invention of the integrated circuit. Its author, J. Kilby of Texas Instruments, placed a few transistors and resistors onto a small semi-conducting plate, which made computers cheaper, increased the speed of processing, increased the memory capacities, and decreased the dimensions of computers and energy use. The most popular computer from the third generation is IBM 360, and the programs BASIC and UNIX.

The fourth generation of computers (1971 – 1989) is famous for the chip, i.e. highly-integrated circuits, since all of the computer's components were able to be placed on one semi-conducting plate. Through this handling of computers was simpler. Computers have a wider application so besides offices they are also used in schools, kindergartens and private homes. In this period, the most popular programs are C, CP/M, MS/DOS 1.0, C++, Turbo Pascal and Windows 1.0.

The fifth generation of computers (1990 -) is known for the RISC chips and comparative architecture, which due to network connecting, enable the same task to be divided and carried out on several computers.

The sixth generation of computers (project) is currently being developed, and will be based on a biochip which will enable computers to work just like the human brain i.e. they will have the ability to learn and adapt to new circumstances (Strugar, 2003, pages 14-16).

It is also worth mentioning that one of the biggest American companies in the world which make computer programs is: Microsoft Corporation, founded in 1975 by B. Gates and P. Allen. At the beginning of the 90s of the 20th century a new discovery that connects the whole world is made: internet. The seeds of its development date back to 1969 when the American Ministry of Defence “launched research with the aim of developing computer networks which would be trustworthy in wartime conditions and connect distant computers of various systems.” (Raič, 2000, page 115) It is cheap, simple and available to people all over the world. With this technological achievement information flows faster and brings people together even more (Grundler, 2003, pages 11-13).

Today there are several types of computers: supercomputers, large computers (central computers), medium computers (mini computers), small computers (microcomputers or personal), table computers, portable computers (notebook, laptop), personal digital aids (Personal Digital Assistant) and their usage in teaching enables many activities such as: writing, calculating, drawing, painting, playing, gathering of information, keeping personal and school records, communication, usage in various types of class activities (such as motivation, adopting new knowledge, repeating, testing learned subject material etc.), presentation, animation, creation of videos, simulation of inaccessible reality... Technical-technological progress of computer development is replacing former blackboards and chalk with mobile (cell) phones and digital PDA “plates”.

“According to Eurispes, Institute for Political, Economic and Social Studies, in the primary schools, every second pupil (1,500,000 pupils) is used to computers, and every sixth *surfs* the internet. In most cases (56.4%) the computer is used for games, but every third pupil also uses it for learning (Laniado and Pietra, 2005, page 7).

The computer industry also created a rich world of videogames which developed into several categories: action games (combat, shooting), role games, sports games, edutainment, electronic dolls, simulation games...

3.5. POSSIBILITIES FOR MULTIMEDIA USAGE OF COMPUTERS IN CLASS

The basic condition of multimedia usage of computers in class is that teachers and pupils have them in the classroom and that they work. Multimedia presentation of class subject matters requires suitable computer equipment – multimedia computer. Multimedia computer implies that it has the possibility to reproduce and create multimedia content. Besides the central unit, keyboard and mouse, it should have: a web-cam, microphone (some web-cams have integrated microphones), speakers, monitor (suitable for work, min. 17 inch), fast internet connection (min. ISDN, recommended ADSL). The web-cam provides interaction of a moving image and sound via the internet. If necessary, other devices such as scanners, digital cameras and cameras can be connected to the computer. The computer also must have a DVD device for recording and reproducing multimedia contents. Computers can be directly connected to each other, into a local network, or globally onto the internet.

Apart from satisfying physical conditions for basic computer equipment, an important condition is also computer literacy of teachers and pupils. Computer literacy is considered to be when the person is capable of working on a computer and using standard applications (Office tools, tools for internet usage, e.g. Internet explorer, multimedia, e.g. Power Point, Windows media player and one of the tools for electronic correspondence, e.g. Outlook or Outlook Express). Teachers' computer literacy relieves to a great extent work in class. This competency enables the teacher to be sure of himself, to solve assignments quickly and provide help to pupils with lower levels of knowledge quickly, since they are guided towards solving the problem. Therefore, multimedia usage of computers has its applicability in more areas of class activities:

- Written teachers' prep work for class,
- Communication with parents,
- Creating, storing and exchanging documents,
- Organisation of out-of-class teaching,
- Internet purchase of class tools and aids,
- Reviewing multimedia content.

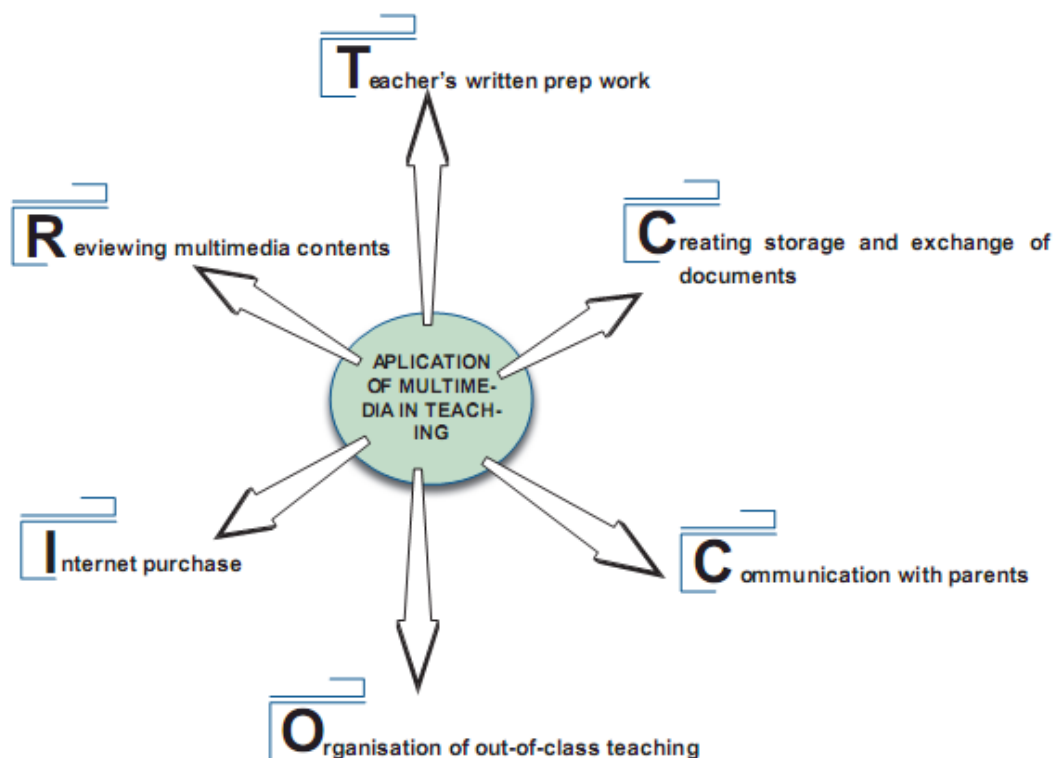
The teacher can use the computer for writing prep work. In it he can attach multimedia components (e.g. such as Power Point presentations, attachments from the internet etc.). The suitability of usage of computers, as opposed to writing prep work into notebooks, is in the

practical reasons of storing large amounts of data onto a local computer or storing it onto one of the portable mediums.

Communication with parents is much easier since teachers and parents do not have to be time-wise connected. Communication through email enables communication which is not dependent on distance and time. The website of the class, with individual pages of pupils as well as entry codes for parents, enables parents to continuously monitor the work and achievements of their children. Besides these forms, the teacher today can communicate with parents by corresponding in real time (chat) and video calls (MSN which enables simultaneous video and audio communication).

Creating, storing and exchanging documents will be carried out at a much greater speed and easier than through classical ways. Documents serve the teachers and pupils for various occasions and needs (invitations, thank-you notes, recognitions, diplomas, gift cards, curricula, research and creative work, correspondence etc.). Research work done by teachers and pupils has been made easier by the usage of multimedia computers since the results can be displayed on several media (recording in a video form, textual, imagery, audio and multimedia). Research work is often connected with finding information on the internet and storing it onto a local computer in a required form, so that it can later be transformed into a final form needed for the pupils and teachers. Usage of information from various sources throughout the world represents a great advantage in comparison with usage of classic sources of information. A part of the creating, storing and exchange of documents relates to the creation of teaching subject matter. Creation of subject matter encompasses: various reproduction of art work, texts, music, teaching demonstration material, exercising and testing (exercises, tests, exams).

Fig 11: Application of teacher's computer literacy in teaching



In organisation of out-of-class teaching, the teacher can book accommodation in hotels and other catering facilities for pupils that will attend school in nature or go on excursions, book transportation, tickets to puppet and theatre shows as well as cinema etc. Teachers in cooperation with the pupils, using multimedia computers and internet access, create future class work. Pupils actively participate in field work, recording project materials and on return create multimedia documents on everything they have recorded (what happened, what they did and where they were).

Using a multimedia computer, they review teaching resources and aids offered on the internet (web shops) and order them in required amounts. The advantage of this type of shopping is in saving of time and money, which means that an optimal price of the sought product can be more easily chosen. The disadvantage is that there is no personal contact with somebody who can help us choose. Also the product cannot be tried out.

With the help of multimedia programs such as Windows Media Player or Power Point, multimedia content can be viewed since they are able to display text, image, sound and moving image simultaneously (educational TV programs, films, music, photographs, video

and DVD recordings). Apart from the listed advantages, practicality is important as almost all activities can be stored in one place, searching for it is easy and simple, visibility is clear and storing of all material occupies very little space.

Multimedia usage of computers is determined by computer literacy of people. Pupils actual curriculum provides computer training through optional class subject of computer science, from the first grade (Curriculum for Primary School, 2006, pages 317-320). Pupils from the first grade are introduced to basic parts of the computer, learn to properly use the computer, from turning it on and turning it off, starting and stopping the programs, using CD and DVD, educational programs and programming tools to the basis of writing text. In the second grade, pupils work with maps and directories, change the appearance of the work surface, review and listen to audio and video CDs and DVDs, work with parts of drawings and their combination from two directories, viewing an image, writing and storing simple text, editing pages of text, colouring characters, commands for moving left and right, drawing pictures with the help of learned commands and basic services of the internet. In the third grade, compatible with children's developmental possibilities, the content that pupils must master is more complex. Teaching subjects cover: media for storage of data, connecting computers, recording audio data, properties of drawings and changing their appearance, marking and copying of text, searching and replacing words, writing a first program, programs for solving calculation tasks, first searches, use of web mail as well as rules of behaviour when sending mail. Pupils of fourth grade record photo data and video data, edit digital photograph, scan, use programs for editing digital photographs and digital video, which means recognising commands and tools within the program. From the themes mentioned, it can be concluded that the basic aims of computer literacy of pupils are:

- “Acquiring skills for usage of today's computers and application programs,
- Familiarisation with the basic principles and ideas that make up computers i.e. information and communication,
- Developing skills for application of information and communication technology in various application areas.” (Curriculum for Primary School, 2006, page 317)

Multimedia usage of computers provides pupils with an audio-visual experience and acquisition of teaching contents. There are several different multimedia teaching material which are used by pupils and teachers in class. Interactive textbooks provide the pupils with active participation in learning since there is a basic activation included for solving certain

assignments. The main advantage of an interactive textbook is that the child, according to its individual possibilities, masters the content, in his/her own pace. Interactive textbooks enable pupils to independently determine the time and way of its usage. Pupils master the teaching content in an interesting and entertaining way. In the Republic of Croatia there are more and more various multimedia educational material on the market: Učilica, Sunčica, Garfield, Tell me more Kids, Orašar, Spikalica, Librokviz... Computers and computer programs may be used in class for expression, editing, recording and transmitting that same information. For different types of information, different programs and media are used e.g. for text Notepad, Wordpad and Word, for drawing Paint, for editing digital photography Photoshop or (free-of-charge) Picassa. One of the programs for creation is Power Point (part of the Office packet), by which image, text and sound are combined in order to transmit the information, i.e. create a multimedia document (presentation). Multimedia digital encyclopaedias are full of information that provides pupils with a systematic display of knowledge. They contain tens of thousands of references, numerous images, sound recordings, animations and video clips. A famous multimedia digital encyclopaedia is Microsoft's Encarta, and another one is, written by ordinary people, Wikipedia. Multimedia virtual guides for museums and galleries educate pupils. They facilitate a virtual visit to museums and galleries. If there is a need to develop a certain type of observation and reaction in pupils, i.e. a certain form of coordination (thinking, decision-making and movement), then computer games are valuable material (driving simulators, solving various problem situations etc.). To children, games represent a form of entertainment. In games, the main characters can be, for example, cartoon heroes (Disney Pixar classics, The Sims).

With regard to the level of computer integration in teaching, Soleša (2006, pages 25-27) mentions the traditional, transitional model and distant-learning model. The traditional model of teaching refers to the usual class work. Time and place are fixed, there are no computers in the class room and the pupils have the possibility of using them in computer science class rooms at specific times. The transitional model is the link between the traditional and distant-learning model of teaching. Elements of usual class work, a fixed time and place, are maintained, but during class visits to the computer science class room can be arranged. In the transitional model, pupils may send answers to teachers via email and mutually cooperate through the system for synchronised communication. Distant-learning model abandons the traditional model of teaching, since the pupils are not bound by place or time. Distant-learning

implies using the internet to access content that cannot be found on our computer, but somewhere on a server online. Here, physical distance does not play a role.

3.5.1. Conditions for forming multimedia educational material

The basic aim of forming multimedia is to create high-quality teaching resources which will be used to impact the developmental changes in pupils. In doing so, there is a need to meet certain criteria. “Didactic formation of teaching media implies structuring of content with optimal consideration for former questions and expert answers to them. Attention is paid to “level of presentation”, use of technical terms, redundancies, the nature of tasks for those learning, visualisation of content, extent of “steps” in presenting basic content, aesthetic formation of media etc. For a complete fulfilment of the given criteria, there is a need to ensure team work of various experts.” (Matijević, 2000, page 29) It can be concluded that formation of multimedia educational material is a complex activity and thus we should think about: suitability for pupils, quantitative and qualitative structure of information, as well as implementation of these in teaching strategies, since quality educational material should be used in the best possible manner in class. An example for this type of action also represents application of the cognitive theory of overloading in the process of learning, since it influences the teaching strategies of teachers, as well as the formation of multimedia. The significance of applying this theory is in recognising different levels of pupils’ previous knowledge and adapting multimedia teaching material to the individual possibilities of the pupils in learning. “If previous knowledge is lacking, there is a need to reduce unimportant cognitive overloading by applying teaching methods that compensate for the pupils’ deficiency in knowledge. Methods for satisfying pupils with lower levels of previous knowledge are:

- Prepare easy-to-understand displays,
- Use relevant images,
- Explain images with sound or integrated text (not with both),
- Avoid unnecessary explanations
 - Not adding words for self-explanatory images,
 - Not explaining visual images with sound and text simultaneously,
 - Writing succinctly, clearly and keeping it short,
 - Avoiding unimportant themes,
- Use direct outlines of lessons,

- Use slow blending of work examples,
- Well-thought writing of text.

If the previous knowledge of the pupils is rich, overuse of teaching methods should be avoided, with respect to pupils' knowledge. Ways of satisfying pupils with rich previous knowledge are:

- Do not add unnecessary explanations in the form of image or text,
- Define practical exercises rather than working examples or finishing off examples,
- Do not put extra effort into high-quality texts,
- Use direct teaching which stimulates discovery.

If there are pupils of various, rich and poor, levels of previous knowledge in class, be adaptive to the differences. Ways to satisfy pupils with different levels of previous knowledge are:

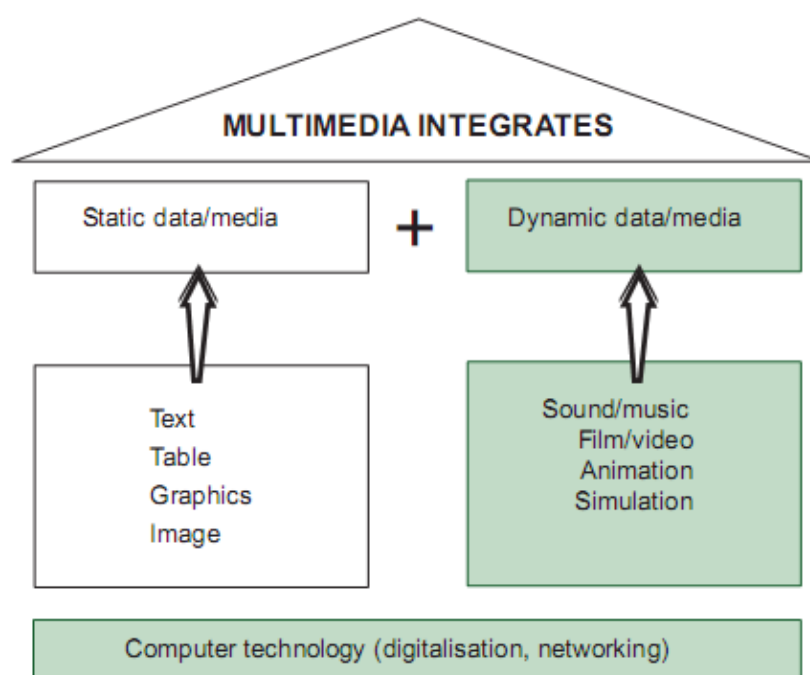
- Use adjustable teaching, electronic learning,
- Use preparations for levelling out understanding,
- Carry out preconditions, assumptions,
- Use pre-tests for determining suitable segments for pupils,
- Divide pupils into groups of beginners and advanced.» (Clark, Nguyen and Sweller, 2006, page. 295)

From the above-mentioned, it can be concluded that in forming multimedia teaching material, it is important to satisfy the psychological, computer science and didactic-methodical conditions. These conditions have an interactive relationship. In forming multimedia "it is important to didactically devise a role for each medium in a multimedia combination. Unnecessary repetition of the same content through different media should be avoided. In combining multimedia, each individual medium should be given certain didactic roles which will depend on the characteristics and advantages of the medium itself as well as on the mental condition of attendees and class goals." (Matijević, 2000, page 72) Psychological conditions relate to the developmental level of the pupils and require suitable didactic-methodical strategic work of the teacher and pupils, as well as forming different developmentally suitable multimedia teaching material, compatible with computer science laws. Linking conditions for forming multimedia teaching material and criteria for choosing multimedia in class are apparent here. This means that in forming multimedia, attention should be paid to computer science laws, but their integration with other elements of a didactic-methodical field is also important.

3.6. THE STRUCTURE OF MULTIMEDIA

The structure of multimedia represents its construction i.e. components. It has already been mentioned that each multimedia is made up of two or more media. Faulstich (fig. 12) shows us a graphic example of computer multimedia integration.

Fig. 12: Integration of multimedia (according to: Faulstich, 2000, page 298)

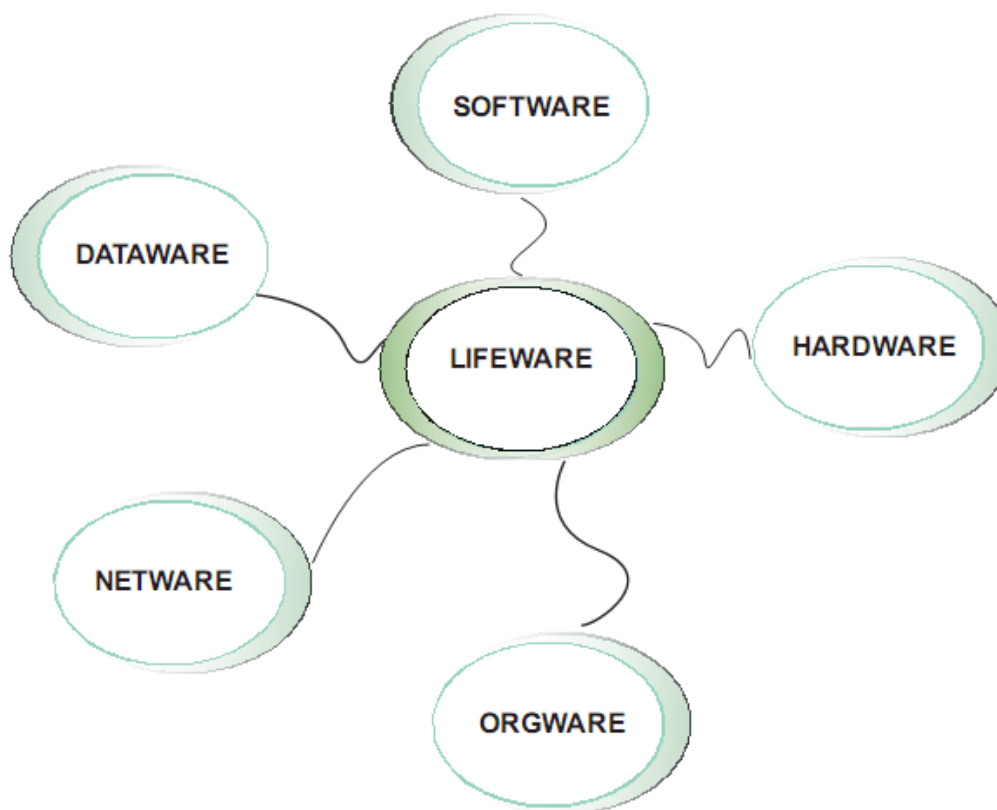


Static and dynamic media are components of computer multimedia. Static media are: text, table, graphics and image. Static media display static information. Dynamic media represent: sounds, music, film, video, animation and simulation. Dynamic media display information that is in constant motion. Any form of connecting static and dynamic media comprises multimedia integration.

Various combinations of media in multimedia research and learning impact the awareness of pupils' personal capacities, since they cover audio-visual sensory areas i.e. correspond to the needs of different styles of pupils' learning in class, but in doing so, attention must be paid to the suitability for the pupils' developmental age.

Besides structure of multimedia, it is interesting to mention the structure of educational information technology (IT), which comprises the following elements (Srića, 1999, page 40): lifeware, software, hardware, orgware, dataware and netware (fig. 13).

Fig. 13: Structure scheme of educational information technology (IT)



The English word ware means: manufactured good, good and it is often a suffix in many IT expressions (Bujas, 2001, page 994). Lifeware is made up of system users and experts who devise or participate in planning, forming and applying didactic material in teaching. Hardware is the physical (material) basis of IT without which transmission of information would not be possible. Software comprises sources of knowledge which represent non-physical (non-material) elements necessary in teaching (interactive textbooks and other multimedia educational materials, “packages”). Orgware is the basic strategic trigger of all elements into a functional unit for the purpose of carrying out the goal of educational IT. It represents didactic-methodical procedures of strategic action towards educational achievements of pupils. Netware’s assignment is communicational linkage of system elements by creating communicational networks. The basic role of dataware is creating a concept, organising and storing information into a database.

3.7. SOME ELEMENTS OF TEACHING STRATEGIES SPECIFIC FOR MULTIMEDIA USAGE

Multimedia contents are carried out with the help of methodical-didactical field elements. Formation of multimedia content requires application of teaching methods and techniques as well as social forms of work, which are recognisable for multimedia usage. Alessi and Trolip (2001, pages 89-302) list five elements: tutoring, hypermedia, practising, simulation and educational games.

Tutoring provides for individualised learning. High-quality tutoring, besides presenting information, includes guidance during practising and evaluation. Categories that make up the structure of tutoring are: introduction part, questions and answers, evaluation of answers, feedback information on answers, remedial action (repetitive mediating), organisation and sequencing parts of the curriculum, monitoring the pupil while guiding him/her.

Hypermedia in its program structure has many “pages” each containing texts, images, sounds, video, animated clips and are linked to other pages, texts, images, video and animated clips. Several different hypermedia forms exist e.g. encyclopaedia references, specific subjective references, analysis of the case studies, construction set, edutainment, museums and archives.

Pupils are given freedom in learning i.e. in choosing their own way of acquiring knowledge, which can be a trap for those pupils that have weaker organisational skills and independence in learning. Therefore, pupils often have a need for easier management of hypermedia through modified contents and links.

Practising class subject matter with the help of the teacher’s guidance and workbooks can be effective. However, usage of carefully planned and formed multimedia accompanied by games, competitions, interesting image items etc. can trigger stronger motivation and greater effectiveness (Alessi and Trolip, 2001, page 181). It is important for practice to be in line with the needs of the pupils, their developmental possibilities and learning styles. Otherwise, practising is dry, monotonous, mechanical. Practising is based on selection of content, terms, problems etc., the pupil responds to the question asked, the replies are evaluated, the pupil receives feedback information and after successful solution of the task, the activity is concluded.

Simulation represents the technique of teaching which is nearest to the real world and activities, processes, occurrences and situations. Therefore, it is of extreme importance to pupils. The advantage of simulated teaching is the effectiveness of what has been learned i.e. level of recognition and degree of utilization of pupil's experience in real-life situations. Alessi and Trolip (2001, page 214) divide simulations into procedural and situational with regard to how to do something, and physical and repetitious with regard to simulation of something.

Educational games are extremely useful in teaching from the first to the fourth grade of primary school. As a result of the link-up of games i.e. entertainment and learning, the compound *edutainment* was coined. Educational computer games often have in their conception the previously-mentioned elements e.g. simulation, practising and hypermedia. Apart from educational games being motivating, pupils enjoy learning through entertainment and master a lot of applicable knowledge and life skills. In terms of content, they cover various fields of human activities, and they can be played individually, in teams, competitions, respecting the rules of the game.

Several elements of teaching strategies which are specific for using multimedia in class have been mentioned. In this connection, in a didactic sense, attention should be paid to several directions: developmental possibilities of the pupil, possibilities of purchase (which multimedia educational tools are there in the school's inventory, on the market, what products are available, is there a possibility of forming one's own multimedia educational tools for the pupils' needs...), the qualitative features of multimedia (to what extent does the chosen multimedia satisfy didactic criteria), personal and professional competencies of the teacher, teaching strategies (what pedagogical-educational achievements of pupils, methods and techniques of teaching, social form of work and types of teaching classes, are planned by the teacher).

3.8. MULTIMEDIA FEATURES IN TEACHING

Multimedia features in teaching are characteristics which are distinctive to them. They are described by existing certain multimedia features in teaching. There are many so several basic ones will be singled out (according to: Strmčnik et al, 2003, pages 314-316):

Multimedia are based on computer technology, which implies a corresponding developmental level of computer technology, as well as its further upgrading. Features of computer multimedia are: digitalisation of data, capability of data storage and link-up of computer systems.

Multi-coding is a multimedia feature of containing codes (symbols) within the multimedia itself. In order for pupils to understand information, they must decode multimedia. Semiotic multimedia needs to be adjusted to certain developmental levels of pupils in order to successfully decode and “read” messages.

Multimodality or multi-sensory of multimedia is described as a synthesis of auditory, visual and tactile sensory areas. Through this, multimedia represents a richness of information which is received through the auditory, visual and tactile senses.

Complementariness of multimedia is manifested in interfusion and interaction of included media. One medium complements and enriches a second, third...etc.

Multimedia are *integrative*, meaning, they make up a whole unit composed of several media and modalities (static and time-independent and dynamic and time-dependent). The media mentioned are integrated.

Interactivity of multimedia enables pupils interaction with contents so the feedback link of information flow between pupils and the system is reciprocal. The technical possibilities of multimedia provide pupils with the possibility of choice and sequence of content usage.

Reflectivity of multimedia is a quality that encourages pupils to think, but it can also enable a pupil to reflexively express achieved levels.

Adaptability of multimedia can be viewed in two ways: internal adaptability represents reciprocal media adaptation of which it is composed, while external adaptability is directed towards developmental possibilities of the pupil for whose age it is intended.

Multi-functionality of multimedia enables its usage in various or similar purposes. Since it can hold different information, those differences can be used for the achievement of different teaching goals and tasks, making it practical.

Inter-culturality of multimedia signifies a link of different cultures. Multimedia contents are recognisable in cultures of different nations.

Multitask-doing as a characteristic of multimedia, “can be manifested in a synchronous work of several processes. Concurrence points to the fact that media can be analogously displayed.” (Nadrljanski, 2000, page 14)

Computer multimedia have capabilities of using information (forming, reproduction, distribution and memorising), distributing information (satellite, internet), digitalising information (from memorising, processing, sending to reproduction), using one network for several functions, possibility of direct prompting of information from various sources. The central role of the computer is media integration into one unique – multimedia, interactive component of digital communication, where dialogue between several participants or between the participant and the computer is enabled, media organisation method (more and more entering into private spheres, as well as commercial). A modern approach is created to education, ways of entertainment, possibilities of individualisation of mass communication (for example, we ourselves create our own television program, blog, website etc.), interpersonal communication in the areas of work, learning, informing and play. (Mikić, 2001, pages 249-250)

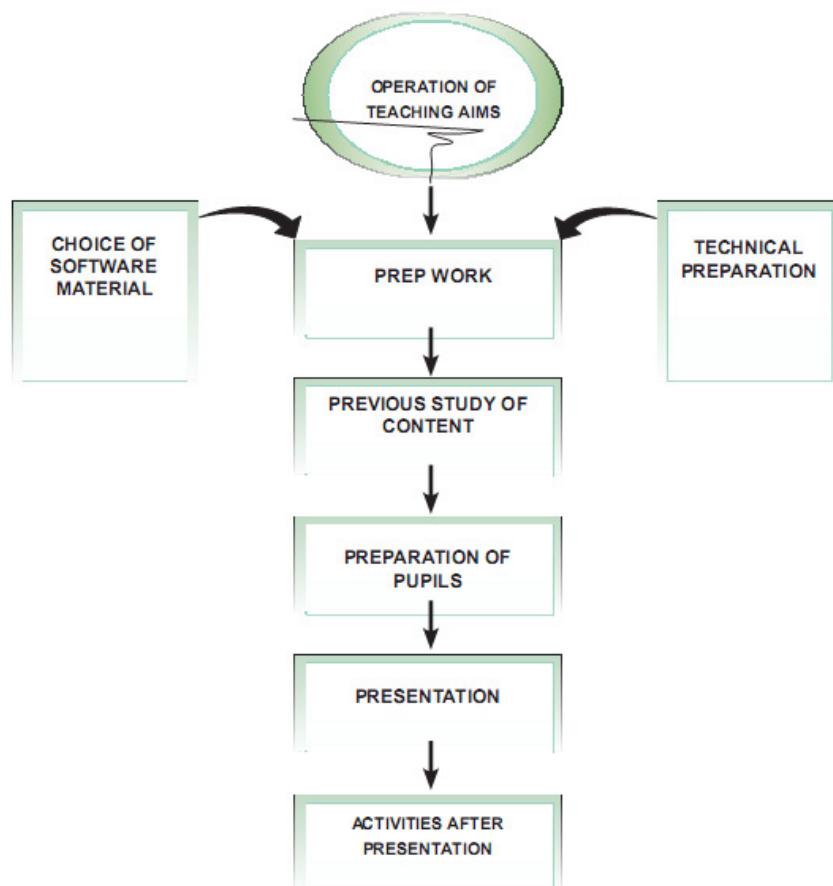
These features of multimedia provide the teacher with many possibilities in creating teaching strategies. Likewise, they also make the work in class easier, as already at the start they create better conditions with the possibilities that they provide and which did not exist previously in teaching. Using the internet, pupils quickly find the required information. Formats of stored information are smaller in comparison with video cassettes (e.g. CD, DVD and USB). Multimedia educational tools are conceived on the principle of play, as extremely powerful techniques of learning, making teaching easier etc. With regard to the features mentioned, it can be concluded that multimedia represent a turning point in improving teaching technology i.e. learning.

3.9. ALGORITHM OF MULTIMEDIA USAGE IN TEACHING

In class, the teacher uses multimedia in teaching strategies, thereby wishing to achieve certain teaching aims with pupils. Pupils, in turn, use multimedia as a source of information which they wish to acquire. Multimedia is one of the didactic-methodical field elements. In teaching strategies, they create an interactive relationship with other elements: teaching aim, teaching principles, types of classes, methods and techniques of teaching, social forms of work, spatial-material conditions and curriculum. “Multimedia sources of knowledge are didactically devised integrated media with certain themes, curricula or parts of curricula.” (Matijević, 2000, page 124). Apart from being integrated with other elements, they also represent “small-scale” integration, as their structure is made up of the linkage of several media (image, text, sound, video recording, animations).

When a choice of media is made, a series of procedures follow where teaching the pupils is algorithmised, and then work begins on the pupils becoming independent, focusing on their training for independent discovery of new algorithms in learning.

Fig. 14: Algorithm of multimedia usage (Blažič, 1998, page 69)



Algorithm of multimedia usage in teaching displays certain procedures by which teaching aims can be achieved in the most rational manners. Operationalisation of teaching aims is geared towards prep work which comprises choice of software material and technical preparation. Previous study of content prepares pupils for the presentation, after which activities follow. Here it is worthwhile mentioning that presentation, e.g. of interactive textbooks, provides a choice of different methods for presenting class content, which represents a modern characteristic in the usage of a teaching resource.

Similar to the usage of television in class (Itković, 1997, page 329), usage of all multimedia in class activities is conducted in three phases: introductory, main and final. In the introductory part, pupils prepare for “interpretation” of multimedia content through conversation, remembering previous work activities, repetition of content, announcement of goal, plan i.e. means of viewing content etc. In the main part, pupils use multimedia (individually, in pairs, groups or frontal social forms of work). Their attention can be kept by manual guidance of multimedia e.g. in such a way that the teacher determines sequences and then questions the pupils about the details. In the final part, pupils reconfirm their knowledge of the subject, write the main ideas into notebooks, discuss, express their opinions, viewpoints, practically apply new knowledge, research, validate, evaluate work etc., store the multimedia away and clear up their working area. Besides the three mentioned, Stevanović also mentions a fourth one, the application phase of class work:

“1. The preparatory phase covers: ways in which pupils’ previous experiences can be used, connecting new content with previously acquired content, time duration, motivation system and setting the goal for the class hour.

2. Operational phase: in this phase, key teaching content is presented to pupils (content that pupils cannot learn through individual work), new facts, terms, terminology, important facts, suitable sources of knowledge, frequency of extensity and intensity of applying teaching devices, methods of solving educational, pedagogical and functional assignments in the curriculum (subject matters), the position of pupils and teachers, ways of communication (active forms and methods of teaching), creating a link with the subject matter which will be subsequently studied.

3. Verification phase: instruments for evaluation and self-evaluation, system of self-marking – objective test procedures (tasks for 5-minute objective examination, a series of objective

tasks, tests, examinations, working lists, dictations, essay tests etc.), evaluating the function of the teacher during class (that he/she is operational, not lecturing), communication systems (two-way and multi-way communication), manner of acquiring knowledge (active-passive, productive-reproductive).

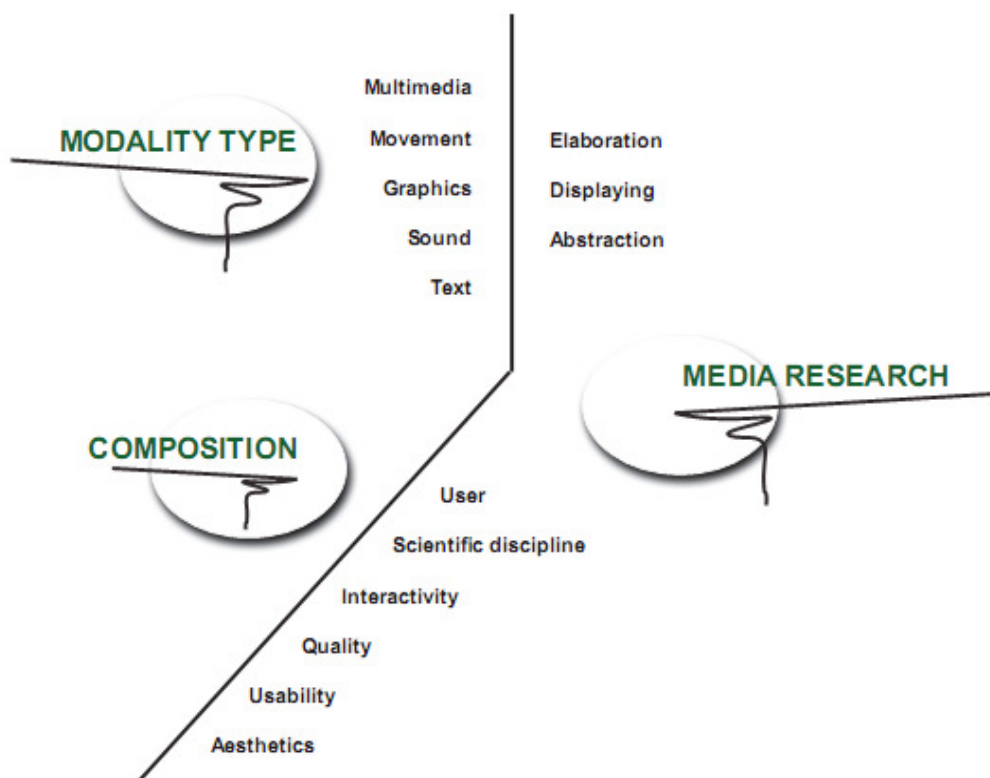
4. Application phase: types and scope of homework, manner, place and time of doing homework, creating individual (pupils') assignments, examples, manner of practising acquired knowledge, habits and skills, exercise system relating to self-evaluation, self-checking and self-marking. (Stevanović, 1998, pages 297-298)

It can be concluded that multimedia can contribute to the teaching quality if didactic-methodical precepts which are noticed in multimedia, as well as in its relation to other elements of the didactic-methodical field, are respected.

3.10. TAXONOMY OF MULTIMEDIA

Taxonomy of multimedia represents their systematisation, thus providing them with an organised review. Taxonomy of multimedia is based on the taxonomy of media, and with regard to the lack of research in this field, opens many possibilities for future research. Rachele S. Heller is a scientist who, in her own scientific-research work, studies the taxonomy of multimedia (fig. 15). Taxonomy of multimedia is defined in an IT context i.e. through computer capabilities of displaying multimedia. The structure of multimedia taxonomy display comprises: type of medium, media research and context.

Fig. 15: Taxonomy of multimedia display (Rachelle et al, 2001, page 65)



There are various types of modalities (sound, image, movement) which comprise or can comprise multimedia. Diversity of media must be clear in the sense that: *text* represents alphabetical and numerical symbol language, *sound* includes spoken words, musical forms and other audio information, *images* include photographs, images, drawings, while *movement* is displayed by moving pictures, video-recordings or animations. Multimedia includes a link between any two or more media mentioned.

Multimedia expression comprises: elaboration (detailed development), display and abstraction. *Elaboration* of display involves concept-thinking development of elements which comprise multimedia. This does not mean that the display level of the message will always be the simplest. *Display* of content enables numerous possibilities. For example, the same text can be displayed in bullets, in a Power-Point presentation, in various forms and sizes of letters etc. The category of *abstraction* is linked with a metaphor. If during speech there is mention of sea, a text may be displayed in a wavy form. Context is made up of: users, scientific discipline, interactivity, quality, usability and aesthetics. *Users* discuss within the frameworks of the given content or discipline, and form their opinions and viewpoints on the quality of the

displayed content, usability and aesthetic formation. Quality can relate to the technical aspect and may be described by features of display clarity, authenticity of reproduction, clarity of forms on the screen, technical synchronisation of two or more media etc.

Taxonomy of multimedia is important in knowing its essence i.e. elements that influence its formation.

3.11. RELATIONSHIP BETWEEN MULTIPLE PRESENTATION OF INFORMATION AND MULTIMEDIA AS DIFFERENT ELEMENTS OF THE DIDACTIC-METHODICAL FIELD

In the Slovenian language, in the IT understanding of multimedia, instead of the word multimedia, the word «večpredstavnost» is often used. *In IT interpretation there is a possibility of understanding these two terms in the Slovenian language as synonyms. However, in didactics the given terms cannot and should not be considered as synonyms since that would lead to identifying methods and techniques of teaching with teaching devices and tools.* In this paper, the opinion is that these two words are very alike, but are not synonyms. Therefore, there is a need for a clearer determination and explanation of the term multimedia and «večpredstavnost», and their inter-relationship, even more so because in a poly-factorial model of teaching they comprise two different elements (teaching devices and methods). In Slovenian literature, no information has been found that would accept or reject this statement, but there are indicators that Slovenian scientists who are at the same time authors of numerous books and scientific papers on the theme of multimedia usage in teaching (Blažič and Gerlič), use the term multimedia in their research.

“Večpredstavnost” is a Slovenian phrase used by many, but interpreted differently. It is a term in Information Technology (IT) which includes sound, images and video recordings, as well as letters and numbers. In the grammatical analysis of the word, multimedia is a noun (which represents an object), while večpredstavnost (multiple presentation) is gerund (relating to activity). The word “večpredstavnost” is made up of the prefix “več” and the word “predstavnost”. *Več* “signifies a greater amount or measure” of something (SSKJ, 1995, page 1012). *Predstavnost* is “1. characteristic, characteristic of the presented...2. ability to present” (SSKJ, 1995, pages 985) “*Representable* is someone whom it is possible to present...

Presentation means to mediate to the greatest extent characteristics of someone or something... to cause something to occur in our consciousness as a consequence of renewal of features...to cause something to occur in our consciousness as a consequence of viewing, thinking or emotional activity. *Representability* is a characteristic, features of the presented: to enable representability of events, ranks, physical experiments.” (SSKJ, 1995, page 984)

From the above, it can be concluded that “večpredstavnost” is a term used for presenting information in various ways. Since multimedia is used for presenting information in several different ways (through image, sound, animation, video clips and text), it can be said that multimedia has the capability of multiple presentation of the given. However, in a didactic sense, besides multimedia multiply and audio-visually presenting information, multimedia is also multiply representable, since its role is viewed through an interactive relationship with all other elements of the didactic-methodical field. Multimedia can be used with different methods: by demonstration, oral lecturing, conversation, practical work etc. For example, if the pupils are given an assignment to make a PowerPoint presentation on forest birds, each pupil will in his/her own way present information on forest birds and we will not have two presentations the same. In this sense, multimedia is a device by which pupils individually present information on forest birds. Analogously, each medium can also be presented in several different ways i.e. methods. Pupils choose one of the infinite possibilities for presenting assigned information, firstly, within the multimedia they are using, and secondly, within the teaching strategy, with regard to the manner in which they will present their work to other pupils in the class. “Večpredstavnost” is a characteristic of multimedia stating that information can be simultaneously, audio-visually, in many ways, presented as well as used in class as a *method* or *teaching technique*, while multimedia is, in a technical or physical sense, a *teaching device* that contains information within itself. In order for information to reach the pupil from multimedia, it is presented in a audio-visual manner. In multiple presenting of information, the emphasis is on communicational transfer i.e. activity of transmitting information to pupils. Therefore, multiple presentation refers to methodical procedures i.e. ways in which information is transmitted, while multimedia is a teaching device that synthesises two or more media, that hold information linked with class contents.

Due to the above-mentioned, multimedia and multiple presentation are not and cannot be synonyms. Therefore, it can be concluded that:

1. Various multimedia have the same characteristic: they can multiply, in various combinations, present information (through audio-visual sensory channels), as opposed to media which do not have this characteristic;
2. Multiple representability is a characteristic of methodical approaches to interpretation of all multimedia and media. Each media and multimedia can be multiply interpreted by pupils in class, and as elements of the didactic-methodical field, in an interactive relationship with other elements of the didactic-methodical field can be interpreted in many ways through teaching-strategic activity.

3.12. TEACHER TRAINING FOR EFFECTIVE USAGE OF MULTIMEDIA

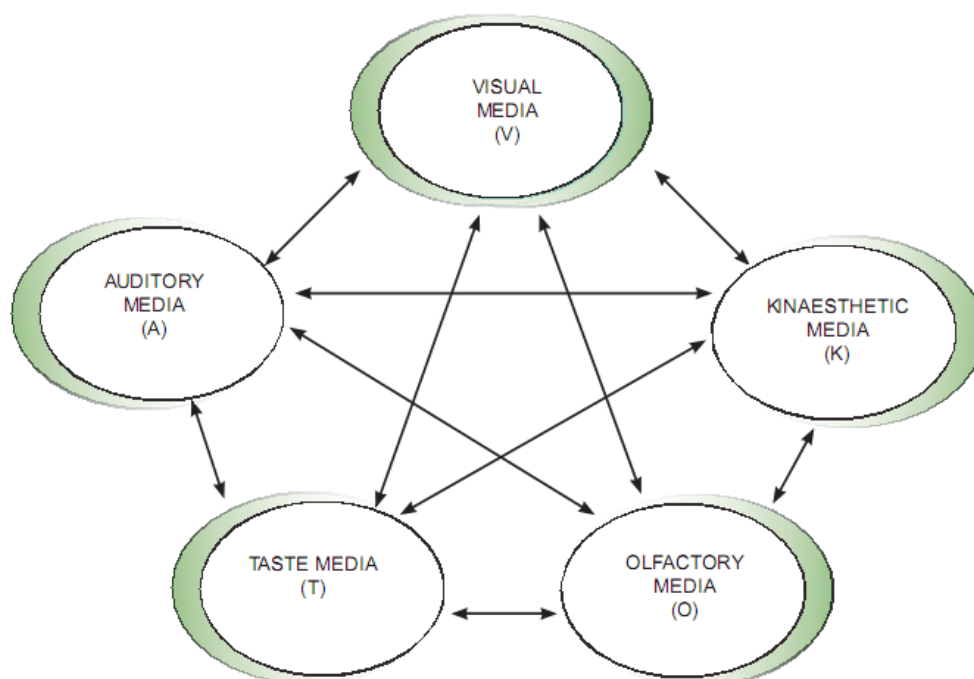
The title of this section can be analysed in three ways: 1. Why train teachers? 2. Why train teachers for usage of multimedia? 3. Why train teachers for effective usage of multimedia? With each following question a more detailed indication of interest guideline is narrowed down. The answer to the first question on training teachers is closely connected to their lifelong education, in order to acquire new knowledge within the framework of developing didactic-methodical competencies. This provides various possibilities of learning, both for the pupil as well as for the teacher, in the way of exploring something new in the field of the latest technical products. With the application of contemporary teaching devices such as multimedia, teaching gains qualitative new dimensions. This is also the answer to the question of ‘why should the teacher be trained in multimedia usage’? Due to constant new technologies, it cannot be concluded that everything can be learned about multimedia and new learning is not required, in fact the opposite is the case. The latest developments have to be constantly monitored and applied in teaching. Teacher training for multimedia is an ongoing process. The answer to the third question has been clearly pointed out by Mandić (Mandić, 2003, page 18) in his book *Didactic-Computer Science Innovations in Education*: “Without application of contemporary didactic media, the teacher would not be able satisfactorily to adapt his/her teaching style to cognitive styles and learning styles of the pupils; he/she would find it difficult to satisfy their diverse needs and encourage curiosity and motivation for learning; even with the best will in the world, the teacher would not be able to ensure that each pupil proves himself/herself in an individual way, seeks meaning in certain activities and masters the teaching content at his/her pace: the teacher would not be able to allow gifted

pupils speed up their progress in learning and let slower pupils learn to the best of their abilities.” From the above-mentioned, it can be concluded that effective multimedia usage relates to the effects usage of multimedia has on pupils, which ought to be one of the ultimate goals of teaching. Besides this, effective multimedia usage implies teachers’ competence in creating teaching strategies, where they skilfully combine all elements of the didactic-methodical field. Therefore, the following are important for multimedia usage in teaching: educational policy of the teacher and his/her personal and professional competencies, the teacher’s awareness of pupils’ potential and usage of the latest technical products for class, and the ability to create more effective teaching strategies where multimedia is used.

3.13. MULTIMEDIA IN TEACHING

With regard to technical development, today in teaching there are many media and multimedia. Each individual medium, given the type of sense they trigger, belongs to: auditory, visual, kinaesthetic, taste or the olfactory area. The practice of using media of various sensory fields is manifested in teaching. It is important that media of all sensory areas are represented. “However, one sense should not suppress another one (if the senses are normal), so with the help of teaching technology, class should be organised in such a way that the senses mutually complement each other. Each individual teaching device gives its specific contribution to teaching, but we must know how to use them *moderately, gradually and with understanding and criticalness.*” (Itković, 1997, page 308) Moderation, gradualness, understanding and criticalness, in media usage, are in line with the criteria of their choice. Likewise, there is the habit of combining media of various sensory areas. Fig. 16 shows numerous possibilities of combining individual media.

Fig. 16: Combinations of media



The most common combinations of multimedia comprise audio-visual media, more precisely audio-visual multimedia, as multimedia are concurrent components of at least two or more media of the audio-visual sensory area.

Multimedia in teaching happens due to combining different media and multimedia with the aim of influencing developmental changes in pupils. “Multimedia in teaching signifies mutual supplementation and enrichment in the impact of two or more media e.g. textual and audio-visual, or the teacher’s lecture, supplemented with overhead projector and text.” (Matijević, 2000, page 125). In this paper examples of various combinations of media and multimedia will not be given, but there is a desire to point out that teachers and pupils are themselves able to determine which combinations to use, according to authentic class situations.

Multimedia in teaching happens as a product of reaching pedagogical-educational achievements of pupils: “Multimedia approach to fulfilling the contents and aims of pedagogy and education can be provided by the teacher through a meaningful integration and correlation in the daily work of his/her oral lecture (personal medium) using other teaching media (e.g. cassette recorder and slides) but this will be more successfully carried out if he/she relies on the help of a personal computer which regulates the work of the entire

electronic classroom with several different media.” (Bognar, Matijević, 2005, page 344) Usage of different media and/or multimedia in class, on a working day, should be carried out in a complementary manner of choosing them, and by devising teaching strategies the usage aim should be predicted. Furthermore, media and multimedia carry out various didactic functions: “One medium is suitable for motivation (e.g. class film), a second is simple for material preparation and usage in the pedagogical-educational process (e.g. overhead projector). One medium will authentically show some scenes from nature (again class film), while others will be preferred when the learning process needs to be optimally individualised along with ensuring intensive two-way communication and permanent provision of feedback information to persons learning (computer).” (Bognar, Matijević, 2005, page 343) The need for combining media and multimedia arose as an impetus for sensorial teaching which impacts on quality in teaching through various sensory integrations.

The teacher and pupils have numerous possibilities for combining media and multimedia during the working day of the class. Due to the dynamics of situations, there are no hard and fast rules on *when* to use *which* media and/or multimedia. “Namely, the historical development of teaching equipment has had a spectrum development trend because of its continued multiplication and differentiation, which resulted in its multiplicity, but also their break-up into numerous individual sources, which triggered a certain fragmentation of class work, with all negative consequences. Because of this, the process of media differentiation has lately been accompanied by the process of their integration, which has the same meaning as the process of integration in teaching, i.e. it supports the process of class integration.

The integration process of multiplied media, in the beginning, was of a smaller scale, e.g. synthesizing text and images in textbooks, connecting audio-components and video-components in audio-visual sources, adding slide shows and records to books, outlining so-called multimedia textbooks, integrated textual, visual and auditory sources in electronic class rooms etc. A step forward was made in mutually connecting individual media through various technical devices so as to simplify and quickly put into operation – successively or simultaneously.” (Potkonjak et al, 1989, page 72) Successive usage of media and multimedia states that one should be used after another, while a simultaneous usage is based on concurrent usage of more media and/or multimedia. “The greater the diversity and level of these methods of expression, the deeper and more diverse the processing, thus the effects of teaching are more valid. It could be said that the learning method in class is sensitive to the

form in which the content is presented (source). Diversity and level of activity in learning is greater if various different sources are used... Communication is more successful if various channels (sources) are used in transmitting contents, information, messages. The channels mutually complement each other. In direct, authentic situations, there are many things that cannot be seen, heard, touched... It is not possible to transmit every content by every channel...Therefore, the sources should be distinguished with regard to their credibility in displaying a certain content. In this line of thought, there is talk about a teaching “kitsch”, when modern technical devices and media overshadow the source. In an inadequate appliance of television, films, overhead projectors etc. many examples of this can be found, when we seek verbal words from film or TV, words they cannot deliver, when serious work overshadows “classroom shine” (Jelavić, 1998, page 45) Here a danger lies since by multiplying media or inadequately choosing media or multimedia, the question of authenticity of information transmitted by media and multimedia is at stake. In theoretical contemplation, possibilities of multimedia combination have no end. Nevertheless, in practice limits to acquiring information exist due to information overload (e.g. in shopping centres, it is very difficult to immediately spot the product we are looking for because of the wide variety). Likewise, if pupils are simultaneously shown lots of information, the capacity of their reception is limited, which means that through inadequate choice of multimedia we will create the opposite effect i.e. pupils will not be able to acquire all information due to the information overload of its display.

4. RELATIONSHIP OF MULTIMEDIA AND OTHER STRUCTURAL ELEMENTS OF THE DIDACTIC-METHODICAL FIELD

Multimedia is one of the structural elements of the didactic-methodical field. The relationship between multimedia and other structural elements of the didactic-methodical field are analysed as an interactive linkage. The choice of multimedia in teaching strategies should not be coincidental. Other structural elements of this didactic-methodical field should stipulate the choice of the most effective multimedia in class and vice versa. The structural elements are divided into several groups (according to: Lavrnja, 1998, page 129):

Psycho-structural elements comprise the teacher and pupils. Using multimedia mostly depends on the awareness of the teacher about the role and significance of multimedia as well as their usage in teaching. Contemporary teaching imperatively requires the teacher to have educational skills of using various multimedia, especially computer and digital multimedia. One of the tasks of the teacher is to train pupils for independent usage of multimedia for the purpose of learning. The teacher and pupils themselves devise a wide spectrum of multimedia necessary for class work. Psycho-structural elements emphasise the communicational significance and correlativeness of live multimedia as well as communication with all other multimedia used in class.

Didactic-methodical elements comprise: teaching aim, methods and techniques of teaching, type of teaching activity and teaching principles. Multimedia provides information which enables the teaching aim and assignments to be carried out, and they relate to developmental changes in pupils. Teaching aims determine ultimate points of class work, e.g. acquiring knowledge, skills, habits, viewpoints etc. Multimedia provide a content-related dimension of accomplishing teaching aims. The teaching aim is significant in determining multimedia within a teaching strategy. This means that the choice of multimedia depends on the pedagogical-educational achievements of pupils. In using multimedia, various methods and techniques of teaching are present. The relationship between methods and techniques of teaching and multimedia is inter-dependent. Through certain procedures and forms, multimedia are studied. Determining multimedia priority is important in teaching i.e. their combinations since the emphasis is on the most effective. Besides the relation with pupils, teacher, teaching aim, methods and techniques of teaching, multimedia achieves its purpose in various types of class hours. For a certain type of class hour, a certain type of multimedia is

needed, or even the same one is used in various roles: introducing new content, its interpretation, repetition, practising, testing and marking or through combined activities. Multimedia is also in line with teaching principles. Each principle is a guideline in choosing suitable multimedia in teaching. Principles are rules which should be respected during multimedia usage.

Content-related-themed elements contain certain didactic criteria of multimedia formation. Multimedia are used meaningfully. Their usage depends on age suitability of pupils, their motivation, linguistic understanding (possibility of coding and decoding messages), programmed teaching contents, technical capabilities for presenting content, as well as physiological characteristics (presence of audio-visual area by which information is transmitted). Multimedia influence the direct experience and can be attractive, interesting and authentic. Choice of multimedia is regulated by selecting content which is planned for class. As the curriculum prescribes information needed to be acquired, the choice of multimedia is aligned with programmed teaching contents.

Socio-cultural elements imply a socio-cultural environment. It comprises persons who develop certain relationships. In fact, the whole work in class is based on these relationships i.e. communication of pupils and teacher. Multimedia can be used in various social forms of work: individual, group, pair, team, frontal and free forms of work.

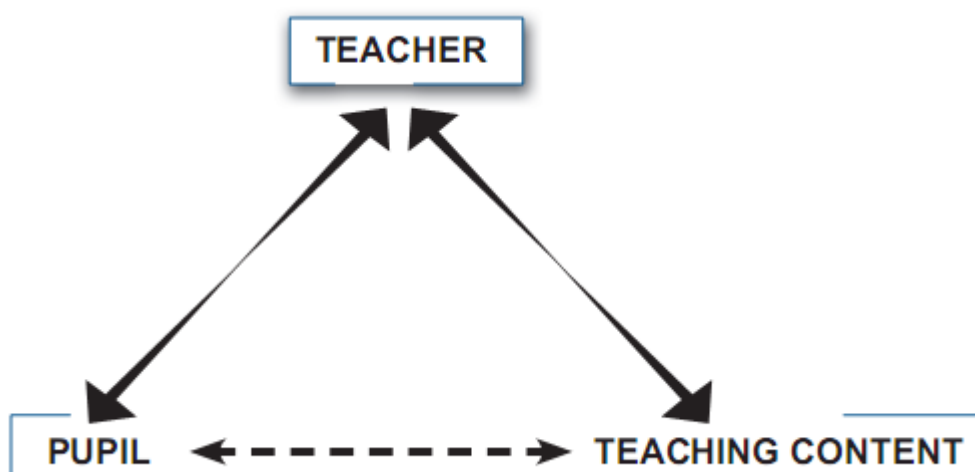
Spatial-physical (material) elements relate to the spatial-physical (material) environment in which class activities are performed. Media and multimedia require previous knowledge of pupils and the teacher on rules of their usage and maintenance, and the way they are stored in the classroom is of great importance.

4.1. THE POSITION OF MULTIMEDIA IN VARIOUS TEACHING MODELS WITHIN THE FRAMEWORK OF POLY-FACTORIAL UNDERSTANDING OF TEACHING

Previous didacticians' view did not emphasise the importance of multimedia, as systematic research on multimedia usage of computers are of a later date (towards the end of the 80s of the 19th century when multimedia computer technology was invented). Therefore, different models of teaching were previously focused on personal media (teacher and pupil), and subsequently impersonal media (teaching tools and aids). As awareness about complexity of the structure of elements in didactic-methodical fields grew, so did the teaching models develop from simpler to more complex ones.

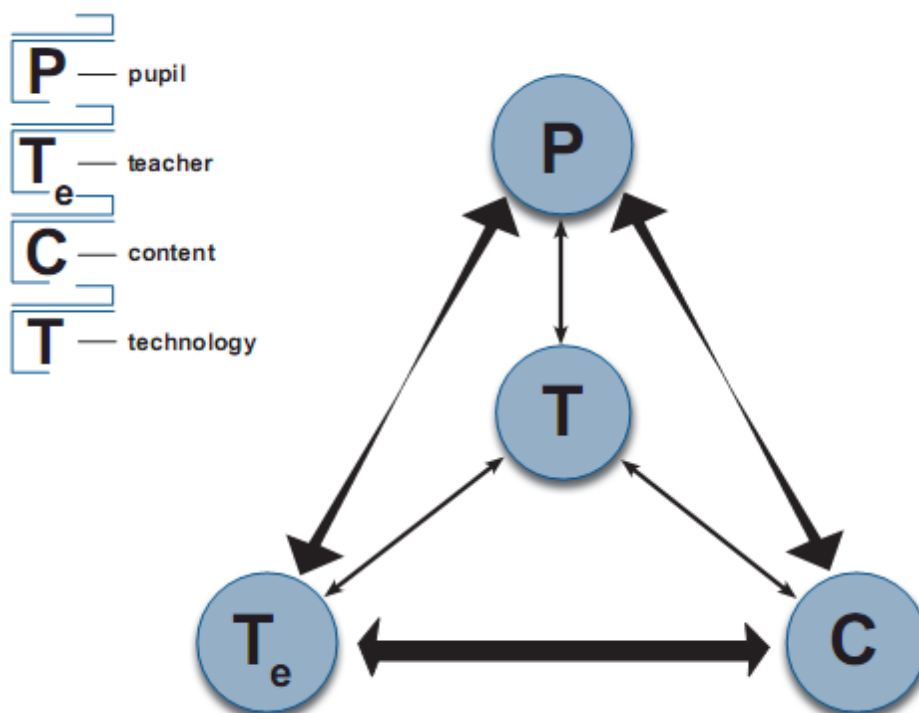
Traditional teaching emphasises three important elements of teaching: the teacher, the pupil and teaching content. This is where the term didactic triangle comes from. The teacher is a qualified expert who professionally carries out his/her work. The pupil acquires knowledge, develops skills and adopts pedagogical values. The teaching content is determined by the curricula for each individual age of the pupil. Poljak (1985, page 157) displays the traditional didactic triangle (Fig. 17) in which the teacher has a mediating role between the pupil and teaching content. Pupils along with the teacher are in a direct relationship, but in an indirect relationship with teaching contents, which means that through the mediation of the teacher's lecture, they acquire contents.

Fig. 17: Traditional didactic triangle (Poljak, 1985, page 157)



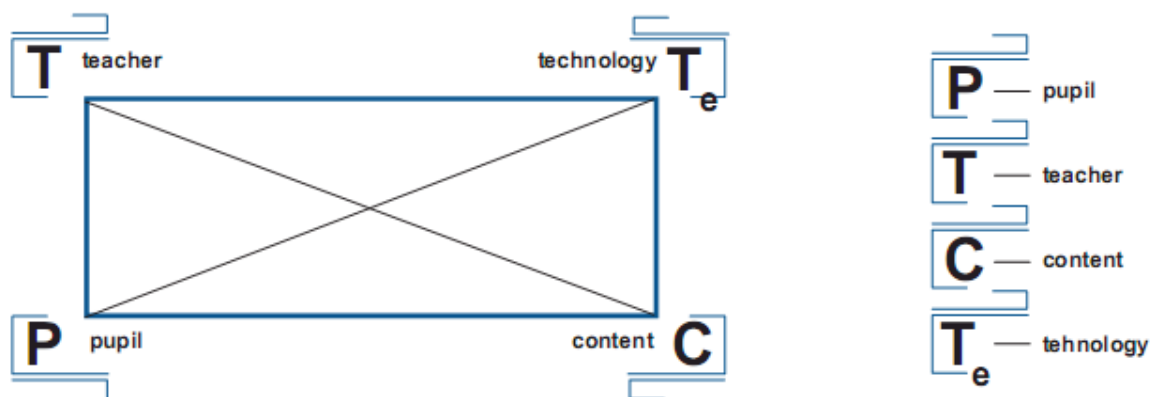
Matijević (2000, pages 24-25) displays a didactic pyramid in which the relationship between basic elements of teaching: pupils, teacher, contents and technology (Fig. 18) can be seen. The role of teaching is transferred from personal to impersonal media. Therefore, the relationships between basic elements of teaching are changed. The pupil is a subject who learns and acquires knowledge from primary and didactically formed sources of knowledge. Teachers have the task to devise and moderate class activities. Educational technology unites basic elements of teaching, determines their relationships and roles.

Fig. 18: Didactic pyramid – relationship between basic elements of teaching (Matijević, 2000, page 24)



In analysing the most important elements of teaching, Poljak (1984, pages 93-95) furthermore mentions a didactic quadrangle (Fig. 19) and writes: “We support those pedagogues who in today’s development of educational technology are committed to a more moderate and *more realistic solution*, in transforming the didactic triangle into a didactic quadrangle, which we can graphically display in the following manner:

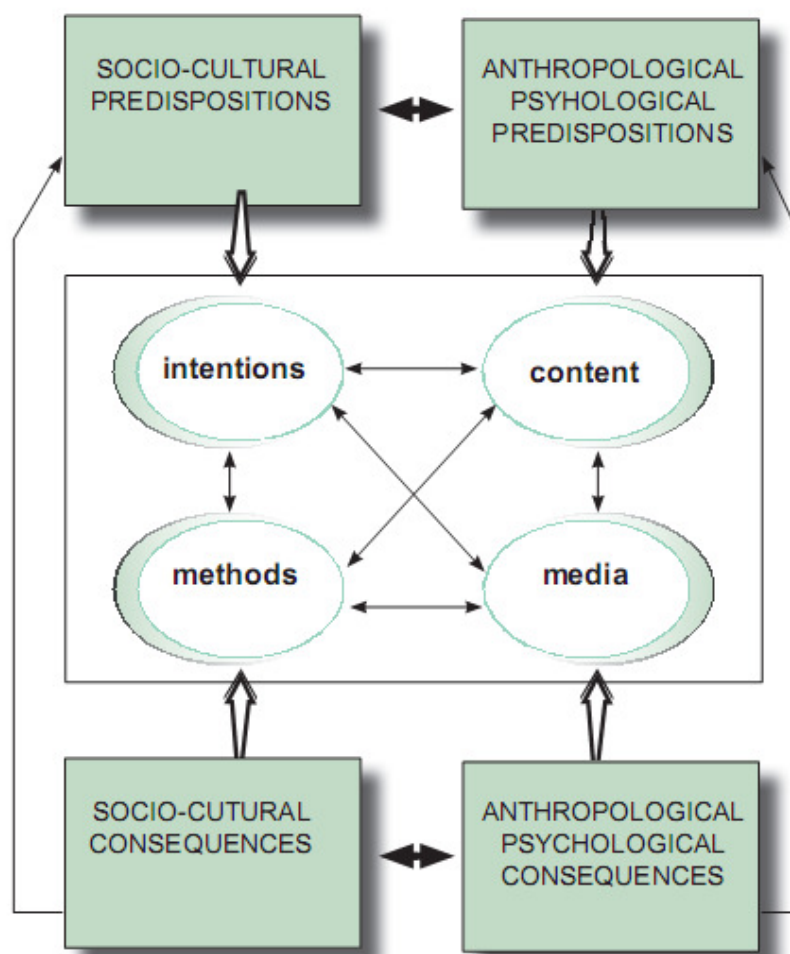
Fig. 19: Didactic quadrangle (Poljak, 1984, page 95)



Along with the pupil (U), teacher (N), teaching content (S), we also have technology (T), in which the educational function is installed. Among all of them there is a mutual connection”... The increasing significance of technology i.e. media influenced the transformation of the didactic triangle into a didactic quadrangle. In the same source, Poljak mentions that some didacticians through differentiation of certain factors, propose a didactic multi-angle i.e. poly-factorial model of teaching, but because of basic understanding, he sticks to a global display of a didactic quadrangle.

In European didactics, abandonment of the three element model of teaching and analysis of poly-factorial models occur in the 60s of the 20th century. The role of media in relation to the elements of teaching is presented by Heimann (founder of the Berlin didactic school) in the *structural model of teaching* (Peterßen, 2001, page 126). The structure of the model comprises: intentions (aim), content, methods and media in communication, influenced by socio-cultural and anthropological-psychological predispositions (Fig. 20).

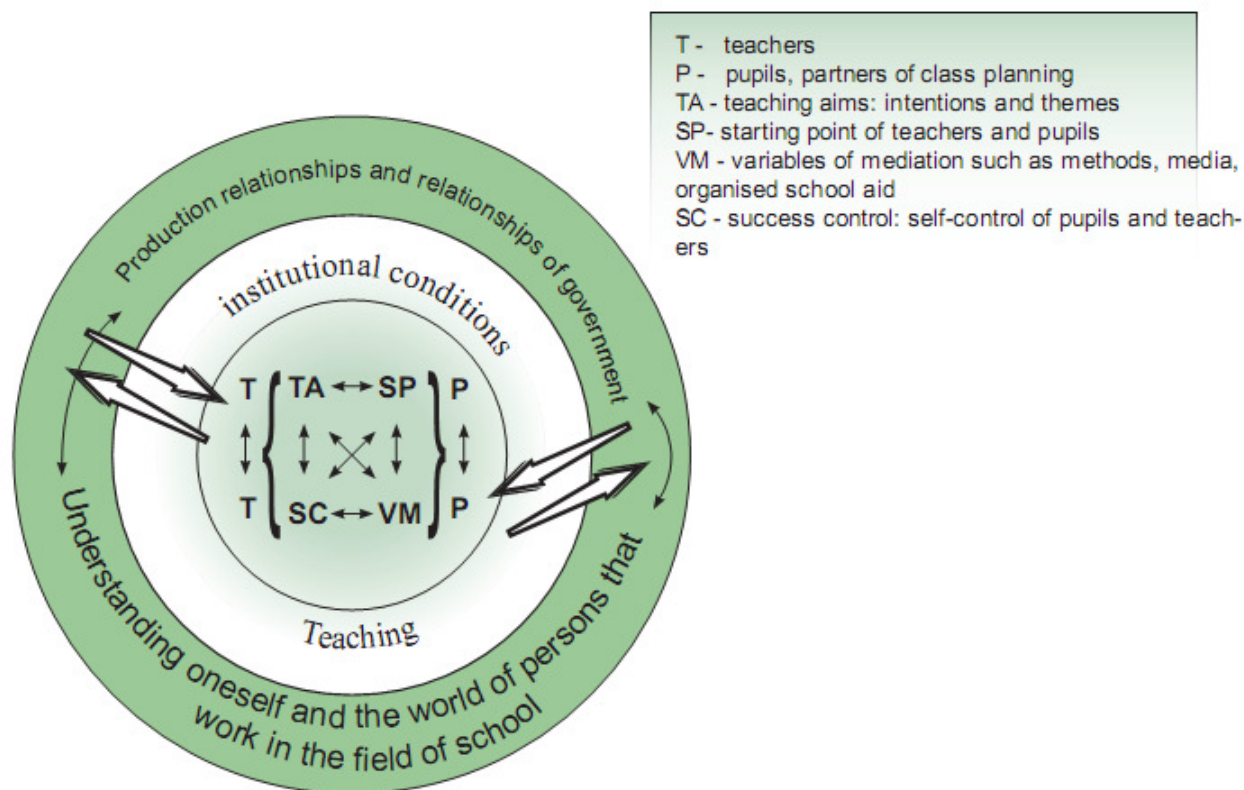
Fig. 20: Structural model of teaching (Heimann; according to: Peterßen, 2001, page 126)



The listed elements are mutually connected in a dependent relationship. The significance of media as elements of greater effectiveness of teaching is especially pointed out. The choice of media in teaching should necessarily be aligned with intentions, contents and methods. Likewise, every other element should be aligned with the rest, meaning that it is in an interactive relationship with them and the level of their interdependence stipulates the quality of teaching. Through their mutual relationships i.e. actions, certain changes occur i.e. socio-cultural and anthropological-psychological consequences.

The concept of the “Berlin model” was completed by Heimann’s co-worker, W. Schultz, who presented it in 1980 as a “Hamburg model”. In the “Hamburg model”, Schulz displays moments of didactic-planning action in implicational linkage among the elements (Fig. 21).

Fig. 21: Moments of didactic-planning action in implicational linkage among elements (Schulz; according to: Peterßen, 2001, page 134)



In accordance with ecological systems theory (mentioned in the section: significant research of didactic multimedia in the field of education in the USA), Schulz created a comprehensive model of didactic planning which is influenced by: production relationships and relationships of government, understanding oneself and the world of persons that work in the field of school, institutional conditions of teaching as well as the following elements: teachers, pupils, teaching aims, starting point of teachers and pupils, variables of mediation such as methods, media, organised school aid, and success control. The central part forms four didactic questions:

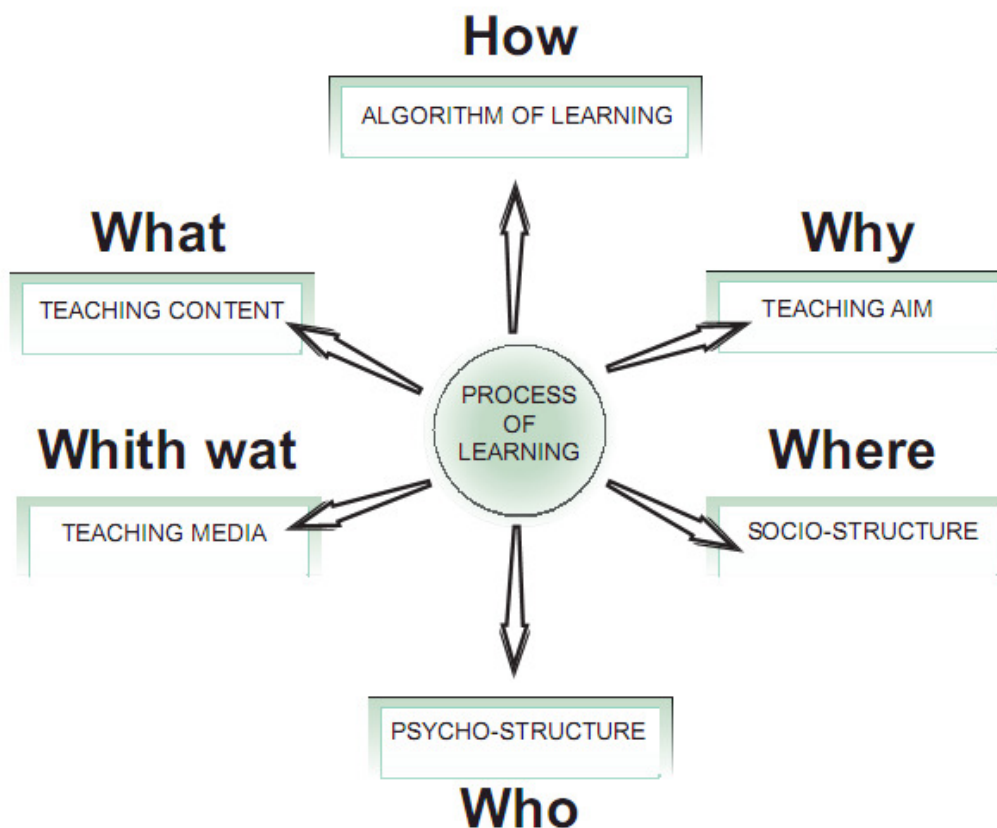
1. Who is learning and from whom? The question relates to participants in class, those are pupils and teachers. An important starting point is their previous knowledge, experiences, convictions etc.

2. What needs to be learned? This question is directed towards pedagogical-educational aims i.e. achievements, and explains the intentional context of class activities.
3. By which variables of mediation is it possible to best achieve the aim? Schulz under the variables of mediation implies methods, media, the course of teaching activities, social forms of work etc. Planning the usage of media is based on application and sequence of display of those media by which we will bring all elements into the best possible relations.
4. How will success control be determined? Directed attention on success control points out the significance that the author attaches to evaluation. In this manner, devising criteria for evaluation of class activity success is stipulated, by which their effectiveness can be viewed.

The differences between the models is in that the teacher, in the “Berlin model”, is the central person who decides on planning and analysing the process of learning, whereas the “Hamburg model” includes the teacher and pupils in an interdependent relationship, where media are first in the development of school communication between the teacher and pupils, enabling transfer and mediation of knowledge (according: Blažič, 2007, page 51).

Further research brought about the introduction of many other elements of teaching, along with the existing ones, thus forming didactic multi-angles. Theoreticians explain them individually through various poly-factorial models of teaching. Following the “Berlin model” whose elements were renamed and differently positioned, H. Frank devised a Cybernetic model of teaching elements (Fig. 22). Dimensions of the pedagogical area according to Frank describe the process of learning as a poly-factorial model.

Fig. 22: Dimensions of the pedagogical area according to Frank (Frank; according to Blažič, 2007, page 52)



The teaching process is made up of the following components: algorithm of learning (answers the question How?), teaching aim (answers the question Why?), socio-structure (answers the question Where?), psycho-structure (answers the question Who?), teaching media (answers the question With what?), and teaching content (answers the question What?). In the cybernetic didactic theory, the main questions are how to and with what reach teaching aims (according to Blažič, 2007, page 52). As opposed to the “Berlin model”, the socio-structure and psycho-structure are equal elements of other components, while instead of methods Frank mentions the algorithm of learning. It is important that all elements are in interaction and complement each other.

In contemporary poly-factorial models of teaching, media are equal structural elements with other elements of teaching. Besides an interactive relationship of media with other elements of teaching, their relationship is also complementary since one depends on the other and one influences the other during selection i.e. creation of teaching strategies. By using two or more media with a computer, Gerlič displays (2000, page 197) the didactic multi-angle (Fig. 23).

The display of multimedia in education with the didactic multi-angle comprises the segment of the poly-factorial model which is focused on media, multimedia and teaching content.

Fig. 23: Display of multimedia in education with didactic multi-angle (Gerlič, 2000, page 197)

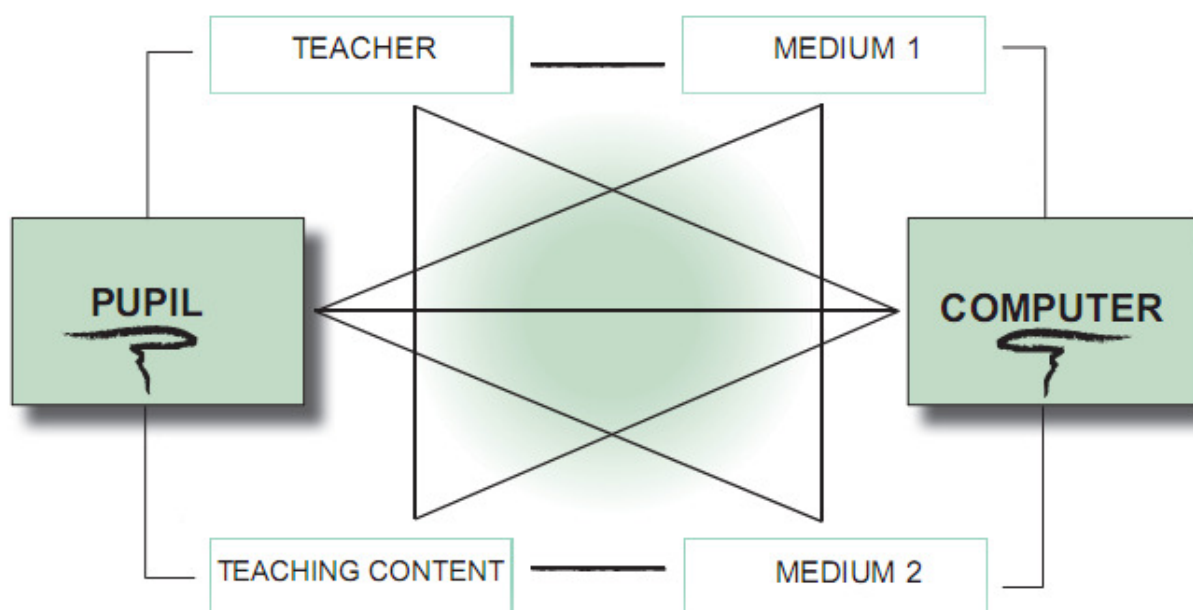
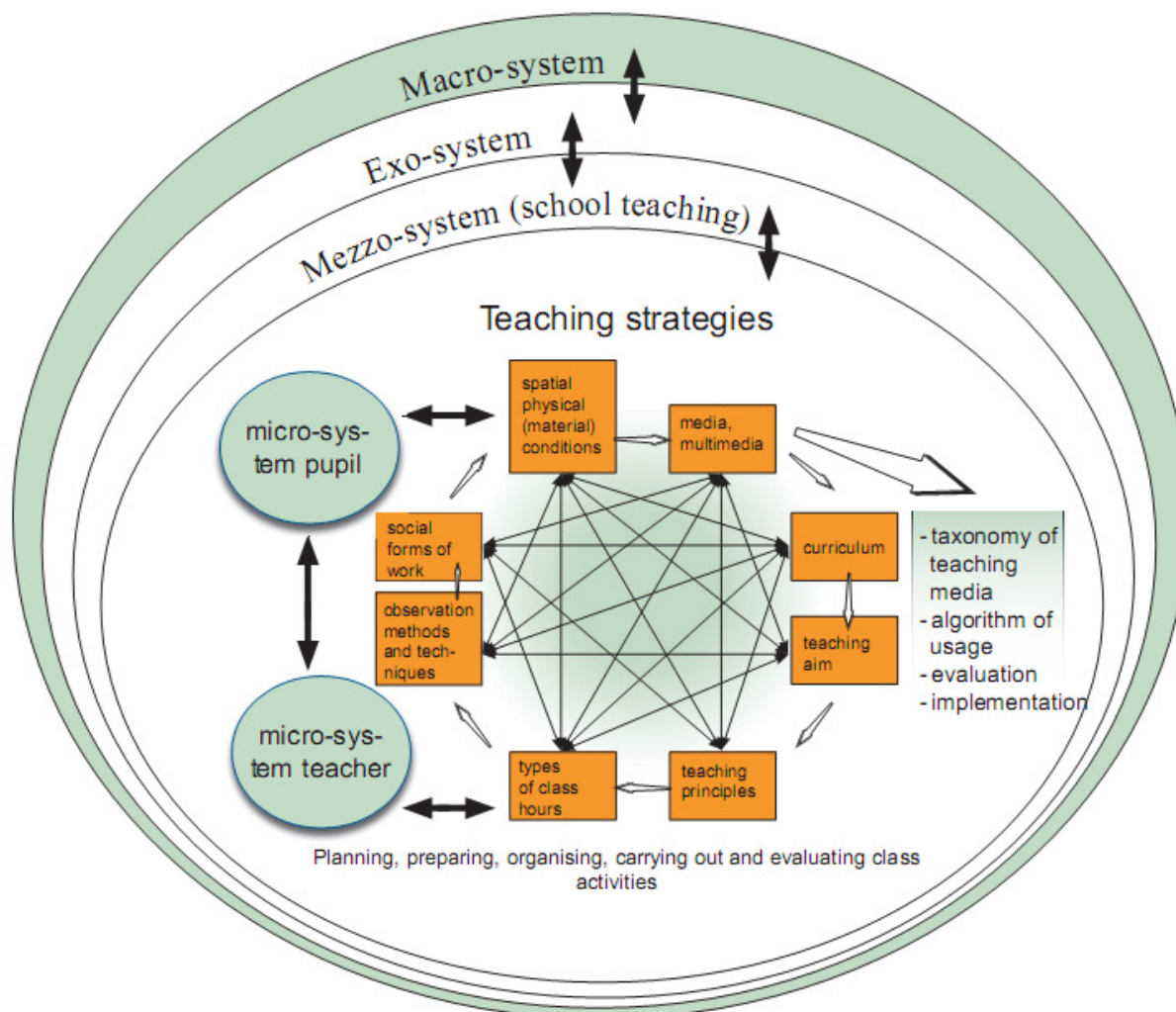


Fig. 23 is in fact a derivative version of the didactic quadrangle where the basic elements are pupil, teacher, teaching content and teaching technique. In the dimension of teaching technique, here there is mention of only one of many possibilities which can be involved in the process of learning. The example shows us two forms of multimedia learning. In the first one we can observe the computer as a multimedia source of knowledge, whereas in the second example medium 1 and medium 2 are given along with a computer, by which teaching assumes a multimedia significance. Links between the mentioned elements of the didactic multi-angle point out the importance of the interactivity of those involved.

Fig. 24 shows structural elements of the poly-factorial teaching model and these are: pupil, teacher, other media and multimedia, curriculum, teaching aim, principles, types of class activities, teaching methods and techniques, social forms of work and spatial-physical(material) conditions.

Fig. 24: Poly-factorial teaching model



This poly-factorial teaching model has its starting point in Bronfenbrenner’s theory of ecological systems as well as in: the “Berlin” and “Hamburg” model. It shows the connection of all sub-systems of a system which is reflected in the pupil’s achievement in learning during class in school. The difference of this poly-factorial model in comparison with the model of environment structure in the theory of an ecological system, lies in the fact that this model, within the environment structure, focuses attention on elements of teaching strategies and shows and describes in more detail the structure of teaching activities, as well as the relationships of elements within the micro and mezzo-systems. The link of this poly-factorial model with the “Berlin” and “Hamburg” models can be seen in the poly-factorial display of

structured elements of the didactic-methodical field as well as their impact in a wider socio-cultural context.

This model shows the universality of its application as it is operational in all societies, due to the fact that the principle of activity is the same. The poly-factorial model of teaching shows the complexity and through this, the complexity of multimedia teaching as well. On a horizontal level, the poly-factorial model comprises: class participants – teacher and pupils as well as other elements of the didactic-methodical field: curriculum, teaching aim, teaching principles, types of class activities, teaching methods and techniques, social forms of work, spatial-physical (material) conditions as well as media and multimedia.

The pupil should be introduced as a whole being of the new age, now already of the generation O, indigo and crystal children, who are arriving with lots of previous knowledge, actual skills and possibilities. The pupil of the 21st century requires contemporary teaching which is based on the dynamics of the process, which constantly change various effective class activities. Today's position of the pupil in class differs from all previous ones. This is due to the lifestyle in conditions of a great inflow of information, therefore today's children are more informed than children of previous generations.

Pupils mutually differ by many categories (age, gender, social environment they originate from, style of learning ...) and therefore differently experience multimedia in class. Multimedia teaching stimulates a synthetic experience in pupils, which means it provides them with simultaneous experiences of audio-visual senses. By stimulating audio-visual senses in teaching and learning, clearer and richer impressions are created, and there is emphasis on a stronger awareness of personal potentials. Thereby, with class work authenticity of teaching and learning is carried out where the pupils in class have a greater possibility of success. Pupils adopt class contents using various media and multimedia. Pupils are more independent, active and involved in class work. Multimedia teaching encourages the development of meta-cognitive skills in pupils which thereby provide them with long-lasting knowledge and application in the same, similar or different life (problem) situations.

The teacher is also a participant of the teaching process and a person who is a moderator of class work. The teaching process greatly depends on his/her personal and professional competencies i.e. convictions. This means that the teacher carries out a certain educational policy. In the work of the teacher, there can be auto-censorship. Auto-censorship is the

“internal brake” in the teacher which prevents him/her in qualitative thinking and acting when among pupils. These “internal brakes” are a result of scarce knowledge or improper convictions. Very often they are negatively reflected onto the pupil, and the consequences appear during class work or after class, sometimes even years after completion of schooling.

The work of the teacher in class is specific since it is carried out according to the principle of personal concentration. This can often be an advantage, since during lectures more class subjects can be covered, thus the pupils’ possibilities of acquiring new knowledge increases. In the contemporary teaching approach, the teacher teaches the pupils how to learn, i.e. how to independently reach necessary information and the purpose of learning, where the ability to self-educate arises. “...no matter how effective learning might be, everything will not be able to be learned, and so it will be more important learns how to acquire knowledge, rather than know a certain amount of knowledge which in no given moment can be satisfactory.” (Bezić, 1983, page 188). Therefore, the choice of multimedia should be based on the needs of the pupils, but also on indicators received by evaluating previous class activities. Teachers should follow trends, possibilities of newly-invented multimedia, dedicated to procuring them, trained for their application in class, raise pupils for proper storage, maintenance and usage of all media and multimedia in the classroom, school etc.

Media and multimedia are teaching devices and aids which can be: bought, rented, formed or, for the needs of the class, procured in other ways. “It should be pointed out on this occasion that multimedia does not supplant the teacher, but serves as an excellent complement to the spoken word, blackboard, textbook, teaching transparencies, geographical maps etc”. (Mikić, 2001, page 249) Moreover, all media and multimedia used in class interact. Katica Ivanišević’s (1977, page 73) research “Audio-visual tools and multi-source set in foreign language teaching” in which 5th grade pupils were examined from three primary schools in Rijeka, is interesting. The results showed that by using AV devices and multi-source sets, the number of pupils who achieved Bs and As grew, and the number of pupils with lower grades fell. Media and multimedia in teaching are not sufficient by themselves. The aim is by selecting them to create pedagogical-educational achievement. Pupils should be concurrently educated on the media and multimedia culture. “Technical media (e.g. television) can mediate, “display and bring closer” reality in space and time, in their perspective, in abbreviations, in explanations and “various viewpoints” which can have an advantage in “presenting reality” but also flaws if the content is not comprehensible and if pupils do not

understand the specific “media language”. Therefore, it is necessary in application of technical and other media in teaching and learning to carry out didactic organisation in such a way that media present, reproduce the real world and events, but also in doing so explain the specifics and functions of subject matter, point out the essential aspects and “bring closer to pupils” in a psychological and cognitive-emotional way. Media, especially technical, provide this proximity, but not by themselves. For that, there must be a didactic application of media in the processes of teaching and learning.” (Lavrnja, 1998, page 133)

The curriculum determines the scope, depth and sequence of class contents. The scope of the curriculum displays broadness of knowledge and skills which the pupils must acquire, through the depth of the curriculum, the level of analysis in studying content and level of quality formation skills are determined, whereas the sequence points out the order of interpreting class contents. Curriculum determines the contents which are studied by pupils. The curriculum is one of the guidelines of multimedia choice. Multimedia contain information which are planned by the curriculum or information which can influence its execution.

With the teaching aim certain expected changes are determined which should occur in each pupil with the help of class activities and contents. “... aims represent a standard (referential framework) which enables establishing, guiding, marking and regulation of curriculum teaching and learning.” (Jelavić, 19998, page 127) Expected changes refer to pupils’ knowledge, skills, habits, opinions and interests. These type of aims are geared towards the development of the pupil, as opposed to aims which are based on consistent obligation of following class contents which are the purpose of class work. If the aim is unclear, the class unit cannot be qualitatively carried out. It is the teacher’s choice to decide on which aim to pursue, in what manner he/she wishes to work with the pupils in class and what will the aim finally achieve. Whatever the educational policy of the teacher, that is how the interpretation and role of multimedia in class will be.

Teaching principles are basic maxims which the teacher should respect during class work. They should be based on individual possibilities of pupils as well as laws of the teaching process. The guiding train of thought is the principle of quality class teaching and learning. It is integrated in all teaching principles and there is no need to emphasise it.

The principle of activity and development guides pupils to qualitative changes of their own personality. Multimedia stimulate sensory, expressional, practical and intellectual activities of pupils. The more active a pupil is, the assumption is that that he/she will develop more successfully.

The principle of allowing differences of opinion and expression is easily carried out since multimedia provide pluralism of pupils' procedures and problem-solving where the pupils reach solutions independently.

The principle of age determination and individuality emphasises a structure of multimedia which must be compatible with awareness of children's psychology and their individual potential.

The principle of systematisation and gradualness supports those multimedia that stimulate pupils in a logical sequence of exercising procedures, forming pupils' opinions and habits, acquiring and training in expression etc. and provides them with activities guided from easier to harder ones, from familiar to unknown ones, from simple to complex ones...

The principle of vividness and abstractness also influences the choice of multimedia. Vividness in pupils helps them in acquiring facts, while abstractness impacts on generalisations. Facts and generalisations form the pupil's knowledge. Explicit information of multimedia is adopted by pupils through all sensory experiences. The younger the pupil, the more vivid i.e. concrete information is necessary. It is precisely because of this that multimedia are suitable because they simultaneously provide pupils with reception of information. Vividness is based on primary sources of objective reality and therefore there is a greater need for natural multimedia in lower grades. As the child grows, so do his/her developmental possibilities, and so abstraction is introduced even more. Abstraction has terminological basis and is more and more taking on the role in class through multimedia. Therefore, there should be great attention paid to the choice of media and multimedia in teaching, in accordance with the pupils' development. With media and multimedia that is suitably chosen, clearly formed and adapted to pupils, we can reach expected pedagogical-educational achievements in pupils. It is also important to point out the effect of multimedia usage in class. The level of sensory cognition is the lowest in the use of speech. A higher level

of achievement is manifested in the usage of teaching devices, and the highest in a connection of speech and teaching devices (see table 5).

Table 5: Amount of memorised material (Soleša, 2006, page 51)

TRANSMISSION OF INFORMATION	AMOUNT OF MEMORISED MATERIAL	
	after 3 hours	after 3 days
<i>speech</i>	20 - 70 %	10 %
<i>teaching devices</i>	72 %	20 %
<i>speech + teaching devices</i>	85 %	65 %

The principle of rationalisation and efficiency directs the choice of multimedia towards those that perfect and simplify class work as well as help achieve high levels of learning results with regard to individual possibilities of pupils. Efficiency of multimedia usage is in using less energy to achieve greater results i.e. the greatest possible effects of teaching and learning.

Types of class hours can be classified with regard to the algorithm of learning. By doing so, we introduce pupils to a certain problem, interpretation of certain class contents, practising class contents, their repetition, testing or as a combination of all previous ones. Class activity of prep work introduces pupils to a problem. Introduction of pupils covers various contents of different teaching subjects by which we guide pupils towards sensitisation of the problem i.e. its discovery and understanding. After identifying the problem, class activity follows, in which contents are explained more in depth. Contents may be interpreted by the teacher, pupils or some type of multimedia. Practising contents is a class activity which is based on operational procedures of certain skills or stimulating pupils' abilities. Through repetition, previous work is confirmed and with each repetition some activities impact more qualitatively with pupils on their ability to master new knowledge. Testing adoption of teaching contents with pupils is done with the aim of obtaining feedback information on their work, although this is imposed as an imperative in all class activities. There are various forms of testing adoption of teaching contents. So in the exchange process of receiving and modifying

information, acquired differences in knowledge, abilities etc. are diagnosed. A combined type of class hour is also the most common in classes. It comprises a synthesis of all previous types. Multimedia can be used for any one of the learning stages mentioned: memorising previous activities, introduction to a problem, interpretation of content, practising, repeating and testing what has been learned.

Methods and techniques of teaching are the next element of the didactic-methodical field. The teaching method represents a meaningful procedure or pupil's and teacher's working method. Many authors mention various classification methods. Poljak (1985, pages 74 – 111) in Didactics lists the following methods: demonstration, practical work, drawing, writing, reading and work on text, discussion, oral lectures. Jelavić (1998, pages 48 – 58) mentions verbal, visual and training methods while Filipovič (1988, pages 233 – 282) underlines the following methods: oral lecturing, class discussion, text work, written works, illustration and demonstration as well as laboratory and practical works. Prodanović (1975, pages 317 – 349) classifies methods into three groups: verbal-textual, illustrative-demonstrative and laboratory-experimental. The choice of method to be used should be left to the teacher. Teaching techniques are an integral part of the method. Teaching techniques represent teaching situations, they are numerous and it is good to alter them as they create the dynamics of class activities. The teacher chooses teaching methods and techniques by which he will use multimedia in class.

Social forms of work which are used in class are different: individual, group, team, frontal and free forms of work. During the class, it is desirable to combine different social forms of work as they are mutually coordinated and complement each other, making up the dynamics and diversity of class.

In accordance with the number of pupils in class and fulfilment of social forms of work to be done, here attention should be focused on the “amount” of multimedia which are needed in class. The role of multimedia is also to enable various social interactions of the pupil in the class room.

Spatial-physical (material) conditions refer to the classroom where the class is held. The classroom is a mirror of the teacher and pupils. “Objective conditions impact on learning directly and indirectly. The space and class equipment affect the “richness” or “poverty” of

class activities...the kind of equipment accompanying certain class contents does make a difference. From the other side, the space and equipment impact on the subjective feeling of the pupil and teacher. Inadequate space and bad equipment create a feeling of aversion and a lack of commitment. Creating suitable objective conditions of teaching is the prerequisite for more qualitative learning.” (Jelavić, 1998, page 32) Teaching media and multimedia are part of the spatial-physical (material) conditions required to carry out teaching. There should be a place where they can be: collected, put away, used properly and maintained. Multimedia and different media create a multimedia classroom and provide for multi-disciplinary teaching and learning. Their basic role is availability of information to the pupils. However, they are dependent on the human factor, as not even the latest multimedia in modern spatial-physical (material) conditions are any guarantee for quality of teaching. Having multimedia does not always mean using them as they are dependent on the activities of the teacher and pupils. The needs of the class impose certain conditions: infrastructure, lighting, shading, easily-maintained floors, colour of the walls which give a pleasant feeling, airiness, suitable temperature, silence... The furniture is appropriate for the bodily development of pupils and needs of the class. It is easy to manipulate so the classroom assumes different dimensions for different purposes of learning. Various media and multimedia are available and always accessible to pupils. For the purposes of learning, pupils are directed to the media room outside the classroom.

From the described structural elements of the poly-factorial teaching model and their relationships with multimedia, it can be concluded that they are mutually dependent on each other. The higher the harmony of their relationships, the more qualitative the learning process is. When the teacher and pupils activate and materialise other elements of the didactic-methodical field, stimulating their interactive relationship, then we can speak about a teaching strategy effect. On a horizontal level, there are many different and unique teaching strategies, which means that all teachers and pupils develop an authentic teaching situation, regardless of the educational policy of the teacher. Therefore, the possibility of a multiple combining of elements of the didactic-methodical field shows the multi-levelled action of the teacher and pupil in practice, in accordance with their starting position, resulting in a multi-levelled impact i.e. their final state occurring on completion of teaching strategies - class. This further means that no two same teaching strategies exist and all strategies which the teacher uses in class cannot be equally successfully carried out because of the continued “situational dynamics”. Situational dynamics make up many elements e.g.: the mood of the pupil and

teacher, different paces of development and developmental level of pupil, unexpected inhibiting factors...

On vertical levels, a macro-system, exo-system and mezzo-system directly or indirectly impact on the micro-system i.e. class achievement of pupil. Therefore, the poly-factorial teaching model, on vertical levels, is manifested through social, cultural, political and other features of certain societies. Through an exo-system and mezzo-system, a macro-system impacts through its educational policy on the micro-system and profiles them through teaching patterns that micro-systems repeat in their future positions within a mezzo-system, exo-system and macro-system. As regards the profiling of society, teaching will form and bring about an identity of the individual. In order to set in motion a developmental approach to pupils which stimulates satisfaction of learning, it is necessary to raise awareness of the teacher to higher levels, thus removing old patterns of thinking, behaving and acting. This then breaks the vicious circle of a content-related approach to teaching. However, the question is asked what is an individual society ready to do in this direction and what is the level of social awareness?

There is no recipe or rule for the most successful combination of elements of the didactic-methodical field in teaching strategies, due to the developmental dynamic-teaching subjects and situational dynamics generally. Therefore, it is always necessary to apply evaluation as it creates a qualitative shift in further implementation of multimedia in teaching. An absence of this or partial evaluation reduces the quality of its usage.

4.2. TEACHING STRATEGY

Multimedia is part of the didactic-methodical field and the relationship between multimedia and other structural elements of the didactic-methodical field is observed in their mutual interaction and complementarity. Through their activation, a certain goal-oriented activity is created.

Analysing the term strategy in a military encyclopaedia, the word strategy comes from the Greek work which means leading an army: "Strategy is a system of learned knowledge and skills (theory and practice) on preparing and leading a war as well as using force in order to

achieve certain military, political or economic aims.” (Gažević et al, 1975, page 171) Analogous to the stated definition, *teaching strategy* is defined as the skill of preparing, organising, leading and evaluating teaching activities. The structure of teaching strategies answers the basic question: who, what, when, where, how, why, with what, how to proceed? Therefore, a teaching strategy is understood in a poly-factorial sense, as each structural element answers some of the questions mentioned. When all structural elements are placed in “operation” (impact, action, activity) for the purpose of pedagogical-educational achievements, teaching strategy is then created. “Strategy is generally speaking a global skill or science on execution of some complex actions (e.g. leading a war or organising a pedagogical-educational process). Methods and procedures are included in didactics and pedagogical strategy, i.e. manner of activating participants of the pedagogical-educational process in carrying out the task of pedagogy and education.” (Bognar and Matijević, 2005, page 408).

Part of teaching strategies comprises computer teaching strategy, arising with the development of computer usage. In line with that stated, Blažič mentions Hendriks’ division of strategy: *strategy of mediating in class contents, (strategy of tutorage), strategy of repetition, practising and using knowledge, hypermedia strategy, strategy of simulating and micro-world strategy* (Strmčnik et al, 2003, pages 316 -321). The strategy of mediating in class contents enables the pupils an individual approach to learning through a linear and interactive program. The advantage of this strategy is in exceeding the possibilities offered by classic teaching media, while weakness lies in the complexity of creating such programs for which teachers are rarely trained to carry out. The strategy of repetition, practising and using knowledge is focused on the typology of teaching activities and so, in line with the strategy mentioned, programs for repetition of already learned material are used in class. Programs of practising have proved to be less suitable as individual complex problems offer many significant solutions which are difficult to cover with educational back-ups. That is why a much greater impact in learning can be provided by hypermedia information strategies as they enable pupils of greater cognitive possibilities different approaches in resolving the set tasks, thus giving them greater freedom in creating their own solutions, while simultaneously, the stated advantage, is also a disadvantage in teaching pupils with difficulties in learning. The strategy of simulating provides for ease in learning with qualified and professional training as it demonstrates some natural occurrence, harder-accessed reality, functioning of technical, economic or social systems, dangerous situations or works etc. Micro-worlds strategies also

stimulate the ability to resolve problems and independent learning, which is very important in the development of competencies for lifelong learning. Hypermedia programs, simulations and micro-worlds besides independent, stimulate cooperative and silent learning. However, in class, oral skills should be honed which provide pupils, besides rhetorical skills, an exchange of experiences in acquiring silent knowledge (tacit knowledge). Dialogue teaching strategy stimulates communication between pupils and computer educational back-up in giving mutual feedback information.

Different authors have different approaches to strategies, as well as classifications. Bognar (Bognar and Matijević, 2005, pages 267 – 294) classifies them into: *pedagogical strategies (existence, socialising and individualising) and educational strategies (learning, teaching, experiencing and expressing the experienced, practising and creating)*. This classification strategy relates to social forms of work and phases in the process of learning. Based on the research done by I. Reece and S. Walker, Matijević (I. Reece and S. Walker; according to: Matijević, 1999, pages 497 – 502) mentions *strategies suitable for work in large groups, strategies suitable for work in small groups and strategies for individual work*. This type of classification of teaching strategies is based on social forms of work. Each strategy type has listed its methods and techniques of teaching differently e.g. strategies suitable for large groups of pupils: lecturing, demonstration, discussion, debate, “questions and answers (Q & A)”, video recordings, strategies suitable for smaller groups of pupils: seminar, workshop, game, “brainstorming”, group “buzz”, “field trips”, role-play, “breaking the ice”, simulation, case studies as well as strategies for individual learning and teaching: project, tutorial system and distant learning.

R. J. Marzano, J. D. Pickering and J. E. Pollock (2006) list nine teaching strategies: *finding similarities and differences, summarising and noting, increasing effort and giving recognition, homework and exercising, non-linguistic displays, cooperative learning, determining aims and giving feedback information, creating and checking hypotheses and headwords, questions and complex organisers*. Most of the strategies show techniques of learning or method of work in class, one relates to social forms of work and the other to the aims. Each individual strategy listed relates to a certain element of the didactic-methodical field, while during work, in a poly-factorial teaching model, the strategies are observed holistically, since each one comprises all elements of the didactic-methodical field.

In practice, of course, there are numerous teaching strategies. They are mutually autochthonous and unique, which means no two same teaching strategies exist. Matijević (Matijević, 1999, pages 501 – 502) writes about criteria for the choice of strategies: “There are no universal rules which determine when and how to apply these strategies in everyday class situations. Nevertheless, it is possible to point out basic elements that stipulate their choice and change. The most important ones are: pedagogical and education aims, the nature of learning content, pupil’s psychophysical features and previous experiences, geographical position of school, economic conditions as well as teacher’s viewpoints and competencies. Teachers are nevertheless recommended to more frequently change displayed teaching strategies and to always find new solutions for creating class situations with the pupils. Teaching strategies are flexible forms because the teacher and pupils are unpredictable systems. Therefore, no ideal, universal, teaching strategy exists. They mutually differ in sets of differently structured elements of all elements. Even if we were to repeat a class work done by the same prep work in a same class department, the class activities would be carried out differently. The main reason for this is the human factor. “...credibility of learning provides for (and represents an important assumption) the credibility of social processes whose essence is to learn to understand and accept others in order to be understood and accepted (social reversibility in communication)...Here we are talking about balanced communication which implies respects both components: information-cognitive and interactive-affective... The role of pupils in teaching activities should be increased, to the “detriment” of the teacher’s verbal activities. In that case, teaching is more oriented to the pupil’s experience and so vertical communication is more and more transformed into horizontal communication. The person who is learning (pupil), logically, must be more active than the person who is teaching. There is no proper learning and achievement of the pupil without proper activities. Symmetric communication assumes avoiding domination of any participant of class.” (Jelavić, 1998, pages 35 – 36) Qualitative social interaction of teachers and pupils creates conditions for more qualitative learning.

In fig. 23 in the poly-factorial teaching model, all elements of the didactic-methodical field are shown. The strategy of teaching activity comprises: preparing, organising, executing and evaluating class activities. All structural elements of the didactic-methodical field are built into the preparation of the following class performances. Before the performance itself, attention should be paid to the organisational aspects by which all necessary conditions are assured. In practice, it often happens that by reacting to concrete situations and needs of the

pupils in class changes the preparation “in operation” with the aim of a more qualitative performance. The last stage of class activities comprises evaluation. Evaluation of class work is extremely important as it represents a regulator of future strategies. With evaluation, class activity is focused towards new, more effective solutions. All that was good in the performance is kept, while the less effective performance is replaced by better solutions. All structural elements of the poly-factorial teaching model are specific and important. Absence of any one of them impairs the teaching strategies, along with the didactic-methodical assumptions. The quality of teaching is at the lowest level when, in forming teaching strategies, potentials of all elements of the poly-factorial teaching model are not used. Therefore, the effectiveness of class work is influenced by the level of teacher’s competence in taking the best from each element in a given moment, as well as in their mutual interaction.

In a strategic activity, the choice of media and multimedia is important because of authenticity and credibility of learning, which make up the basis in reaching pedagogical-educational achievements of pupils. “How to and in what way mediate a content and make it available to the pupil (directly, indirectly, combined). It is known, namely, how form of presentation of some content (verbal or written word, image, model, direct observation of occurrences, processes, objects in authentic or experimental conditions..) must be maximally in line with it so as to avoid informational loss...So, for example, if we wish to learn about a painting “Self-portrait with a dog” (M. Kraljević), the best would be to see the painting directly (original). However, if we cannot do that, we will accept (as the best replacement) a reproduction of the same dimensions. If we cannot do even that, we will accept a reproduction of smaller dimensions. Failing that, a black-and-white photograph will do. If that is not to hand, all we have left are spoken and written words. It is impossible then to transmit visual arts with what is (in this case) important. It is noticeable here how each (following) replacement is, in a certain sense, a substitute for the original. Informational losses become greater and greater, even essential. Naturally, the credibility of class learning drops. Mediation of contents can be improved if the number of channels is increased. Each of them, if we use comparative advantages, will enable the pupil (recipient) to “see” more and better. Namely, direct sources can be so redundant that it is almost impossible (without drawings, images, models, spoken words...) “to see” that which should be “seen”. Here, of course, is where media are welcome. Diversity in ways of presenting (the source) some content provides for a more varied and richer processing (cognitive activity). A direct result is better reception, a more qualitative and proper knowledge/experience, fewer “sounds” in communication, greater credibility of

communication. Here learning is shown as communication in which the teacher (the one who understands learning and teaching, who knows WHAT and HOW) stimulates the pupil (questions, tasks, suggestions, corroborations...) on essential (relevant) activities so that reception and processing of “incoming” contents will be effective. Communication, therefore, enables learning to be based on an organised responsorial activity of the pupil.” (Jelavić, 1998, pages 33 – 34) In this citation, the significance of strategic action in choosing media can be seen so that there is no informational loss.

Pupil activity plays one of the key roles in pupils’ achievements. “Based on the method “tell me” (verbal or visual perception) we keep in our memory 15% of what we learn (we learn from what others tell us). Based on the method “show me” (participation), we keep in our memory 90% of what we learn (we learn from what we tell ourselves and what we see).” (Greene, 1996, page 33) Apart from this, we should define what a successful or unsuccessful child means to someone? Is a successful child one who has excellent grades in school, ability to find a way in life situations or something else? With a strategic approach where the aim is to execute a certain class program, mechanical learning is created and those strategies do not have a deeper meaning. “It has become clear that the processes of acquiring knowledge and skills are highly connected to feelings of personality, self-esteem, possibilities of self-actualisation. The result of this is new educational strategies that strive greater success, but also who do not lose sight of the fact that for the school the greatest good is the individual himself/herself.” (Jelavić, 1998, page 14) A deeper meaning is achieved only by those teaching strategies which are geared developmentally to the pupils, since they stimulate pupils to have a positive attitude towards school and learning, meaning, pupils learn because of themselves and not because of grades, parents or teachers.

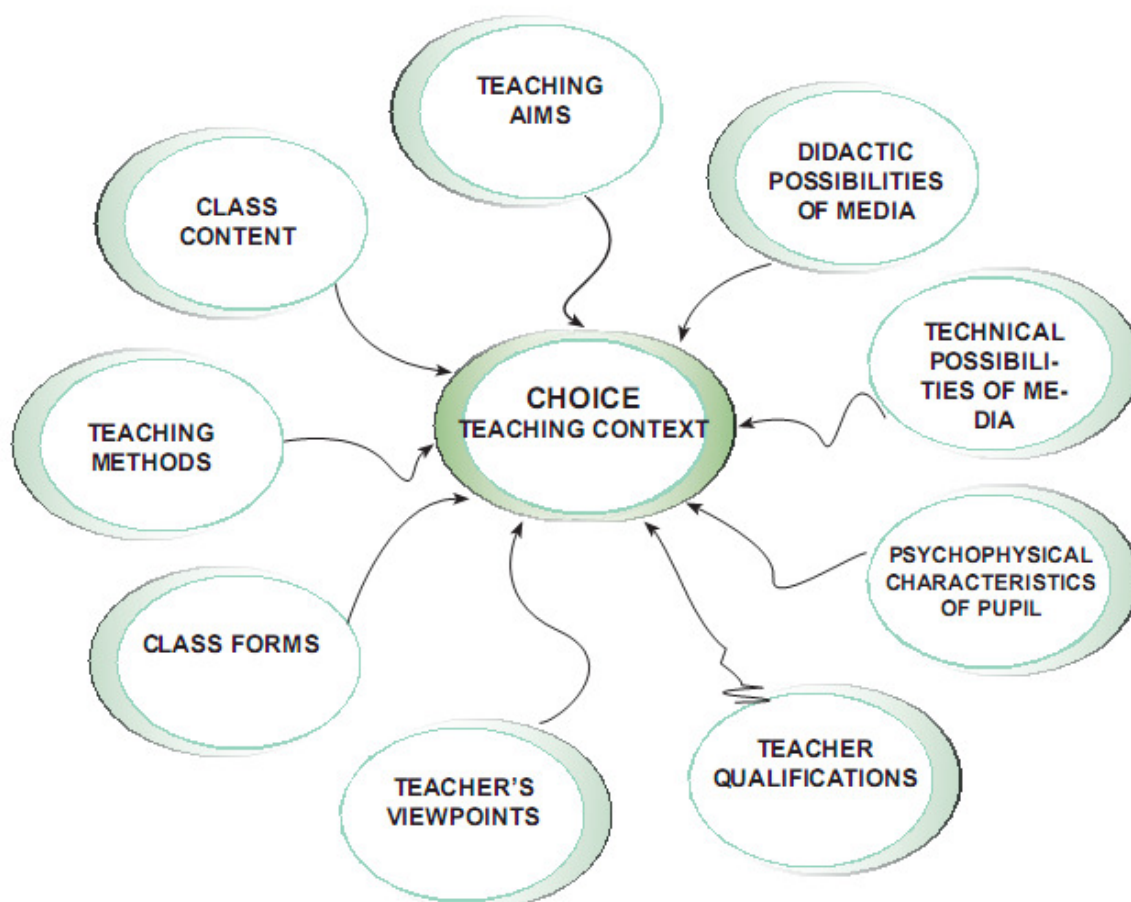
5. DIDACTIC CRITERIA FOR CHOOSING MULTIMEDIA

Didactic criteria for choosing multimedia are basic guidelines by which multimedia are analysed, chosen, used, formed and evaluated. Didactic criteria are also used for evaluating the suitability and effectiveness of multimedia in teaching strategies.

Way back in 1963, in the Encyclopaedia Dictionary of Pedagogy, didactic requirements for forming teaching resources were laid down: “that they are not overloaded with content, they provide economic acquisition of proper knowledge, they are in line with teaching aims and assignments, they stimulate pupils for activity and provide independent practical work, they develop physical and psychological skills in pupils, they are adapted to children’s strengths, they are not dangerous for the health of the pupils.” (Franković et al, 1963, page 525) The stated requirements relate to the formation of media; however, the same applies to formation of multimedia.

In his book “Uvod v didaktiko medijev”, Blažič (1998, page 13 – 119) writes about the didactic term of media, mentions classifications and taxonomy of media, lists elements for choosing learning media, explains the algorithm of media usage in teaching and analyses visual and auditory media. Blažič (1998, page 45) in the scheme of structural elements for the choice of media displays the manner in which teachers choose media in teaching.

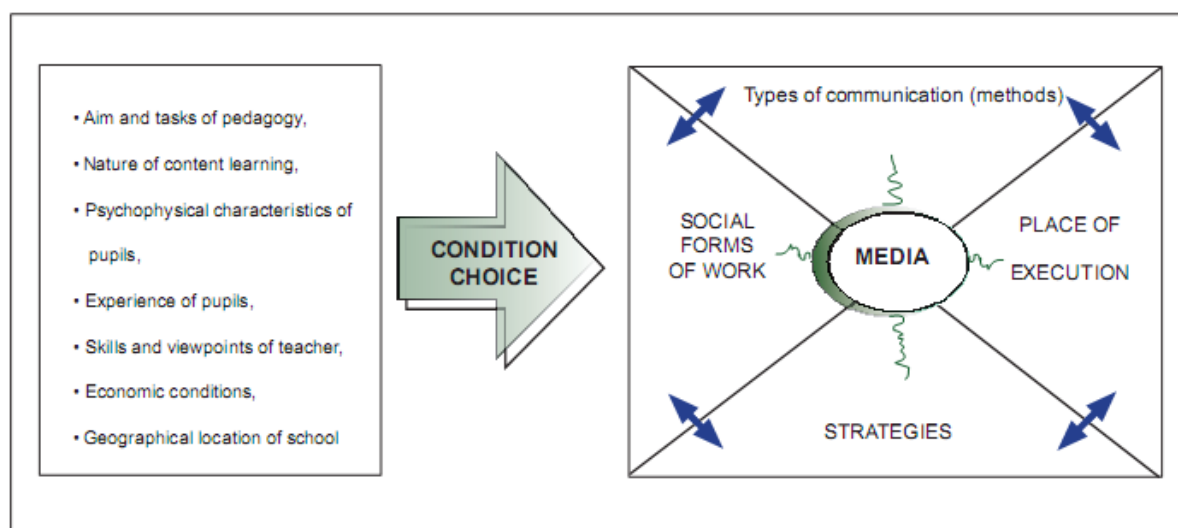
Fig. 25: Structural elements for the process of choosing media (Blažič, 1998, page 45)



Structural elements for the process of choosing media comprise: teaching aim, didactic capabilities of media, technical capabilities of media, psychophysical characteristics of pupils, teacher's competence, teacher's viewpoint, teaching forms of learning, teaching methods and class contents (Fig. 24). The author emphasises the significance of media in the teaching-communicational process. Didactic significance of audio-visual media is manifested through various functions which stimulate pupils, as for example: observing, motivation, informing, individualisation and reproduction.

Matijević (Bognar and Matijević, 2005, page 348) interprets choice of media determined by: aim and tasks of pedagogy, nature of content learning, psychophysical characteristics of pupils, pupils' experiences, skills and viewpoints of the teacher, economic conditions and geographical location of school (Fig. 26).

Fig. 26: Conditions for choice of teaching media (Bognar and Matijević, 2005, page 348)



In this connection, pedagogical aims focus choice of media on suitable social forms of work, types of communication, place of execution of teaching activities and teaching strategies.

Didactic criteria of multimedia choice depend on elements of the didactic-methodical field:

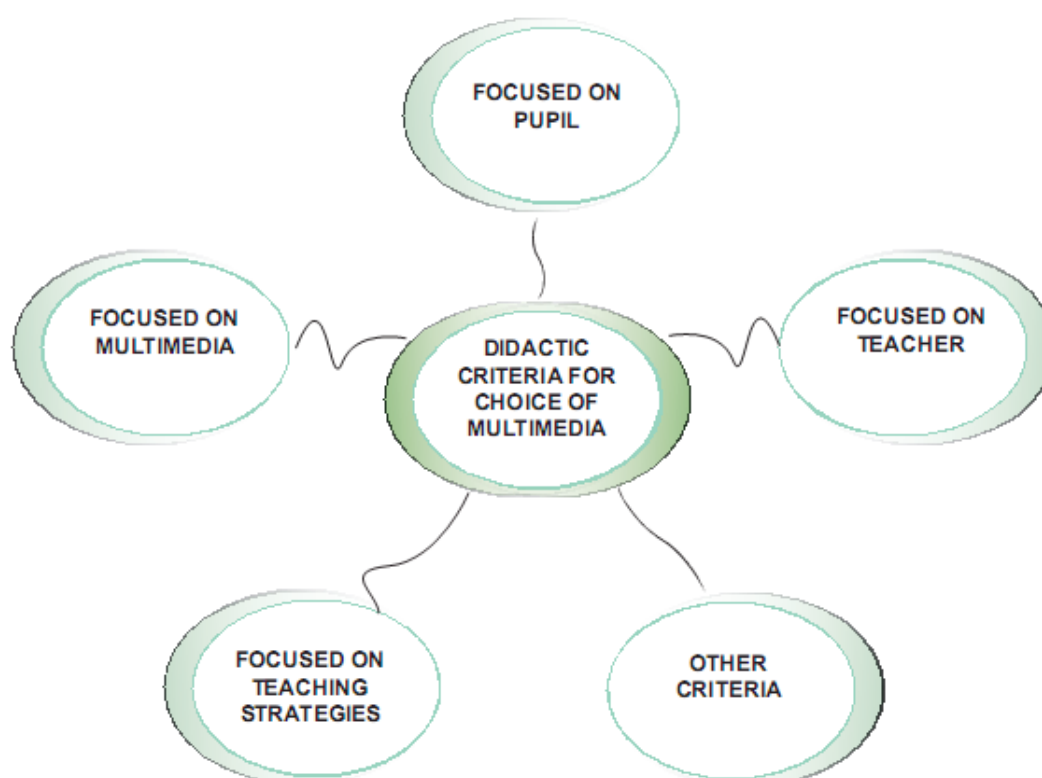
- “We must harmonise teaching aims and teaching contents with the level of intellectual development and interests of pupils;
- The scope of mediation of teaching content should be adapted to the possibilities of acceptance by every pupil;
- Learning contents should be adapted to pupils’ abilities of understanding;
- Learning time must be adapted to the pace of the pupil’s individual learning potential;
- Difficulty level of teaching tasks which pupils have to resolve should be adapted to individual progress in learning.” (Strmčnik et al, 2003, page 311)

The stated criteria of multimedia evaluation: teaching aim, teaching content, comprehensibility of content, time of learning and difficulty level of teaching tasks, are geared towards the pupil. This means that the pupil is the basic regulator of evaluation and choice of multimedia.

P. Plut (1980, pages 58 – 60) lists three basic conditions with choice of teaching resources: pedagogical-psychological, specific capabilities of teaching resources and economic conditions, of which each has more structural elements. Pedagogical-psychological criteria encompass: an analysis of teaching aims and content, analysis of the pupil and teaching environment i.e. conditions for learning. Specific capabilities of teaching resources relate to their characteristics with which they are defined: form of information, level of credibility of information, modality of information with regard to the sensory channels, pupil's participation in the process, searching for presented information in the teaching process and the teacher's role. Economic criteria contain: expenses of labour for preparation and manufacture of teaching materials, analysis of investment in teaching resources and results of those investments i.e. their effectiveness ("cost benefit" analysis).

On the basis of all criteria of media choice listed, classification was carried out of didactic criteria of multimedia choice geared towards: pupils, teacher, multimedia, teaching strategy and other criteria.

Fig. 27: Didactic criteria for choice of multimedia



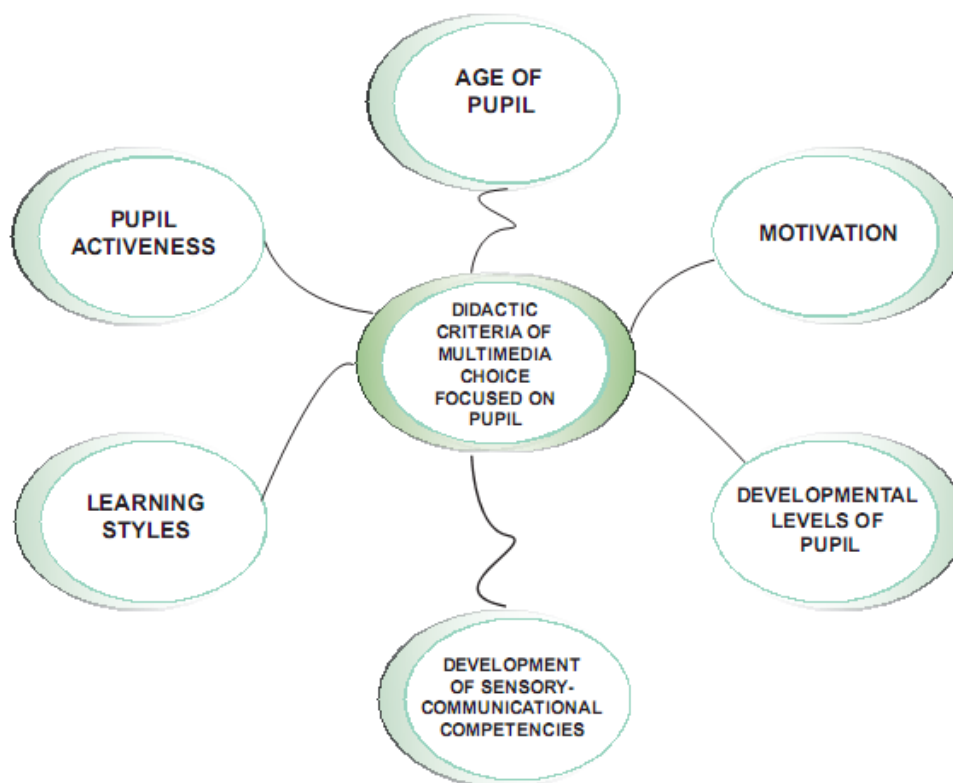
No explicit classification of criteria exists for choice and evaluation of multimedia; criteria are constantly being updated in line with changes of contemporary didactic developmental trends. Apart from this, regardless of the fact that criteria of multimedia choice are divided into certain categories, they are in an interactive relationship, which means that they mutually penetrate and condition each other. "Choice of teaching resources is a complex problem and is not only the subject of pedagogy, communicational science, sociology or economy." (Plut, 1980, page 60) This means that breadth of knowledge and action towards interdisciplinary approaches is expected from the teacher, as the leader in the teaching process, both in the choice of multimedia and other teaching devices and aids as well as in the teaching strategy. Therefore, these criteria are only an incentive for further reflection. With regard to the complexity of the teaching activities, there is no ready-made recipe which is applicable for all pupils equally. "Didactics of media will never succeed (nor do they strive to) in prescribing what media will be used and when. Finally, in each pedagogical situation, several different approaches and solutions can be found, taking into consideration previous factors." (Bognar and Matijević, 2005, page 351). Therefore, it is logical to focus research on the characteristics of media and multimedia, redefine their didactic-technical specific qualities, in line with contemporary technical formation and inventions on the one hand and with teaching strategies on the other hand; it would be interesting to research further the connection of multimedia and their effectiveness in achievements of pupils.

It is important to emphasise that didactic criteria for choice of multimedia in teaching also applies to choice of media in teaching with the remark that there are differences in their specific qualities. Apart from the fact that in all categories which contain the word *multimedia* the word *media* is replaced, there are differences in didactic criteria focused on teaching resources. While multimedia in a sensory-communication structure are composed of auditory and visual information, media can have only one information from the following: auditory, visual, kinaesthetic, taste, or olfactory. Apart from that, a quantitative structure of information is missing, as regards the relationship of two different (audio-visual) sensory channels of information, which is a specific quality of multimedia.

5.1. DIDACTIC CRITERIA OF MULTIMEDIA CHOICE FOCUSED ON PUPIL

Didactic criteria of multimedia choice focused on the pupil are established on the basis of requirements which result from children's development and their learning potential. The basic questions are: Is the chosen multimedia suitable for the age i.e. psychophysical maturity, previous knowledge and previous pupils' experiences? Do multimedia sufficiently stimulate the varied experiences of the pupil, are they interesting to the pupils and do they trigger their further willingness and interest to participate? Do multimedia satisfy the needs of all pupils in class?... Didactic criteria of multimedia choice focused on pupil, previously seeks answers to this and many other questions. Therefore, didactic criteria of multimedia choice which are focused on pupils comprise: age, motivation, developmental level of pupils, development of sensory-communicational competencies, learning styles and activity of pupils.

Fig. 28: Didactic criteria of multimedia choice focused on pupil



The guiding principle of stated didactic criteria is suitability of multimedia for the age and development of the pupil. The basic starting point is in the fact that classes are attended by pupils from the age of 6 to 11. The age of the pupil determines the choice of multimedia which should match precisely their age group. The younger the pupils, the greater the demand

for multimedia which contains concrete information. And inversely: the older the pupils, the greater the need for abstract information.

With other criteria which relate to the intrinsic nature of pupils' motivation, multimedia are chosen with regard to the stimulation of pupil's willing participation. "I wish, I want, I can" are basic assumptions of the willingness of pupil's learning, as without this multimedia cannot achieve its role in the teaching process. The willing participation of pupil in multimedia can strengthen creative external stimulation. Multimedia can play an exceptional role in motivating pupils for learning. Their dynamics break the monotony of teaching activities, attracting attention and engaging pupils in an active relationship in the process of teaching and learning.

With regard to the developmental level of pupils, the class structure is heterogeneous. Here we will not discuss low, average and high levels but it should be pointed out that every pupil has his/her own development level as well as different previous knowledge, potential, interests, experiences, working habits and abilities. This kind of differentiation among pupils determines their individual characteristics as well as the environment in which they interact and live (in accordance with the environment structure and based on the theory of ecological systems). Therefore, with these criteria we determined and choose the level of information "dosage."

Criteria of developing sensory-communicational competencies depend on the abilities of the pupil for reception and processing of information as well as their linguistic comprehensibility. The linguistic comprehensibility of multimedia applies to the ability of the pupil in decoding and coding of information, i.e. the ability to receive, modify and process information.

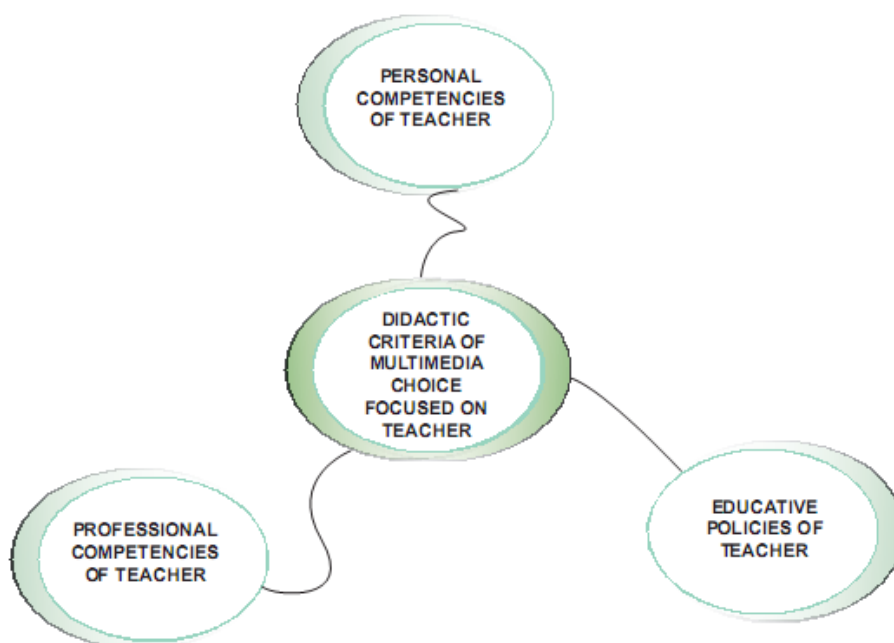
Multimedia have a deeper meaning in pupil's learning, in accordance with their learning styles. In order for pupils to develop, it is necessary to facilitate learning, not any kind, but in accordance with their different learning styles (one of the classifications is e.g. visual, auditory, verbal and kinaesthetic style of learning). Learning styles are connected with profiles of domination (cross-lateral and homo-lateral profiles) where they are correlated with the dominant sensory and dominant brain hemisphere. Therefore, the teacher should know the preferred learning styles of his/her pupils and, in line with this, choose multimedia which best suit them.

Audio-visual structure of multimedia is interesting in itself to the extent that it attracts the pupil's attention and creates external motivation. However, this is still not enough. The criteria of pupil activeness relates to the level of pupil activity during multimedia usage, from those that will passively observe the teacher's or other pupil's (as not every pupil has his/her own computer) multimedia usage to the level of independent multimedia usage where he/she will carry out his complete activity through solving problem assignments of multimedia educational back-ups and receive constant feedback information on his/her work. In this way, multimedia stimulate pupils to participate.

5.2. DIDACTIC CRITERIA OF MULTIMEDIA CHOICE FOCUSED ON TEACHER

Didactic criteria of multimedia choice focused on the teacher relate to his/her competencies. The most common questions are: What kind of opinion does the teacher have about multimedia usage? Is the teacher trained for multimedia usage? Which types of multimedia has the teacher used and for what purpose? The didactic criteria of multimedia choice focused on the professional competencies of the teacher are divided into: personal and professional competencies of the teacher and the educative policies they implement.

Fig. 29: Didactic criteria of multimedia choice focused on teacher



The personal competence of the teacher is also orientated towards multimedia choice in such a way that the conditions of everyday “work on him/herself” are imposed. In this manner, the teacher becomes positively orientated, open to new knowledge, patient, creative, inspiring, willing and full of working enthusiasm. The aims of the class are thus more easily accomplished as well as creating a choice for multimedia usage in class.

Professional competence can be added along with personal competence, as the personality of the teacher creates his/her professionalism. The teacher’s professional competence covers his/her understanding of multimedia, viewpoints on multimedia, training for multimedia usage as well as training for multimedia usage in teaching strategies.

Understanding of multimedia imposes an obligation on the teacher to keep abreast of the latest technical achievements and acquire knowledge on their capabilities and the impact of their usage in learning. The level of knowledge on multimedia influences the viewpoint of the teacher towards multimedia, and can be at different levels: from extremely negative, neutral and extremely positive.

The teacher’s training for multimedia usage is an exceptionally important criteria as it depends on the viewpoints of the teacher towards multimedia. If the teacher’s viewpoints are positive on the significance and role of multimedia in teaching, it is assumed that they will be used in class and then orientated towards more successful pupil learning.

The teacher’s qualification is shown through his/her professional activity. Such work includes training for didactic-methodical multimedia usage as well as skill of handling teaching tools and aids. The teacher’s level of training can relate to the efficiency of the teacher’s work and multimedia usage. Controversies about whether the computer can replace the teacher are superfluous? “The computer is still only a machine. It cannot replace the touch of a hand, smile, confidential conversation, however much it may try. The computer cannot resolve the emotional problems and difficulties of the pupil or give them support in conflicting emotional situations instead of the teacher.” (Itković, 1997, page 283) What distinguishes the computer from the teacher are the teacher’s personal competencies, qualities which the computer does not have. The main role of the teacher in class is to lead activities. Among other things, he/she provides conditions for multimedia usage in the sense that he/she enables the most favourable choices for pupils and the most effective ones for learning. The teacher focuses didactic-

methodical multimedia usage on devising teaching strategies that encompass teaching elements such as: pupils (their experiences, abilities, potentials, interests and previous knowledge), ability to use multimedia and other, aim and tasks, teaching contents, methods and teaching techniques, social forms of work, stages of learning, available teaching tools and aid etc.

The educative policy of the teacher is the viewpoint which the teacher has about teaching and in class. Therefore, the teacher can achieve a contemporary or traditional approach to pupils, as well as devising teaching strategies and, finally, hold classes. The traditional approach to pupils is formal and based on the obligation for complete execution of the teaching curriculum. Such an educative policy of the teacher is reflected in non-usage or weak usage of multimedia in class for various “justifiable” reasons. The contemporary approach to pupils is focused on the developmental achievement of the pupil. Class is carried out through a flexible approach to the teaching curriculum as well as openness of the teacher for usage of modern teaching tools and aids, among which are multimedia.

Didactic criteria focused on the teacher are important because the teacher’s decisions depend mainly on *if such* and *which* types of multimedia, *when* and *with what purpose*, will be used in class.

5.3. DIDACTIC CRITERIA OF MULTIMEDIA CHOICE FOCUSED ON MULTIMEDIA

Didactic criteria of multimedia choice, as sources of learning and teaching, relate to their formation, structure, choice i.e. usage value. The most common questions that arise are: How complex is multimedia usage? To what extent does multimedia contain information which needs to be transmitted to pupils? How credible is multimedia information etc.? The starting basis for this classification is provided by P. Plut’s research (1980, pages 59 – 60), which gives the characteristics of teaching resources important when choosing them:

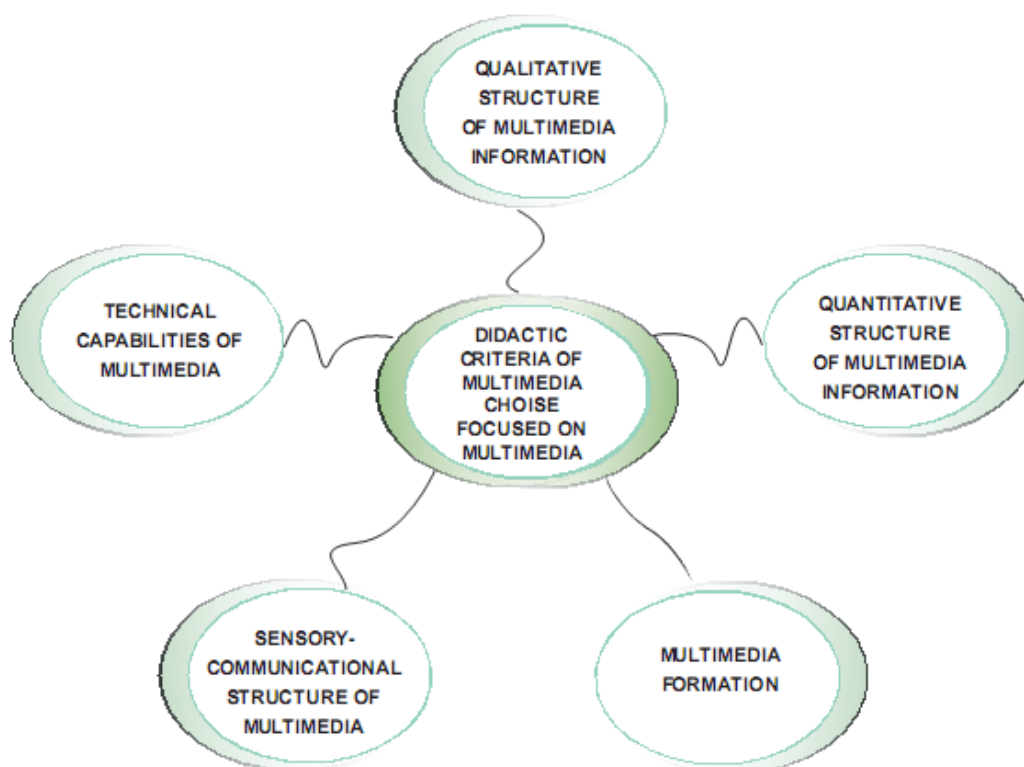
1. “Characteristics which determine the form of information: words, numbers, images;
2. Characteristics which determine the credibility level of information: colour, movement, number of recorded pieces of information, dimensionality of occurrences;

3. Characteristics which determine the modality of information with regard to the sensory channels: auditory information, visual, tactile, combination of different modalities;
4. Characteristics which determine pupil's participation in the process: openness to participate, silent observation, active following with answering (writing, reading and drawing);
5. Characteristics which determine the duration of presented information in the teaching process: possibility of individual following and returning to certain parts (comparison of books and films), possibility of flexibility of teaching devices, possibility of respecting each individual's working rhythm.
6. Characteristics which determine the teacher's role in the teaching process: provide total or partial control and information which he/she mediates; teaching devices determine teaching methods and strategies of the teaching process."

The fourth characteristic which determines the pupil's participation in the process focuses the choice of teaching devices on the level and form of pupils' activities. The fifth characteristic, duration of presented information in the teaching process, also depends on the developmental levels of the pupils, as well as characteristics of the teaching devices. The sixth characteristic relates to the teacher's professional competence, more precisely, his/her teaching strategic role.

The basic criteria of multimedia choice focused on multimedia are: sensory-communicational structure of multimedia, multimedia formation, quantitative and qualitative structure of multimedia information, as well as the technical capabilities of multimedia presentation.

Fig. 30: Didactic criteria of multimedia choice focused on multimedia



The criterion of sensory-communicational multimedia structure brings the world in which we live, have lived, will live, a little closer to pupils along with the world of imagination. This criterion defines the rule that every multimedia contains information which can be acquired through auditory and visual senses in various forms of their synthesis. Therefore, the criterion of sensory-communicational multimedia structure is the vital importance which is contained by all multimedia and by which they differ from media. Pupils watch with their eyes and listen simultaneously with their ears and store the received information short-term or long-term, when information is acquired through a longer time period or for ever. In order to ensure that pupils acquire important information, it is necessary to repeat it more often.

The next criterion of choice relates to the type of multimedia, taking into consideration its formation. Multimedia can be a ready-made, bought product or pupils, teacher, parents and others develop it for the requirements of the class. All stated types of multimedia can be useful and effective.

Quantitative multimedia structure is a criterion by which we evaluate the amount of auditory and visual information in a multimedia combination. In a multimedia combination, every

medium has to have its didactic meaning and there should not be an overload of multimedia information. Multimedia interactivity is a significant element in relation to pupils. The more direct feedback information the pupils have, the clearer their achievements are.

The criterion of evaluating the qualitative structure of multimedia information relates to semiotics and aesthetics of multimedia formation. The didactic significance is that multimedia is semiotically and aesthetically clearly and harmoniously formed and in this sense there should not be multiply-significant messages if pupils are led in one, specific direction. Pupils are trained for correct usage of numbers, letters, speech and symbols. It is also essential to adapt the level of abstract multimedia messages so that the pupils can successfully decode them. Multimedia features are important for the credibility of information as they aspire to bring the truth closer through: precision of data, quality of sounds, colour, animation, video-recordings etc.

The technical capabilities of information presentation imply how the simplicity level of usage as well as the possibilities of multimedia usage are in accordance with the level of competence of the person using it. The technical capabilities of presentation relate to the level of development of technical media and multimedia. Obsolete technology is replaced by new. Today's computer represents a former synthesis of magnetophone, slide projector and electric typewriter (Mužić and Rodek, 1987, page 63). The technical possibilities of the computer and concept of multimedia, apart from the pupil, impact on the speed of execution or its duration, facility and simplicity of manipulation and their usage.

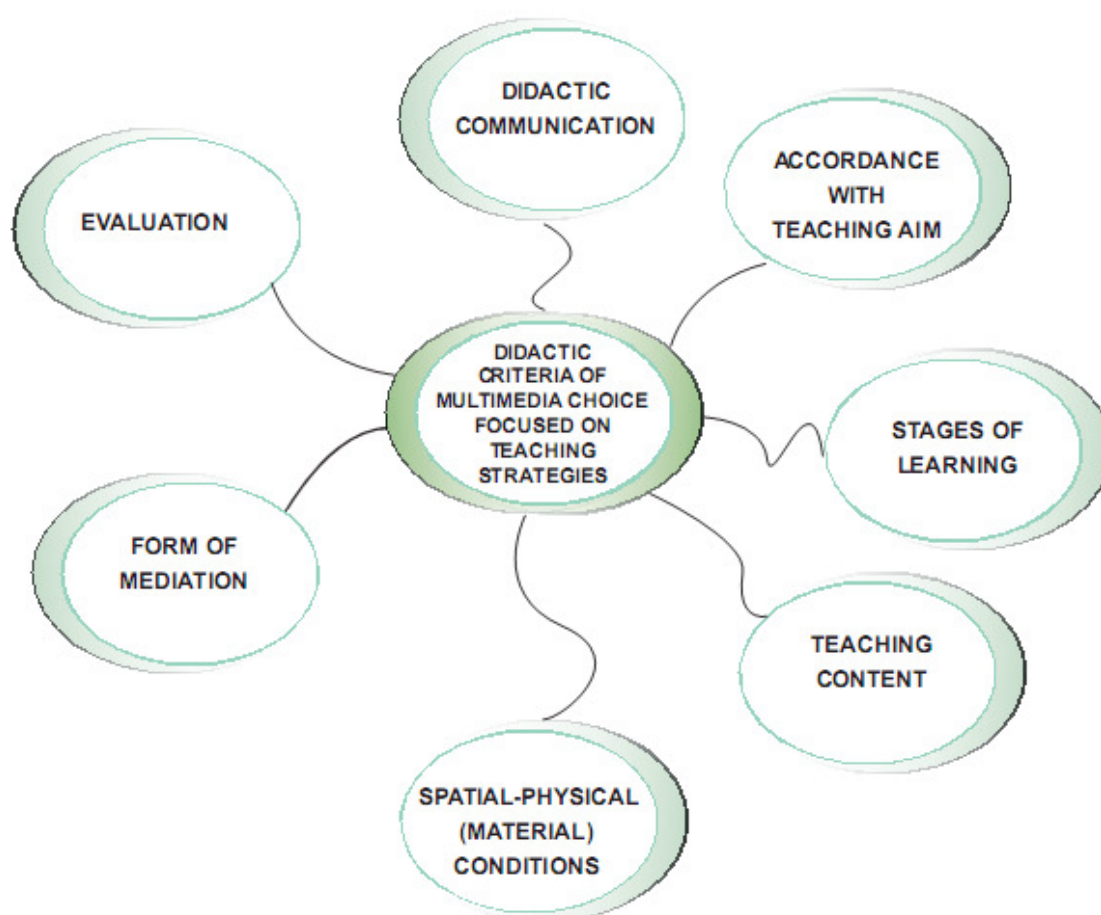
5.4. DIDACTIC CRITERIA OF MULTIMEDIA CHOICE FOCUSED ON TEACHING STRATEGIES

The didactic criteria of multimedia choice focused on teaching strategies are made up of structural elements of the didactic-methodical field. In determining didactic criteria, the most common questions are: Have the chosen multimedia achieved the teaching aim? Was the chosen multimedia more suitable for interpretation of the teaching content than all others, or a different teaching device would be "better" in future? Were the pupils given the possibility for independent work and to what extent were they independent in learning? "In a didactic sense, the sources will be incomplete if only some cognitive elements are shown directly and the

remaining indirectly. On the other hand, there will be a qualitative source of knowledge in class if the facts and generalisations of pupils are shown directly, explicitly, completely, adequately, accessibly and well laid-out, and this is, in fact, the purpose of didactic formation of teaching devices as sources of knowledge. Therefore, from these positions of evaluating a teaching device as a source of knowledge, i.e. is it complete or incomplete, adequate or inadequate, accessible or inaccessible to understanding, logically systematised or non-systematised, and also if the facts and generalisations are expressed directly (explicitly) or indirectly (implicitly) depend on whether learning with the aid of teaching devices will be successful or not.” (Potkonjak et al, 1989, page 95)

Didactic criteria of multimedia choice focused on teaching strategies are classified into: didactic communication, accordance with the teaching aim, stages of learning, teaching contents, suitability of room for multimedia presentation, form of mediation in multimedia presentation as well as evaluation of teaching strategies.

Fig. 31: Didactic criteria of multimedia choice focused on teaching strategies



The first criterion relates to didactic communication i.e. harmonisation of multimedia with teaching methods, techniques of teaching and social forms of work. The content-related specific qualities of multimedia necessitate the choice of specific teaching methods, techniques of teaching, social forms of work and vice versa. Multimedia contribute to the differentiation of the teaching process in class at several levels because they stimulate individualisation that enables different paces of learning. This criterion makes sense as its aim is, in the long run, for all pupils to successfully complete the given assignments.

In accordance with the teaching aim, the following criterion applies. The teaching aim is one of the greatest guidelines for multimedia choice if it is based on the developmental achievements of pupils. The concept of multimedia itself is devised to stimulate development: knowledge, ability, skill, habit and viewpoint. Thus, multimedia with its characteristics provides the possibility of facilitating the pedagogical-educational achievement of pupils.

Learning stages represent a didactic criterion of multimedia evaluation which emphasises the significance of individual stages in acquiring information. The didactic criterion of multimedia evaluation can be analysed “for studying, where the pupil is presented with information and examples, and subsequently is given a problem to solve... The program of exercising or repetition comprises the presentation of information in the form of tasks which the pupil solves with limited time, after which he receives feedback information on his work.” (Itković, 1997, page 282) Through every stage of learning: evoking previous knowledge, learning new contents, practising, repeating and testing, multimedia, similar or different, can be included in the teaching activity.

With the criterion of multimedia choice in relation to teaching content, insight is gained into the quantity and quality of chosen contents in the multimedia usage, which must be in accordance with the teaching program of each individual class subject. Likewise, it is desirable to use multimedia where correlativeness of content is manifested.

Spatial-physical (material) conditions make up the criterion within the framework which can be observed e.g. suitability of space for multimedia presentation. The classroom is a working area which has to satisfy the functional, pedagogical, health-hygienic, aesthetic and ecological criterion of multimedia usage. Modernisation of school and surrounding area represent the external stimulation of learning. One of the basic conditions of work is light. The major part

of teaching should be conducted in natural light. If artificial light is used, it should be high quality. Shadowing i.e. darkening the classroom for multimedia usage must be easily accessible and easy to carry out. In this connection, attention should be paid to choice of colours which lend the working area a feeling of comfort, airiness, relaxation and working élan. The colour of walls influence the mood of people as well as the working performance. The introduction of electric lighting in the area implies a required number of sockets suitably laid out, among other things, for usage of computers. Moreover, it is necessary to have satisfactory heating or air-conditioning of the room. The stated conditions determine the circumstances in which multimedia is used. Attention should be paid to the working area during class as it imperceptibly plays a key role in the pedagogical-educational process.

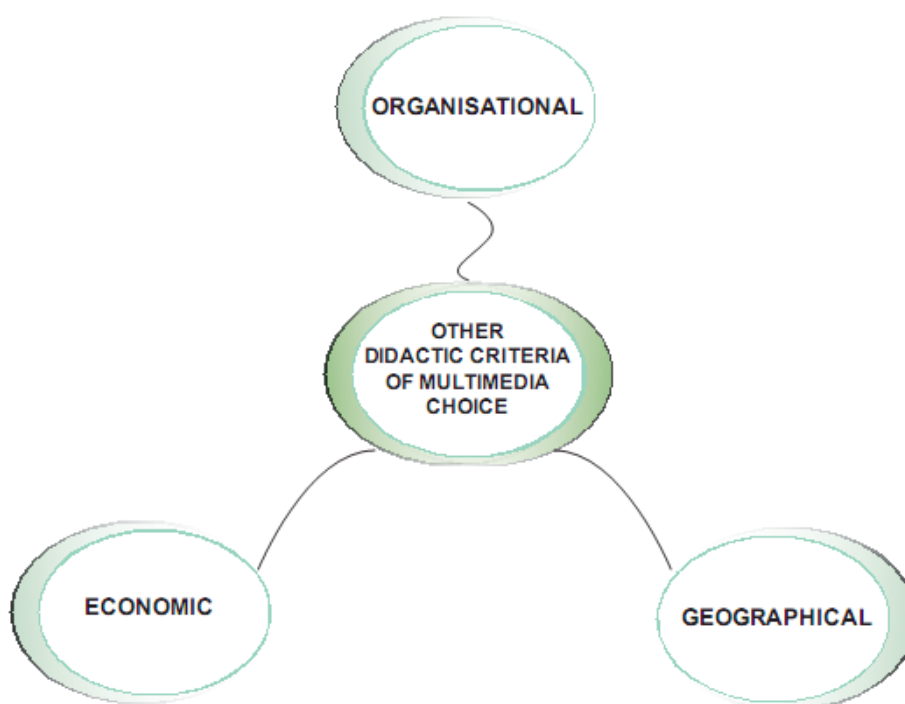
The form of mediation of multimedia presentation relates to the person or persons who manage the multimedia. That can be: the pupil, teacher, qualified staff member etc. This is an important criterion for multimedia choice as the role of pupils in multimedia usage i.e. level of their activities, should be anticipated in advance.

Evaluation of teaching strategies is a regulator in creating new teaching strategies. Part of the evaluation of teaching strategies relates to the evaluation of multimedia usage in the class. The aim of this criterion is in discovering and using those multimedia that create the greatest achievement with pupils in the process of teaching and learning. Positive experiences of multimedia usage are implemented in new teaching strategies, while negative or less effective ones are removed and substituted with better ones. With this in mind, the efficacy of multimedia is researched and priorities are determined with those that give better results. In this respect, it is important to review the correlation of multimedia with other elements of the didactic-methodical field, because regardless of the quality of the multimedia, their total specificity can influence a greater or smaller achievement in learning.

5.5. DIDACTIC CRITERIA OF MULTIMEDIA CHOICE FOCUSED ON OTHER FACTORS

The didactic criterion of multimedia evaluation focused on other factors relates to elements which are not components of the didactic-methodical field but nevertheless can influence the choice of multimedia. The most common question in practice is: How much money does the school have for purchase of multimedia? The didactic criterion of multimedia choice focused on other factors are divided into: organisational, economic and geographical.

Fig. 32: Other didactic criteria of multimedia evaluation



The organisational criterion is reflected in the organisation of work which includes multimedia usage. One of the basic questions is: do pupils in class have one or several computers in their classroom or they do not have even one - has provision for computer usage in the computer science classroom in school already been made? This question can be linked to the following: if pupils use computers in the computer science classroom, is there a time constraint with their arrival, given the schedule of the presence of pupils from different classes in the computer science classroom?

The economic criterion of multimedia choice determines its cost and manner of purchase. In accordance with the money available, the school decides on a cheaper or more expensive

model of computer and multimedia educational back-ups. With purchase, the school can obtain computers and multimedia sponsorship through participating in competitions and prize contests.

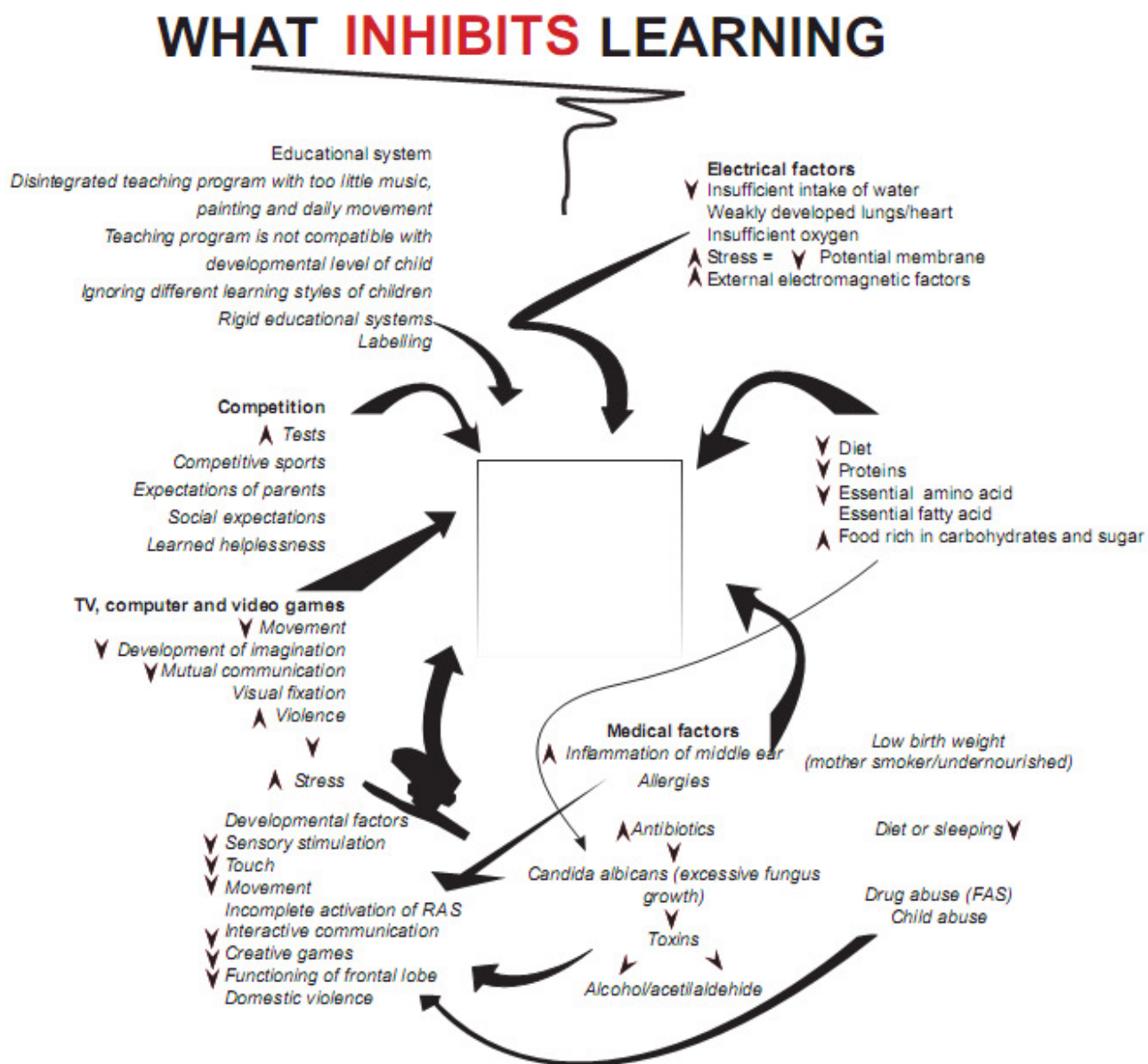
The geographical criterion depends on the location of the school in a place. Very often it does make a difference whether a primary school is built in an urban or rural area. Schools in smaller “backwaters” have relatively fewer possibilities of choice for purchase of multimedia when compared to schools where there are one or more shops offering options for purchase of computers and multimedia educational back-ups. *Relatively* fewer possibilities of choice have deliberately been emphasised, as in today’s world buying over the internet is more and more common, but the buyer is deprived of personal contact with the goods prior to purchasing them. In rural areas, ADSL is often not accessible and thus it is not possible to set up video communication, only textual or audio communication of lower quality.

5.6. EMPOWERING AND INHIBITING ELEMENTS OF LEARNING IN MULTIMEDIA USAGE IN TEACHING

Empowering and inhibiting elements are important for multimedia usage in teaching. They influence the quality of learning. If the didactic criteria of multimedia evaluation are respected, they become empowering elements of learning. The advantages of multimedia learning are based on interdisciplinary knowledge. The didactic-methodical advantages provide for a higher level of interest and dynamics of learning, duration of knowledge as well developmental didactic-methodical competencies of the teacher. Psychological advantages occur through providing a more effective motivation of the pupil through stimulating audio-visual sensory channels. Multimedia display of information is more deeply etched in the mind of the pupil. Pedagogical advantages are based on new forms of training the pupil for life-long education through various forms of individual and individualised learning. Gnostic advantages are manifested in various aspects of providing information, when compared to those which are mediated through only one sensory channel. Social advantages are manifested through easier furnishing of and accessibility to new information to a large number of people.

On the other hand, non-respect of didactic criteria elements of multimedia evaluation become elements that inhibit learning. In the teaching practice, there is the possibility of discovering the negative side of applying multimedia in class. This happens in the event of insufficiently developed didactic-professional competencies of the teacher as a result of deficiency of knowledge. In other words, ignorance or non-respect of didactic criteria of multimedia choice in teaching can trigger the opposite desired effect – ineffective teaching. Fig. 32 shows basic elements that cause stress and inhibit the success of the pupil in learning: the educational system, competition, multimedia (television, computer and video games), developmental elements, electrical elements, diet and medical elements.

Fig. 33: Inhibiting elements of learning (Hannaford, 2007, page 147)



From the stated elements, those which relate to the didactic-methodical approach will be observed. A rigid educational system is composed of rudimentary remains of traditional teaching as consequences of lower consciousness of the structure which places it on levels of a mezzo-system to macro-system. So in practice there is a curriculum with too little music, painting and physical education. The vicious circle is closed by rigid teachers who blindly follow “directives from above”. The solution to this problem is seen in a teacher who will consciously and through a contemporary professional approach remove the stated flaws and moreover transform them according to the pupils. Therefore, the lack of sensory stimulation, movement, creative games and communication, is stimulated by the teacher to the level of the pupils’ needs. Multimedia also can be an inhibiting element in learning when they are not used in moderation, thus suppressing the pupils’ need for movement, interactive communication, development of imagination, and most of all in displaying violence which evokes anxiety and stress in pupils. This is why, again, the role of the teacher is emphasised.

With regard to didactic criteria of choosing multimedia which are stated, elements of didactic criteria are geared towards: the pupil (age, intrinsic motivation, previous knowledge and experiences of the pupil, development of sensory-communicational competency, learning styles, activeness of pupil), the teacher (personal and professional competencies e.g. viewpoints on significance and role of multimedia, teacher’s skills in using multimedia, teacher’s skills in using teaching strategies), multimedia (sensory-communication structure, form, qualitative and quantitative structure, technical abilities for presenting content) and teaching strategies (didactic communication, accordance with teaching aim, phases of learning, teaching contents, suitability of room for multimedia presentation, form of mediating by multimedia presentation, suitability of learning and evaluation of effectiveness of multimedia and teaching strategies). In the previous sections, these elements are described as empowering. Therefore, in this section several examples will be mentioned which describe what happens when didactic criteria are not respected in choosing multimedia, but perform as inhibiting elements.

If the multimedia is not suitable for the psychophysical development of the pupil, it does not fulfil basic didactic-methodical laws, nor laws of developmental psychology. Unsuitable multimedia can be “too easy” – so that pupils are bored or “too heavy” – so that pupils do not understand the multimedia information at all. If multimedia is not understandable to pupils, it should not be used for teaching purposes. Therefore, there is a necessary condition for using

those multimedia which have suitable content i.e. information. Multimedia will not achieve its purpose if pupils do not have enough enthusiasm for participating in learning. Certain previous knowledge and experiences of the pupils can also inhibit pupils in learning. For example, low level of knowledge of the English language can inhibit a pupil in using an educational back-up. All pupils in the class are not equally competent in receiving and processing information. Because of different development of sensory-communicational competencies, pupils in class differently receive and process information. Because of this, they learn in individual ways and achieve various results. A great inhibitor in using multimedia can be the negative attitude of the teacher towards multimedia. Autocensorship can block the teacher since e.g. the teacher is not “stimulated” to make an effort in getting a new multimedia for usage in class, because of “small salaries”, “there are no conditions” for that type of work in classroom or he/she is not sufficiently educated or fully aware of the significance of multimedia teaching and learning through multimedia teaching strategic activity. The Canadian sociologist, Marschall McLuhan (2008, page 22) emphasised that every communicational resource (media or multimedia) impacts on the way of thinking, regardless of the content which is presented: “The impact of media is powerful and deep precisely because as a content, it is given another media. The content of a film is a novel, drama or opera. The effect of film form is not linked with its program content.” Such a viewpoint supports the fact that attention should be focused on choice of communicational devices but in their different usage.

Sensory-communicational structure of multimedia triggers two different senses. Multimedia have no sense when their overloading of information can cause weaker impact of learning. A qualitative structure of information of multimedia can fail if multimedia are not semiotically clear or instead of aesthetic messages, they verge on kitsch . “It is a particular problem also, needless to say, from a pedagogical aspect most of all, when children in experiencing film or television images come face to face with numerous obstacles which hinder understanding of the plot: tempo and the semantic level of titles, semantic level of spoken dialogue, structures of subject, condensed space and time, speed of change of scenes, tricks, identification of numerous characters, relationships among actors, movement of camera, non-linear editing etc.; children up to ten years old identify objects, action and faces on the screen and so through their own construction, the familiar images and scenes are linked by them into a whole unit and work, i.e. what is recognised is transformed into the familiar and understandable with those they find personally pleasing. This *illusion* of understanding,

unknown in relation to children vis-à-vis works of literature, very often leads to children, more or less, *seeing* one thing and *understanding* something else: lack of understanding or misunderstanding of film or television program prevents them from experiencing. The consequences are twofold: in the aesthetic sense, the artistic function of the work is suppressed; in a pedagogical sense, the work has poor impact (eventually undesirable) on young viewers.” (Plemenčič, 1982, pages 18 – 19) The technical capabilities of multimedia presentation can fail just at the moment when the pupils have been prepared for viewing. (e.g. it happens that the LCD projector does not present educational software from the computer on to the projection screen etc.). All complicated solutions of multimedia usage or their formation, which can be potentially dangerous for health or injury to pupil, should be avoided in class.

With regard to didactic communication, certain multimedia require usage of certain methods and social forms of work. It is difficult to ask pupils to complete tasks of some education back-ups if there are 5 parts in the third grade with 30 pupils, 3 computers and team work! Such a teaching strategy must be changed. The pedagogical-educational achievement impacts on choice of multimedia. On the other hand, multimedia is used because of the media appeal itself, which is not consistent with the aim or does not have one. Then we speak about technicism or its mechanical usage. Insufficiently heated (insufficiently ventilated) space, non-airiness of the classroom, insufficient or inadequate lighting, size of room.....can also affect the working activity but also the health of the pupils and teacher. The person who mediates with multimedia presentation can, due to his/her clumsiness, draw attention of the pupils into an undesirable course. Lack of implementation of evaluation cannot give feedback information on which multimedia, when, with which pupils, which aim, to prepare in subsequent teaching strategies.

We can conclude that respecting elements of the didactic criteria enables correct usage of multimedia in teaching. The aim of multimedia usage is thus achieved: they impact on the developmental achievement and changes in the pupil. Non-respect for elements of didactic criteria create inhibiting elements in which multimedia usage does not achieve the expected pedagogical-educational aims.

6. PROBLEM, AIM AND TASKS OF RESEARCH

6.1. PROBLEM

The last century was marked by the appearance of: sound film after the 1st World War, television in the fifties and the computer, which has a wide usage in households and schools from the seventies (see theoretical part under the heading: film, television, computer). As teaching devices appeared, so did the need to study their possibilities as well as to research their impact in learning and their usage in teaching. So in the theoretical part of the paper, the taxonomy of media and their representatives are mentioned: Dale, Gagne, Briggs and Edling. Also the only-found taxonomy of multimedia is mentioned: Rachele, Martin, Haneef and Gievska-Krlju. This taxonomy represents the basis for systematisation of media and multimedia, with regard to their characteristics and gives a clear vision of the possibilities of usage. In this connection, attention should be paid to conditions in which media and multimedia create advantages and disadvantages in usage i.e. conditions in which media and multimedia have a positive or negative role. This information is very important in creating teaching strategies where all structured elements of the didactic-methodical field create inter-dependent relations. Therefore, the didactic criteria for multimedia choice are given in the theoretical part of the paper, together with the basic guideline in creating teaching strategies.

The problem of research is located in the examination attitudes of the teacher and pupils in relation to multimedia in teaching and their usage. This concerns the applicatory research which aimed to obtain feedback information on the state of multimedia application in primary school classes in the Republic of Croatia. The research is focused on carrying out teaching in the classroom where the main teaching facilitators are the teacher and the pupils from the second to the fourth grade of primary school. Classes are made up of heterogeneous groups of pupils (gender, different developmental potential of pupil learning, learning through different styles...). It is assumed that multimedia usage enables successful learning to all pupils in the class, consistent with their individual potentials. In this connection, the complexity of the problem must be emphasised as multimedia have different impacts on pupils. In information transfer, the involvement of the pupil is important i.e. his/her active relationship, intensive work, motivation, previous knowledge and development potentials. The teacher plays the basic role in the pupil's learning success and, among other things, an inclusion of choices and usage of those multimedia that will enable the most significant impact in learning, is expected

from the teacher. It was also interesting to study the physical material surroundings in which the teaching is held. The multimedia equipment of the classroom i.e. teaching tools and aids which represent a source of information to the pupils, can create a rich motivational, creative environment in which the pupils learn. However, the fact that the class is well-equipped with multimedia, does not always guarantee that pupils will automatically obtain new insights or be successful in learning.

On the basis of the previous and this research, the following has been made: display of classification of media with regard to the type of sense, a poly-factorial model of teaching as well as didactic criteria for choosing and using multimedia in teaching. All three mentioned scientific products can be implemented in teaching generally. Thus, a contribution is made to science in a clearer presentation of didactic possibilities of multimedia usage in teaching.

6.2. AIM AND TASKS

The purpose of this empirical research is to acquire knowledge on multimedia usage in classes of primary school in the Republic of Croatia. Insight into multimedia usage in teaching is intended to enhance effectiveness quality of teaching. Therefore, the aim of this research is to establish what the teacher's viewpoints are in relation to multimedia and in what way the teacher uses multimedia in teaching. The following tasks of research has been determined in accordance with the aim:

1. Analyse the Curriculum (2006) for teaching subjects in classes of primary schools in the Republic of Croatia, and by so doing, establish if the teaching contents cover the problem area of multimedia;
2. Check whether there is a plan or program for professional upgrading of school personnel in pedagogical-educational institutions from 2000-2009 i.e. in the Catalogues of professional conferences, within the framework of work content, themes of multimedia in teaching;
3. Choose schools in the county in which the research will be carried out;
4. Survey pupils and teacher of chosen schools (viewpoints of teacher and pupils on multimedia usage in teaching);
5. Process, analyse and interpret data obtained in all previous tasks.

6.3. RESEARCH QUESTIONS AND HYPOTHESES

Research questions

On the basis of the stated aim and research tasks, the following research questions were formulated:

1. Are multimedia represented in the teaching curricula of subjects in classes and in the program of professional upgrading of the Croatian teachers?
2. What type of media and to what extent does the teacher use it in class?
3. Does the teacher carry out evaluation of multimedia usage?
4. Which didactic criteria for multimedia evaluation does the teacher establish in his/her practical work?
5. Does the teacher consider what multimedia are equally suitable for all pupils or, to a different extent, suitable for pupils of various levels of achievement?
6. To which extent are elements which enable multimedia usage in teaching present and how are they linked to socio-demographic variables?
7. Which are the most common elements in multimedia usage which the teacher considers inhibiting in teaching?
8. What is the opinion of the teacher on the advantages and disadvantages of multimedia usage in class?

Hypotheses

1. As no research has been found dealing systematically with teaching curricula as well as a program of professional upgrading of Croatian teachers, the first research question is of an exploratory nature. Therefore, a specific hypothesis will not be formulated.
2. According to research to date, the least usage of olfactory and taste media is expected in teaching, while the greatest usage expected is auditory and visual media.
3. From a total number of teachers who use multimedia in teaching, a very small number of them carry out evaluation.
4. In evaluation, the teacher uses heterogeneous didactic criteria.

5. Mayer points out (2005, page 105) that pupils of least achievement who reach the greatest progress with application of multimedia in learning have the greatest use of multimedia. Because of lack of familiarisation of the teacher with contemporary knowledge on application of multimedia in teaching, it is expected that the greatest number of teachers will not comprehend the difference of multimedia application impact in teaching with pupils of various abilities.

6. It is assumed that the professional competence of the teacher is influential in enabling multimedia usage in teaching as well as his/her acquired knowledge, professional upgrading, level of school equipment. Because research linking professional competencies of teachers, their acquired knowledge, professional upgrading, level of equipment of school in the teaching practice of Croatian schools from the second to the fourth grade and the socio-demographic variables, affirmative hypotheses for this exploratory question will not be formulated.

7. It is expected that the greatest number of teachers will state as inhibiting elements a lack of multimedia in school as the basic problem.

8. It is assumed that the teacher will recognise the advantages of multimedia through their impact on the level of knowledge and motivation of the pupil. It is also assumed that lack of movement and socialisation will be the greatest problems in multimedia usage in teaching.

7. METHODS OF RESEARCH

Methods determined within the framework of the research plan were applied in the research and these are:

1. *Causal-non-experimental method* whereby the required information on multimedia usage in Croatian teaching practice was obtained empirically (ex post facto) on the basis of experience of teacher and pupils;

2. *Descriptive method* whose basic thrust was to find out the teachers' as well as the pupils' attitudes on multimedia usage in teaching (conditions of multimedia usage, the effect and evaluation of multimedia, physical/material surroundings...).

3. A more demanding statistical analysis was applied, i.e. *an analysis of contingency linking of nominal variables* (HI-square test) to the following questions from the teachers' questionnaire:

- Question C 6: Are you professionally trained for multimedia usage? The professional competencies of teachers for multimedia usage was checked with regard to their gender, age, working experience, educational qualifications, status, size and level of equipment of school;
- Question C 7: Where did you get knowledge for multimedia usage in teaching? Acquired knowledge on multimedia was checked in relation to their gender, age, working experience, educational qualifications, status, size and level of equipment of school;
- Question C 8: Which form of professional competence of teacher for choice and usage of multimedia do you propose? The relationship was checked between professional activities as well as form of teachers' professional upgrading and their gender, age, working experience, educational qualifications, status, size and level of equipment of school;
- Question C 9: Do you come across obstacles in multimedia usage..? The relationship of lack of multimedia in school as the greatest inhibiting element was checked as well as gender, age, working experience, educational qualifications, status of teacher, size and level of equipment of school;

And questionnaire for pupils:

- Question 7: Which teaching tool and aid do you love the most? The pupils' preference for teaching tools and aids in relation to gender of pupil, their grade and size of school was checked.

7.1. PROCEDURES AND INSTRUMENTS USED

From procedures for collecting data and instruments, the following were used:

1. An analysis of written document contents (Curriculum for Primary Schools of the Republic of Croatia (2006) and Catalogues of Professional Conferences of Teachers (2002 – 2009));
2. Questionnaire for class teachers;
3. Questionnaire for pupils of the second, third and fourth grades of primary schools

A poll was taken on teachers' and pupils' questionnaire in several primary schools of Rijeka as well as with students on further training for class-teaching at the Teacher Training Faculty in Rijeka. On the basis of feedback information received, teachers' and pupils' questionnaires were further modified with the aim of clearer answers of teachers as well as easier classification of same.

Measuring characteristics of questionnaires were checked on the basis of an analysis with the aid of suitable statistical procedures:

Objectivity was high with the questionnaire as detailed instructions for its execution existed. As regards evaluation of replies, objectivity was also high as precepts and categories on the objective scale type, which were unequivocal and quite clear, had been drawn up. The problem of objectivity appeared in open type questions. To meet the criteria of objectivity, assessors classified replies in the category.

Discriminatorial was established by Ferguson's coefficient as well as the descriptive statistics of obtained data. Ferguson's coefficient $\delta = 0.90$ and higher was considered acceptable.

Reliability was tested on individual groups with the question for which it was assumed that it made up one scale. The coefficient of Cronbach's internal coexistence which was acceptable from $a = 0.70$ and higher was calculated. For other questions, their connection with similar questions in the survey i.e. for those for which it was assumed that replies had to be consistent.

Validity of the survey questionnaire was valid as respondents' replies to a great extent gave those data which were needed.

Economical quality is based on a group-surveyed population of subjects which rationalised time of execution. Evaluation of replies was also quick and simply carried out.

7.2. VARIABLES

For a clear conception of research as well as processing and interpretation of results, independent and dependent variables of monitoring were determined in the survey for teachers and pupils.

Table 6: Survey for teachers, independent and dependent variables used in work

INDEPENDENT VARIABLES	DEPENDENT VARIABLES
Data on teacher:	level of information of teacher on multimedia usage
age	professional competence for multimedia usage
gender	frequency of multimedia usage in teaching
years of working experience	reasons for rare or non-usage
level of education	frequency in use of various teaching media of different sensory areas in all class subjects
status of teacher	combination of multimedia
employment	teacher's inhibiting factors for usage of teaching media
Data on school:	time needed for carrying out preparation in which multimedia is used
class	effectiveness of multimedia teaching in comparison with monomedia
size of school	pupil activity with multimedia usage
level of equipment of school	pupil motivation with using multimedia
education level of teaching media	leading multimedia presentation
	need for qualified personnel in handling multimedia presentation
	forms of professional training of teacher for application of multimedia in teaching
	aim of class work with pupils
	suitability of teaching content for multimedia usage in class
	teaching methods for multimedia usage
	sociological forms of work with using multimedia in teaching
	choice factors of media in teaching
	evaluation of choice of multimedia in teaching
	age of children in introducing multimedia in the pedagogical-educational process
	advantages of multimedia usage in teaching
	disadvantages of multimedia usage in teaching
	sensory area of obtaining information
	success of pupil in class
	methods of teaching pupils
	suitability of multimedia teaching of pupils

Independent variables relate to data on teacher and data on school. Data on teacher contain: age, gender, years of working experience, level of education, status of teacher and permanent or occasional employment. Data on school cover: class, size of school, level of equipment of

school with teaching media and reasons for poor equipment of school with teaching tools and aids.

Dependent variables were viewpoints of teacher on: pupils, multimedia, his/her choice, usage as well as relationship with elements of multimedia teaching strategies: information level of teacher on multimedia usage, professional training for multimedia usage, frequency of multimedia usage in teaching, reasons for rare or non-usage of multimedia in teaching, frequency of various teaching media of different sensory areas in all class subjects, combination of multimedia, teacher's inhibiting factors for usage of teaching media, time needed for preparation in which multimedia is used, effectiveness of multimedia teaching in comparison with mono-media, pupil activity with multimedia usage, pupil motivation with multimedia usage, leading multimedia presentation, need for professional personnel for handling multimedia presentation, forms of professional training of teacher for application of multimedia in teaching, aim of class work with pupils, aim of multimedia usage in teaching, suitability of teaching content for multimedia usage in teaching, teaching methods for multimedia usage, sociological forms of work with multimedia usage in teaching, choice factors of media in teaching, evaluation of choice of multimedia in teaching, age of children for introducing multimedia in pedagogical-educational process, advantages of multimedia usage in teaching and the disadvantages of multimedia usage in teaching. Teacher's data on pupils related to: sensory area of receiving information, success of pupil in class, method of teaching pupils and suitability of multimedia teaching of pupils.

Independent variables contained data on: class, age and gender of pupil.

Table 7: Survey for pupils, independent and dependent variables used in work

INDEPENDENT VARIABLES	DEPENDENT VARIABLES
Data on pupil: class, age and gender	experience of school
	general success in previous school year
Data on school: class, size of school, level of equipment of school with teaching media	pupil's marks from all subjects in previous school year
	preference for teaching tools and aids
	activeness in class
	understanding of teaching content
	frequency of usage of teaching tools and aids

Dependent variables cover teacher's viewpoints on teaching: experience of school, general success in previous school year, pupils' marks from all subjects of previous school year, usage of teaching tools and aids in teaching, activity in class, understanding of teaching contents, frequency of usage of teaching tools and aids and factors of success of all pupils in class. The cross-reference plan encompassed cross-referencing within dependent and independent variables of the survey for teachers and dependent and independent variables of survey for pupils.

7.3. RESEARCH SAMPLE

In every county (Zagreb, city of Zagreb, Krapinsko-Zagorska, Sisačko-Moslavačka, Karkovačka, Varaždinska, Koprivnička-Križevačka, Bjelovarsko-Bilogorska, Primorsko-Goranska, Ličko-Senjska, Virovitičko-Podravska, Požeško-Slavonska, Brodsko-Posavska, Zadarska, Osječko-Baranjska, Šibensko-Kninska, Vukovarsko-Srijemska, Splitsko-Dalmatinska, Istarska, Dubrovačko-Neretvanska, Međimurska) one primary school was designated, where two teachers of the second, third and fourth grades as well as their pupils were questioned. The primary schools were chosen through a random sample. The research

sample was made up of 1,495 subjects of which 126 were class teachers and 1,369 pupils from their classes. The survey was carried out during 2006.

7.3.1. Subjects

The teachers were questioned randomly in each school in each county. In each school, two class teachers of the second, third and fourth grades and their pupils were chosen. Altogether 126 teachers and 1,369 pupils of the second, third and fourth grades were questioned.

Teachers

The subjects were different ages. The youngest teacher was 22 years while the oldest was 64 years old. Age structure of teachers was significantly different. The table below shows results of age of teachers questioned:

Table 8: Age of teacher

<i>Age of teacher</i>	<i>f</i>	<i>f%</i>
Up to 30 years	24	19.1
From 31 to 45 years	60	47.6
From 46 and higher	42	33.3
<i>Total</i>	126	100%

The highest concentration of teachers' age is in the category of 31 to 45 years, less in the age of 46 and more, while the least concentration of subjects was in the age up to 30 years. It can be concluded that the greatest number of subjects is in the age of full working potential.

As regards gender, with dichotomy variables, from a total of 126 subjects 115 (91.3%) were female and 11 (8.7%) were male.

Table 9: Gender of teacher

Gender of teacher	f	f%
Female	115	91.3
Male	11	8.7
<i>Total</i>	126	100%

At first sight, a great gender difference can be seen. Only one tenth of male teachers from the total number of teachers was included through the sample. The existence of a gender stereotype in the teaching profession can be concluded. This situation points to the fact that teaching is a “female vocation”.

Years of working experience relate to the time which the teachers spent in employment. The years of working experience of the teachers/subjects questioned mutually differ, from several months to 43 years of working experience.

Table 10: Teacher’s working experience

<i>Teacher’s working experience</i>	f	f%
From 0 to 10 years	35	27.7
From 11 to 20 years	43	34.1
From 21 and more years	48	38.1
<i>Total</i>	126	100%

The greatest percentage of teachers questioned had from 6 to 20 years’ working experience, this was followed by teachers with 21 and more years’ working experience and the least had up to 5 years’ working experience, which points to the fact that the greatest number of teachers questioned were in the age of full working potential.

Educational level of teacher was the next variable examined. In the practice of Croatian schools there is the possibility of teachers working with three different levels of education: secondary, two-year associate degree and university degree, which relate to the time framework of teachers' educational level of change during the educative vertical of the teaching profession.

Table 11: Level of teacher education

<i>Level of teacher education</i>	<i>f</i>	<i>f%</i>
Secondary & 2year assoc. degree	82	65.1
University degree	44	34.9
<i>Total</i>	126	100%

The greatest number of teachers questioned, 78, have a two-year associate degree, 4 teachers with secondary education while 44 teachers have university degrees. In the sample examined, teachers with two-year associate degrees prevail. Since only four teachers have secondary education, for further statistical processing of data two categories are connected: secondary education and two-year associate degree in one category: secondary and two-year associate degree.

Status of teacher refers to the level of promotion during work in his/her vocation. Therefore there are three levels: teacher, teacher mentor and teacher counsellor. From 126 teachers questions, 101 are teachers, 23 are teacher mentors and 2 are teacher counsellors.

Table 12: Status of teacher

<i>Status of teacher</i>	<i>f</i>	<i>f%</i>
Teacher	101	80.2
Teacher mentor or counsellor	25	19.8
<i>Total</i>	126	100%

From the total number of teachers questioned, only one fifth have a higher level of promotion. For further statistical processing of data, we have connected two categories: teacher counsellor and teacher mentor in one category: teacher mentor or counsellor.

Employment of teacher relates to the information of how many teachers work or do not work in a permanent capacity i.e. permanent position or temporary position. There are 109 teachers employed in a permanent position while 17 of them work in a temporary position. This information points to the fact that 86.5% of teachers have a “solution” to one of the basic existential questions.

Table 13: Employment

<i>Employment</i>	<i>f</i>	<i>f%</i>
Permanent	17	13.5
Temporary	109	86.5
<i>Total</i>	126	100%

The number of class teachers questioned was 126 with 42 teachers in the second, third and fourth grades. An even *distribution of teachers by classes in which they work* was made.

Table 14: Class in which the teacher works

<i>Class in which teacher works</i>	<i>f</i>	<i>f%</i>
Second grade	42	33.3
Third grade	42	33.3
Fourth grade	42	33.3
<i>Total</i>	126	100%

Size of primary schools give us information on the numerousness of school pupils where the teachers work. The research covered 21 primary schools, one in each county. The primary schools chosen differ from one another in the number of pupils attending them.

Table 15: Size of primary schools where the teachers work

<i>Size of primary schools where teachers work</i>	<i>f</i>	<i>f%</i>
Up to 500 pupils	20	15.9
From 501 up to 800 pupils	47	37.3
From 801 and more pupils	59	46.8
<i>Total</i>	126	100%

Therefore, a classification of teachers was made with regard to the numerousness of pupils in schools:

- School up to 500 pupils
- School from 501 to 800 pupils
- School with 801 and more pupils

The least number of teachers included in the research can be found in the small school category, up to 500 pupils (15.9%), a greater number of teachers work in large secondary schools, from 501 to 800 pupils (37.3%), and the greatest number of teachers questioned work in larger schools, from 801 and more pupils (46.8%).

Teachers' viewpoint on level of equipment of primary schools where they work relate to the equipment of the school's teaching tools and aids i.e. media. In the tables mentioned, it can be seen that level of equipment of Croatian schools with media is mainly good (61.1%). A fifth of the teachers consider that they work in very good conditions, taking into consideration equipment of the classrooms with media (20.6%), while a smaller number of teachers stated that level of equipment of school with media was poor (15.9%) or very poor (2.4%). For further statistical processing of data, we have linked three teachers who stated very poor level

of equipment of school with media into the category poor or very poor level of equipment with teachers who assessed level of school equipment poor.

Table 16: Level of equipment of school

Level of equipment of school	<i>f</i>	<i>f</i> %
Very good	26	20.6
Good	77	61.1
Poor or very poor	23	18.3
<i>Total</i>	126	100%

As regards the results obtained, it can be concluded that in just one fifth of schools, level of equipment with media is very good and with four-fifths of primary schools, improvement of equipment should be carried out.

Pupils

In every school chosen, pupils from one of the second, third and fourth grades were questioned parallel with their teachers. Descriptive statistics reveal that *the distributed number of questioned pupils in counties* was relatively even.

Table 17: Distribution of pupils per counties

<i>Distribution of pupils per counties</i>	<i>f</i>	<i>f%</i>
1. Zagrebačka	65	4.7
2. Krapinsko-zagorska	67	4.9
3. Sisačko-moslavačka	55	4.0
4. Karlovačka	80	5.8
5. Varaždinska	68	5.0
6. Koprivničko-križevačka	65	4.7
7. Bjelovarsko-bilogorska	67	4.9
8. Primorsko-goranska	55	4.0
9. Ličko-senjska	71	5.2
10. Virovitičko-podravska	56	4.1
11. Požeško-slavonska	53	3.9
12. Brodsko-posavska	82	6.0
13. Zadarska	68	5.0
14. Osječko-baranjska	76	5.6
15. Šibensko-kninska	67	4.9
16. Vukovarsko-srijemska	68	5.0
17. Splitsko-dalmatinska	65	4.7
18. Istarska	52	3.8
19. Dubrovačko-neretvanska	67	4.9
20. Međimurska	69	5.0
21. Grad Zagreb	53	3.9
<i>Total:</i>	1,369	100%

Apart from counties, data are classified according to grades, age and gender. *Pupils of various classes* were questioned. A total of 1,369 pupils were surveyed as follows: 445 pupils of second grade, 457 pupils of third grade and 467 pupils of fourth grade of primary school.

Table 18: Number of pupils according to classes

<i>Number of pupils according to classes</i>	<i>f</i>	<i>f%</i>
Second grade	445	32.5
Third grade	457	33.4
Fourth grade	467	34.1
<i>Total:</i>	1,369	100%

From the table, it can be seen that the number of questioned pupils by classes are evenly distributed.

Pupil sample, taking into consideration their *age*, is shown in table 19:

Table 19: Age of pupils according to classes

<i>Age of pupil according to class</i>	<i>second</i>		<i>third</i>		<i>fourth</i>	
	<i>f</i>	<i>f%</i>	<i>f</i>	<i>f%</i>	<i>f</i>	<i>f%</i>
7 years	31	2.3				
8 years	387	28.3	10	0.7		
9 years	27	2	394	28.8	22	1.6
10 years			53	3.9	391	28.6
11 years					54	3.9
Total according to class:	445	32.6	457	33.4	467	34.1
<i>Total</i>		1,369				100%

In the second class, the most represented was the category of pupils aged 8 years (90% of pupils). Other pupils of the second grade (10%) were 7 or 9 years old. In the third class, the most represented was the category of pupils aged 9 years (86% of pupils). The remaining pupils (14%) were 8 or 10 years old. In the fourth grade, the most represented was the

category of pupils aged 10 years (84% of pupils). The remaining pupils (16%) were 9 or 11 years old. These data support the fact that in the majority of cases, the pupils' age was compatible with the class that he/she attended.

From a total number (1,365) of pupils questioned from the second, third and fourth grades, 656 (48%) were female and 713 (52%) were male. The number of boys and girls by classes can be seen in the table:

Table 20: Gender of pupils according to class

Gender of pupils according to class	Grade							
	second		third		fourth		total	
	f	f%	f	f%	f	f%	f	f%
Female gender	204	46	222	49	230	49	656	48
Male gender	241	54	235	51	237	51	713	52
Total							1,369	100%

The data obtained point to the conclusion that a little over half of the pupils questioned are male and vice versa, i.e. a little less than half of the pupils questioned are female.

7.4. PROCEDURES OF RESEARCH AND STATISTICAL PROCESSING OF DATA

The procedures of research were based on pilot research and the main research.

The main research was carried out in 2006. There were 126 teachers questioned and 1,369 pupils from the primary schools (total 1,495 subjects). In each county (21) one primary school was chosen at random and the principal of the school was asked for permission to carry out a survey in their school. Due to the scope of the research, school pedagogues were asked to carry out surveys for teachers and pupils and they were sent instructions as well as copies of

the questionnaires. On completion of the survey, pedagogues from all schools forwarded the completed questionnaires by post. The procedure of sending questionnaires, surveying in the schools and receipt of same, lasted about three months. On completion of research, a thank-you note was sent to all schools which had participated in the research.

Procedure of collecting data

Through work on the pedagogical documentation, information was received on the state and interpretation of multimedia contents of teaching technologies. Feedback information on opinions and viewpoints of pupils and teachers on multimedia usage in teaching was obtained through a survey.

Through questions from the survey, answers for variables mentioned were obtained. It has already been stated that the plan for cross-referencing covered cross-reference within dependent and independent variables of questionnaires for teachers and dependent and independent variables questionnaires for pupils.

Statistical processing of data

Data from the empirical part of the doctoral dissertation were processed (parametric and non-parametric statistics) with the help of statistical program SPSS 14.0 Windows for personal computers.

The following statistical methods were used:

1. Descriptive statistics for display of the entire variable sample. The results of descriptive statistics shown are: frequencies, percentages and rankings. Through this, basic data on used variables were obtained as well as which variables would be used in the following research procedures.
2. Hi-square test (calculating differences which are expressed on a nominal level).

8. RESULTS AND INTERPRETATION

8.1. EXISTING CONCEPT OF TEACHERS' CLASS WORK IN PRIMARY SCHOOLS IN THE REPUBLIC OF CROATIA

The existing concept of class work of teachers in primary schools of the Republic of Croatia is based on changes in schooling which occurred with the aim of defining the Croatian National Educational Standards. In the research work, the Curriculum (2006, MSPS) was studied as well as Catalogues of Professional Conferences for Class Teachers from 2002-2009. The stated documents make up the existing concept of class work of teacher.

The tendency of the Croatian National Educational Standards is to introduce a developmental approach to pupils of primary schools as well as targeted uniformity with pre-school, secondary school and university level of the pedagogical-educational system. Two foreign languages have been introduced from the first grade of primary school and free-of-charge textbooks.

The Curriculum (Curriculum for Primary Schools 2006) was drawn up directly by the executors of the pedagogical-educational system in schools: teachers, teacher mentors, teacher advisors, pedagogues, psychologists, special education teachers, librarians and university professors. The basic aim was to reduce the scope of teaching contents in all class subjects, modernise them, to link subject and correlating-subject, distribute them in a balanced manner according to classes as well as define the pedagogical-educational aims and tasks consistent with developmental levels of pupils.

The stated Curriculum contains: rulings from the Minister of Science, Education & Sport, Dragan Primorac, on the curriculum for primary school, aims and tasks of pedagogy and education in primary schools, basic guidelines of pedagogical-educational and class work according to the CCPS, curriculum for carrying out the teaching program, pedagogical-education, school and class work, pedagogical-educational forms, methods and devices of extra-curricular work both inside and outside the class, work with gifted pupils, work with special-needs pupils, executors of the pedagogical-educational work in primary school, pedagogical-educational work of professional collaborators in primary school, school library,

integrative pedagogical-educational contents for primary school as well as programs of all class subjects from the first to the eighth grade.

The Curriculum (Curriculum for Primary Schools 2006, page 12) for pupils from the first to the fourth grades of primary school provides weekly for 5 class hours of the Croatian language, 4 class hours of mathematics, 2 school hours of a foreign language, 1 school hour of art and music culture, 2 class hours of nature and society from the first to the third grade and 2 class hours in the fourth grade, 3 school hours of physical education and health culture from the first to the third grade and 2 class hours in the fourth grade.

8.1.1. Curriculum

One of the tasks of checking the existing concept of class work of primary schools in the Republic of Croatia was to analyse the inclusion of the problem area of multimedia in the curriculum which is now carried out in primary schools. Therefore, the Curriculum for Primary Schools (2006, MSPS) was studied. In the Curriculum the following words are mentioned in a few places: teaching devices and media, while media culture is one of the areas in the teaching of the Croatian language. According to the research of N. Zgrabljić: “Media education in the Croatian educational system is just mentioned. It is carried out only within the framework of the teaching of the Croatian language in primary schools from the first to the eighth grade. The Croatian language in primary schools covers four teaching areas: a) Croatian language, b) literature, c) linguistic expression and d) media culture.” (Erjavec, Zgrabljić, 2000, page 95) One of the aims of pedagogy and education is: “train the pupil to learn, teach them how to learn and help them in learning.” (Curriculum for Primary Schools 2006, page 10) Under training the pupil for learning, the functionality of the pupil is implied i.e. that the pupil learns with the purpose of applying what he has learned, within the frameworks of his individual abilities. Part of the help in learning relates to media and multimedia which are stated in basic guidelines of the pedagogical-educational and class work according to CCPS:

- “Adaptation of teaching forms, methods and devices of work of individual needs of the pupil so as to ensure pedagogical-educational success of each pupil;

- Choice and application of teaching forms, methods and devices which will stimulate the development of all areas of pupils' abilities;
- Taking into consideration the influence of media and other "instructors" in the pupils' environment;
- Usage of primary sources of knowledge, teaching devices and other sources which stimulate observation, independent research, conclusion, curiosity as well as learning *how to learn...*" (Curriculum for Primary Schools, 2006, page 11)

Among other things, in execution of the special or enriched pedagogical-education program for gifted pupils: "provision of conditions for drawing up a program (timetable, teaching devices, literature, forms of teaching or learning)..." (Curriculum for Primary Schools 2006, page 14) is assumed. The same applies for the drawing up of individualised programs for special needs pupils: "initial evaluation, determination of teaching subjects and content, level of acquired contents, time dimension (short-term and long-term aims and tasks), choice of methods, procedures, tools and aids, monitoring and marking achievement of pupil." (Curriculum for Primary Schools 2006, page 16) The pedagogical-educational work of professional collaborators in primary schools also mention teaching tools and aids through preparation of the school pedagogical-education programs and their execution: "creating conditions for execution of the plan and program of school – monitoring the entire work of the school, evaluating the quality of work and didactic-methodical conditions of work; ensuring teaching equipment; production of teaching devices and aids...stimulating the teacher for applying audio-visual devices and computer science equipment in teaching ." (Curriculum for Primary Schools, 2006, page 17) Library-information and documentation work imply among others: "purchase of multimedia sources of knowledge..." (Curriculum for Primary Schools 2006, page 18) The school librarian has many roles, and one of them is to "participate" in the formation of a multimedia school hub through equipment of professional literature, other sources of knowledge and suitable pedagogical-educational technology... A modern library, in an information manner, is a media and communicational hub of the school..." (Curriculum for Primary Schools, 2006, page 19) The aim of pedagogical-educational work in the school library which relates to media and multimedia is separate: "to guide the pupil to books as a permanent source of diverse knowledge (informative, artistic, technical, entertaining), displayed visual, auditory and audio-visual devices (text, image, drawing, map, tone and video recording)..." (Curriculum for Primary Schools, 2006, page 20) Already from the 1st grade, direct pedagogical-educational work with pupils in the school

library plans "...to familiarise them with sources of knowledge and their purposes...(Curriculum for Primary Schools, 2006, page 20)

In the following text, a short review is given on the display of multimedia representation in teaching programs of individual class subjects, according to the order in which they are mentioned in the Curriculum.

Croatian language (Curriculum for Primary Schools, 2006, pages 25 – 34): the class subject Croatian language is made up of five teaching areas in the first grade: beginner's reading and writing, language, linguistic expression, literature and media culture as well as four teaching areas in the second, third and fourth grades: language, linguistic expression, literature and media culture. In the area of media culture the following can be mentioned: film, (cartoon, documentary film, film story). Radio program, TV, press (children's magazines, comic strips, theatre, puppet shows, and computer. For each class from media culture there is a list of films which are suggested for interpretation as well as list of reading material which does not fit into media culture but into literature. The question is asked why the list of reading material could not be part of media culture, if books are media?

It is interesting that not one of the other class subjects has media culture and in each class subject media is used. N. Zgrabljčić, in an article on the Croatian model of media education, writes: "In primary schools, the accent of media culture is on film pedagogy and education. From the first to the fifth grade of primary school, media culture has the task of familiarising children with children's (and cartoon) films as well as children's television programs and TV programs with patriotic contents...." (Erjavec, Zgrabljčić, 2000, page 95) From a methodical-didactic viewpoint, it can be concluded that media culture cannot be a component only of the Croatian language program as the contemporary approach to media culture is viewed in an interdisciplinary manner.

Art (Curriculum for Primary School, 2006, pages 51 – 57) is divided into 4 teaching areas: drawing, painting, modelling and construction, applied form–design in the first, second and fourth grades and 5 teaching areas in the third grade: drawing, painting, graphics, modelling and construction, and applied form-design. At the end of the program for each individual class there is a list of works of art (media) with the aim of specifically researching the problems of art. One cannot ignore the fact that graphics are introduced into the program only in the 3rd

grade, if practice in kindergartens shows along with awareness of the developmental potential of children, that pre-school children enjoy expressing themselves precisely in the art field mentioned, from the crèche age most of all. Apart from this, the question is asked why there are no graphics again in the fourth grade? Furthermore, the lack of logic of the curriculum which provides for one school hour weekly for art is inconsistent with the remarks in the program for art that the contents are carried out in block hours, all the more so because the artistic development of the pupil should be stimulated in a continuous manner.

Music (Curriculum for Primary School, 2006, pages 66 – 73): the program of music covers four basic areas in the first three grades: singing, playing an instrument, listening to music and musical compositions of pupils as well as four basic areas in the fourth grade: singing, listening and getting to know music, playing music and musical notes as well as musical games. There is no mention of multimedia in the program.

Mathematics (Curriculum for Primary School, 2006, pages 238 – 244): in each class there are twenty teaching themes. Multimedia, as a word, is not mentioned in mathematics and indirectly as a suggestion to the teachers for usage of computer science and communicational technology. Possibly media in the form of geometric shapes and figures.

Nature and society (Curriculum for Primary School, 2006, pages 253 – 260) is a basic class subject as it is the starting point in programming of the class work and is in interaction with other class subjects. It contains twenty themes in each grade on: school, home and family, our town, the pupil in traffic, nature, space, time, our body as well as health and the culture of living.

In the program on nature and society, the term multimedia is not mentioned. However, the program is full of a great number of media (e.g. food, plants, water, the clock, calendar....).

Physical education (Curriculum for the Primary School, 2006, pages 321 – 326): the program's scope is determined by the principle of a link between the task of education and physical education by which motoric knowledge is a means for achieving certain tasks and is not in itself the aim of pedagogical-educational work. Completion of these tasks required the drawing up of this program based on a greater number of criteria. The criterion which interests us relates to the objective feasibility of the teaching theme in material/physical

conditions of primary schools of the Republic of Croatia. This means that usage of media depends from person to person and from school to school as all schools are differently equipped and provide various material conditions of work, including media. The program for the first, second and third grades is divided into separate units: walking and running, jumping, skipping over short ropes fixed in place, throwing and catching, running in circles, climbing and crawling, hanging and leaning, rhythmic structure and games.

It cannot be claimed that multimedia is not represented in the Curriculum. Multimedia is mentioned in the text, before individual program of class subjects, generally, and indirectly, as a teaching device in learning. The teacher's obligations is also mentioned for applying audio-visual devices and computer science equipment as well as the task of the librarian for purchase of multimedia sources of knowledge and formation of a multimedia school hub. Multimedia as a term is not mentioned in the program of class subjects from the first to the fourth grades of primary school. Media culture is mentioned only in the teaching of the Croatian language as one of the teaching areas of work. In accordance with this claim, N. Zgrabljic states: "Such an understanding of media culture is quite different from the contemporary concept of media education, which is nevertheless somewhat wider in a theoretical and a practical sense." (Erjavec, Zgrabljic, 2000, page 95) The opinion is present that media culture is observed in a narrow framework i.e. partially, through the accentuated role of film and television programs. Therefore, the need to highlight the problem of multimedia in teaching programs can be seen.

8.1.2. Plan and program for professional upgrading of class teachers

Class teachers carry out multiple roles: they are leaders in the process of learning and development, educators, experts of methodics of art, music, physical education, nature and society, Croatian language and mathematics, planners, organisers and executors of the teaching process, innovators, partners to pupils, parents, guardians, colleagues, outside collaborators, members of various teams. With their work, they stimulate development and culture of the community where they live and promote the school as a pro-social community.

Therefore, it is very important to develop the competencies of the teacher so as to be able to meet the expectations of the pupils in a more qualitative manner. The aim of professional

upgrading of teachers is to acquire new knowledge, abilities, habits and viewpoints leading to further lifelong education, as an extension to their faculty degree and passing the state examination. Changes to the schooling system in the Republic of Croatia are bound to require changes with teachers in the manner of interpreting the Curriculum (Curriculum 2006, CCNS) leading to fulfilment of the developmental needs of pupils. Therefore, the Agency for Pedagogy and Education strives to offer a contemporary concept of professional upgrading which is focused on the achievement and competencies of the pupils.

Participating in the program of upgrading is a working obligation of the teacher who is given points in accordance with the Regulations on progress in vocation. Therefore, a certificate is printed for all participants of conferences on professional upgrading. The plan and program of professional upgrading of class teachers is defined in the Catalogues of Professional Conferences. *The catalogue of professional conferences is a collection of programs of professional upgrading of targeted conferences: kindergarten teachers, teachers, school teachers, professional collaborators and principals of primary and secondary schools as well as pupils' hostels during certain periods of one year.* The catalogue represents a guide to professional development of each educator in accordance with his/her own needs for acquiring professional and pedagogical knowledge required for the personal development and development of the schooling system generally.

Professional conferences intended for the professional upgrading of class teachers should be significant for continual professional upgrading in the lifelong education of teachers. Lecturers at professional conferences are: university professors from various faculties, especially Teacher Training, experts of various professional associations, societies and teachers practitioners. The leader of the professional conference must be aware of the problem area of theory and practice, have first-class skills in communication with teachers as well as devise forms of improving active forms of work.

As the first task in the research was to check whether themes of multimedia are covered at the professional conferences of teachers, through an analysis of the Catalogue of Professional Conferences, from 2002 to 2009, it was established that themes of multimedia were dealt with under the following headings: computer science from 1st to the 4th grade of primary school, the computer and internet in teaching, the computer in teaching, the computer and

internet in classes, Power Point, film in class, internet – advantages and dangers and protection of children from violence in the media.

Table 21: Themes on multimedia in the plan and program of upgrading of class teachers

THEME	TIME HELD	COUNTY
1. Achievements on the project "computer science from 1 st to 4 th grade primary school" (Catalogue, 2004, I part);	8. January 2004.	primorsko-goranska
	13. April 2004.	istarska
2. Computer and internet in teaching (Catalogue, 2005, I part);	28. and 29. June, 23., 24., 25., and 26. August	dubrovačko-neretvanska
3. Computer in teaching (Catalogue 2005 for 2005/2006);	15. October 2005.	primorsko-goranska, ličko-senjska, istarska i osječko-baranjska
4. Computer and internet in class teaching, Power Point (Catalogue 2005, for 2005/2006);	30. and 31. August 2006.	virovitičko-podravska, požeško-slavonska, brodsko-posavska, osječko-baranjska i vukovarsko-srijemska
5. Film in teaching (Catalogue 2006, for 2007);	3. January 2007.	virovitičko-podravska, požeško-slavonska i osječko-baranjska
6. Internet – advantages and dangers, protection of children from violence in the media; 28 August 2009;	28. August 2009.	šibensko-kninska

It must be pointed out that the term multimedia in the catalogues of professional upgrading of class teachers is not used at all. Furthermore, it was interesting to check how much attention is given to teaching tools and aids in education of teachers.

Table 22: Themes on media in the plan and program of upgrading of class teachers

THEME	TIME HELD	COUNTY
1. Textbook serving as a source of knowledge (Catalogue 2002, I part);	25., 26. i 27. June 2002.	dubrovačko-neretvanska
2. Drawing in children's art creativity (Catalogue 2002, I part);	26. June 2002.	virovitičko-podavska
3. Application of children's musical instruments (playing) and creative approach to musical contents (creativity) (Catalogue 2002, I part);	19. June 2002.	vukovarsko-srijemska
4. Role of textbook in teaching music (Catalogue, 2002, I part);	19. June 2002.	vukovarsko-srijemska
5. Analytical judgement of written works of pupils (Catalogue 2002, I part);	21. June 2002.	vukovarsko-srijemska
6. Textbook serving source of knowledge (Catalogue 2002, II part)	4. September 2002.	dubrovačko-neretvanska
7. Reception and interpretation of literary text (Catalogue 2003, I part)	22. April	požeško-slavonska i brodsko-posavska
	23. June 2003.	bjelovarsko-bilogorska
8. Puppet media in teaching Croatian language (Catalogue 2003, I part);	8. January 2003.	primorsko-goranska i karlovačka
	9. January 2003.	istarska
9. Using textbook literature (Catalogue 2003, II part);	27. i 28. August	splitsko-dalmatinska
10. The puppet in children's life, puppet shadow – basic work and making puppet shadow (Catalogue 2006, for 2007);	26-28. June 2007	primorsko-goranska istarska i ličko-senjska
11. Integration of music and media culture;	12. April 2007.	osječko-baranjska
12. Introduction to puppet art, making puppets, puppet animation (Catalogue 2009, I part);	14.-16. April 2009.	primorsko-goranska
13. Children's rights: Media and children (Catalogue 2009, I part);	17. June 2009.	primorsko-goranska
14. Media and children (Catalogue 2009, I part);	26. August 2009.	istarska, ličko-senjska

Themes which explained the problem area of media usage in teaching included: textbook, musical instrument, children's drawing, written work of pupils, literary text, puppets, media culture and media generally. The media mentioned stimulate auditory, visual and tactile senses and they were given greater attention in relation to multimedia.

Having studied the Catalogue of Professional Conferences, it was noticed that multimedia as a term is not used at all in the plan and program of professional upgrading of teachers.

However, during professional upgrading of teachers, multimedia was interpreted with themes on: the computer, internet, Power Point, computer science in class teaching and film. In this respect, it should be pointed out that all themes were not interpreted in all counties, only in certain ones (table 19). From a possible twenty-one counties, ten (Primorsko-Goranska, Ličko-Senjska, Istarska, Osječko-Baranjska, Virovitičko-Podravska, Požeško-Slavonska, Brodsko-Posavska, Vukovarsko-Srijemska, Dubrovačko-Neretvanska and Šibensko-Kninska) covered a certain theme or some of the themes mentioned on multimedia during the period from 2004 to 2009. These data are not satisfactory taking into consideration the significance of multimedia in teaching. There are two basic reasons for insufficient inclusion of the theme on multimedia in the plan and program of professional upgrading of teachers. The first reason of insufficient inclusion of the theme on multimedia lies in the fact that the Ministry of Science, Education & Sport one-sidedly determines the theme for professional upgrading of teachers in order to bring it in line with the national examinations in fourth grades. Therefore, themes which determine more the stated requirement of compatibility are placed in the catalogue. The second reason for insufficient inclusion of the theme on multimedia lies in the proposals of themes from foreign agents of education, as they have the possibility of incorporating some other themes. Only certain agents showed sensitivity for the theme on multimedia as well as media in teaching generally.

8.2. TEACHING TOOLS AND AIDS WHICH TEACHERS USE IN CLASS

The second research question related to the type of media and the frequency of their usage in teaching. Through analysis of teachers' replies, media of all the sensory areas are used in class: visual, auditory, kinaesthetic, olfactory, taste as well as their different combinations. The table below shows the level of frequency of media usage. Teachers give the highest priority to visual media (65.9%), followed by auditory (63.5%), various combinations of media (42.1%), kinaesthetic (34.1%), olfactory (11.9%) and taste media (7.1%). This means that the teacher in class encourages the taste modality the least (altogether 9 teachers) and smell (15 teachers). Multimedia, as an audio-visual media component, is used less than visual and auditory media (42.1%). Apart from multimedia, teachers use various multimedial combinations of media of various sensory areas.

Table 23: Media of various sensory areas

<i>Media of various sensory areas</i>	<i>f</i>	<i>f%</i>
Visual area	83	65.9
Auditory area	80	63.5
Any combination: visual, auditory, Kinaesthetic, taste and olfactory areas	53	42.1
Kinaesthetic area	43	34.1
Olfactory area	15	11.9
Taste area	9	7.1

From these results, it follows that the significance of multimedia usage and multimedia stimulation in teaching is recognised by 42.1% of teachers. This information is an indicator of a lower awareness of teachers in stimulating sensory integration.

Parallel with examining the opinions of teachers, pupils' replies were obtained regarding the type of teaching device they prefer in class. They chose media which they enjoy using during learning. The ranking of teaching tools and aids which the pupils prefer shows that the favourite multimedia is the computer (40.8%). This is followed by: ball, skipping rope, hand rings, vaulting buck (38.9%), textbook (32.4%), video-cassette (26.3%), art equipment and material (25.3%), cassettes with music (22.9%) and pictures, posters (19.5%).

Table 24: Teaching tools and aids preferred by pupils

<i>Pupils' preference of media and multimedia</i>	<i>f</i>	<i>f%</i>
Computer	558	40.8
Ball, rope, hanging rings, vaulting buck	533	38.9
Text	444	32.4
Video-cassette	360	26.3
Art equipment and material	346	25.3
Cassettes with music	314	22.9
Pictures and posters	267	19.5
<i>Total</i>	1,369	100%

The ranking of teaching tools and aids which pupils prefer shows that pupils mostly opted for the computer, the reason being because it provides for diversity, learning dynamics and direct feedback. The ball, skipping rope, hand ring and vaulting buck were chosen immediately after the computer, which demonstrates the need of pupils for physical activity. The textbook is a basic and daily teaching device for learning in the majority of class subjects. Video-cassettes as audio-visual teaching devices are of interest to pupils. Art equipment and material, cassettes with music, pictures and posters were ranked last as visual, tactile or auditory media.

The next question related to the opinion of pupils concerning the frequency of usage of sources for learning in class. As much as 52.3% of pupils point out that in class these sources are used as much as they are needed, 38.6% of pupils would use learning sources more often while 9% of pupils would reduce their usage in class.

Table 25: Representation of usage sources for learning in class in relation to pupils' preferences

<i>Media for learning</i>	<i>f</i>	<i>f%</i>
Should be used more often	528	38.6
Should be used rarely	123	9
Should be used as much as they are now	716	52.3
Did not respond	2	0.1
<i>Total</i>	1,369	100%

Pupils who point out that sources for learning in class should be used more often, emphasise that they do not provide enough satisfaction of their needs in learning during class; this suggests that teachers should include more sources for learning that are in accordance with the pupils' wishes. Reduction of usage of sources for learning in class is an indicator of their over-usage and they should be moderated in some other way precisely for pupils with such an attitude. Furthermore, the needs of pupils for more frequent or rarer usage of learning sources in class indicate that 47.6% of those questioned make up the population of pupils who think that learning sources are not "tailored to their needs" and selection of learning sources in accordance with different developmental levels of pupils should be considered. Their replies should be important to didactic criteria of choice of learning sources in drawing up future teaching strategies.

Exploring the relationship of media, multimedia and independent variables, statistically significant results between the relationship of media, multimedia, gender, class and size of school were obtained.

The preference of teachers for usage of teaching tools and aids vis-à-vis their gender was checked. In this way, feedback information was obtained wherein media and multimedia were given advantage in learning by boys and girls i.e. which media and multimedia is their favourite. From the results obtained, shown in table 26, it can be seen that boy and girls are different in ranging preferences of teaching tools and aids. For girls, their favourite is the textbook (17.9%), followed by: sport equipment (17%), art equipment and material (15.7%), computer (14.2%), cassettes with music, speech and sound effects (13.4%), video-cassettes (11.6%) and pictures and posters (11.4%), while boy emphasised the computer in the first place (26.5%), followed by sport equipment (22%), video-cassette (14.7%), the penultimate place is shared by cassettes with music (9.6%) and art equipment and material (9.6%) and finally pictures and posters (8.1%).

Table 26: Teaching tools and aids in relation to gender of pupil

<i>Teaching tools and aids</i>	<i>Gender</i>			
	<i>F</i>		<i>M</i>	
	<i>f</i>	<i>f%</i>	<i>f</i>	<i>f%</i>
Textbook	245	17.9	199	14.5
Cassettes with music, speech and sound effects	183	13.4	131	9.6
Pictures and posters	156	11.4	111	8.1
Computer	195	14.2	363	26.5
Video-cassette	159	11.6	201	14.7
Ball, skipping rope, hand rings vaulting buck	233	17	300	22
Art equipment and material	215	15.7	131	9.6

With further investigation of the relation between teaching tools and aids and pupil gender, a statistically significant difference between boys and girls is obtained. Girls and boy differ in their preference of media.

Table 27: The value of χ^2 test for linkage between various teaching tools and aids in relation to gender

<i>Variable</i>	χ^2	df	p
Textbook	14.01	1	0.000
Cassettes with music, speech and sound effects	17.49	1	0.000
Pictures and posters	14.56	1	0.000
Computer	61.23	1	0.000
Video-cassette	2.35	1	0.125
Ball, skipping rope, hand rings and vaulting buck	5.49	1	0.019
Art equipment and material	37.53	1	0.000

Girls more often than boys state that they like: learning from textbooks ($\chi^2=14, 01$; $df=1$; $p<0.001$), use cassettes with music, speech and sound effects ($\chi^2=17.49$; $df=1$; $p<0.001$), pictures and posters ($\chi^2=14.56$; $df=1$; $p<0.001$) as well as art material and equipment ($\chi^2=37.53$; $df=1$; $p<0.001$). Boys more often than girls state that they like using the computer ($\chi^2=61.23$; $df=1$; $p<0.001$) along with the ball, skipping rope, hand rings and vaulting buck ($\chi^2=5.49$; $df=1$; $p=0.019$).

Girls more than boys like using: the textbook, cassettes with music, speech and sound effects, pictures, posters and using art equipment and material while boys more than girls prefer sport equipment (ball, skipping rope, hand rings and vaulting buck) and computer. The results are completely compatible with their favourite subjects. Girls most of all prefer: the Croatian language, music and art, which suggests that they are inclined artistically. Boys prefer more using the computer i.e. technology attracts them, technical machines, devices. Boys also have a greater need for motoric activities and like teaching tools and aids which are used in physical education. In accordance with their favourite class subjects, pupils prefer teaching tools and aids. This means that with preferences towards certain subjects children often accept

those media and multimedia which are used and vice versa. With regard to the preference of media and multimedia, there is simultaneously a preference for class subject. The exceptions are video-cassette, whose usage is not statistically significant with regard to gender. There are not statistically significant differences between boys and girls in relation to the usage of video-cassettes ($\chi^2=2.35$; $df=1$; $p=0.125$), which means that the pupil's gender is not linked to the preferences of this teaching device. This further means that video-cassettes for both boys and girls leave an equal impression in audio-visual communication.

Furthermore, a preference of pupils in using teaching tools and aids in class was tested in relation to the class they attend. The aim was to establish which teaching tools and aids are preferred in learning by pupils in the second, third and fourth grades. From the results obtained, shown in table 28, it can be seen that the pupils of the second, third and fourth grades differ in ranging preferences of teaching tools and aids. The pupils were offered the possibility of multiple choices and so the percentages related to a certain class. Pupils of the second grade favour the computer the most (41.1%) followed by: video-cassettes (39.3%), sport equipment (39.1%), cassettes with music, speech and sound effects (34.4%), textbook (32.8%), art equipment and material (25.2%) as well as photographs and posters (19.3%). Pupils of the third grade also prefer the computer in the first place (41.8%), followed by sport equipment (40.9%), textbook (30.9%), art equipment and material (29.1%), video-cassette (20.1%), cassettes with music, speech and sound effects (19%) as well as pictures and posters (18.6%). Pupils of the fourth grade also prefer using the computer (39.4%) followed by sport equipment (36.8%), textbook (33.6%), art equipment and material (21.6%), video-cassette (19.9%) as well as cassettes with music, speech and sound effects (15.8%). It can be concluded that pupils of the second, third and fourth grades prefer using the computer most of all. The justification for these responses can be seen in the needs of pupils for usage of multimedia products which represent a contemporary technological achievement and newly-devised didactic products for learning. Sport equipment immediately follows the computer as the pupils develop through them their motoric activities which correctly impacts on the physical development of the pupil. In last place the pupils of the second and third grade emphasise pictures and posters while pupils of the fourth grade underscore cassettes with music, speech and sound effects. Pictures and posters stimulate the sense of sight while CDs with music, speech and sound effects stimulate the sense of hearing, so their common characteristic is in stimulating perception of pupils with one sensory channel.

Table 28: Teaching tools and aids in relation to class

Teaching tools and aids	Class					
	2 nd grade		3 rd grade		4 th grade	
	f	f%	f	f%	f	f%
Textbook	146	32.8	141	30.9	157	33.6
Cassettes with music, speech and sound effects	153	34.4	87	19	74	15.8
Pictures and posters	86	19.3	85	18.6	96	20.6
Computer	183	41.1	191	41.8	184	39.4
Video-cassette	175	39.3	92	20.1	93	19.9
Ball, skipping rope, hand rings vaulting buck	174	39.1	187	40.9	172	36.8
Art equipment and material	112	25.2	133	29.1	101	21.6

It was interesting to check whether there is a statistically significant difference in the attitude of pupils towards teaching tools and aids among pupils of the second, third and fourth grades in class. By studying the relationship of teaching tools and aids and independent variables, it is concluded that *among teaching tools, aids and class pupils*, there is a statistically significant difference between pupils of second, third and fourth grade and choice of cassettes with music, speech and sound effects, video-cassettes as well as art equipment and material in relation to other teaching tools and aids available (textbook, pictures, posters, ball, skipping rope, hand rings, vaulting buck and computer) where no statistically significant results were found. Pupils of the second, third and fourth grades differ in their preference of certain teaching tools and aids.

A statistically significant difference among classes was obtained in relation to the choice of cassettes with music ($\chi^2=50.2$; $df=2$; $p<0.001$). Pupils of the second grade more often state that they like cassettes with music, speech and sound effects (34.4%) as sources of learning; pupils of the third grade less mention the same media (19%) while pupils of the fourth grade use it the least (15.8%).

Table 29: Value of χ^2 test for linkage between various teaching tools and aids in relation to class

<i>Variable</i>	χ^2	df	p
Textbook	0.85	2	0.654
Cassettes with music, speech and sound effects	50.19	2	0.000
Pictures and posters	0.57	2	0.750
Computer	0.58	2	0.747
Video-cassette	57.75	2	0.000
Ball, skipping rope, hand rings, vaulting buck	1.63	2	0.442
Art equipment and material	6.83	2	0.033

A statistically significant difference was obtained between classes in relation to the choice of video-cassette ($\chi^2=57.75$; $df=2$; $p<0.001$). Pupils of the second grade (39.3%) more often chose video-cassette while the third (20.1%) and fourth (19.9%) grades less often. A statistically significant difference between classes in relation to choice of art equipment and material ($\chi^2=6.83$; $df=2$; $p=0.033$) was obtained. Art equipment and material as a teaching tool and aid were more often the choice of third grade pupils (29.1%), less for second grade pupils (25.2%) and the least with pupils of the fourth grade (21.6%).

Pupils of the second grade prefer cassettes with music, speech and sound effects and video cassettes with pupils of the third and fourth grades. This result is connected with development of the pupil. The higher the class with pupils, the stronger their attitude and individuality are, so for example, they like less and less teaching tools and aids which somebody else chose or provided for them as in the case with the teaching of music, where ready-made musical didactic material for listening is provided in accordance with the existing curriculum. Pupils of the third and fourth grades more have their idol (musical, acting) and so they prefer themselves to choose and suggest the contents for listening and watching while pupils of the second grade are more under the influence of the teacher. Apart from that, CDs and DVDs are more and more replacing cassettes with music, speech and sound effects and video-cassettes.

Pupils from the third grade prefer art equipment and material than pupils of the fourth grade. The fact that in the fourth grade pupils have more subjects should not be overlooked; there are

other teachers apart from their class teacher and in art class, the tasks are more complex. There is more attention paid to defining art and the curriculum only provides for one school hour weekly.

There are no statistically significant differences between classes and textbooks, pictures and posters, computers and sport equipment. Pupils from all classes learn from textbooks as it is an obligatory basic teaching tool. Pictures and posters are also offered in the majority of class subjects to pupils of all grades. Pupils make posters during class and publishing houses also offer a wide choice of posters for different subjects for all grades in class teaching, as stimulation for easier acquisition of contents. The computers are attractive because of the many options of learning that they offer, starting with pre-school age, so it is to be expected that pupils already in the second grade use them independently. Sport equipment is obligatory in all grades in physical education and in the majority of cases pupils like them in all classes.

Preference of pupils in using teaching tools and aids in class in relation to the size of the school was checked. It is interesting to see which teaching tools and aids pupils prefer in learning, from smaller (up to 500 pupils), medium-size (501 to 800 pupils) and large schools (801 and more pupils). From the results obtained, shown in table 30, it can be seen that pupils of various large schools differ in ranging preference of teaching tools and aids. Pupils from smaller schools prefer textbooks the most (25.7%), followed by pictures and posters (25.1%), the computer (24.4%), art equipment and material (24%), cassette with music, speech and sound effects (21.7%), sport equipment (19.9%) as well as video cassette (18.3%). Pupils of medium-size schools emphasise video-cassettes (28.9%) in the first place, followed by sport equipment (28.1%), art equipment and material 26.6%), pictures and posters (25.1%), the computer (24.9%), textbook (24.8%) and cassette with music, speech and sound effects (21.7%). Pupils of larger schools mainly emphasise cassettes with music, speech and sound effects (56.7%), followed by video-cassettes (52.8%), sport equipment (52%), pictures and posters (49.8%), textbook (49.5%) as well as art equipment and material (49.4%). It can be concluded that more often the bigger the school, the more pupils choose all stated teaching tools and aids, as during class they are offered more i.e. they use them more, so in the majority of cases the proportional relationship of school size and its equipment of teaching tools and aids can be seen.

Table 30: Teaching tools and aids in relation to size of school

Teaching tools and aids	Size of school					
	Up to 500 pupils		From 502 to 808 pupils		From 801 and more	
	f	f%	f	f%	f	f%
Textbook	114	25.7	110	24.8	220	49.5
Cassette with music, speech and sound effects	68	21.7	68	21.7	178	56.7
Pictures and posters	67	25.1	67	25.1	133	49.8
Computer	136	24.4	139	24.9	283	50.7
Video-cassette	66	18.3	104	28.9	190	52.8
Ball, skipping rope, hand rings vaulting buck	106	19.9	150	28.1	277	52
Art equipment and material	83	24	92	26.6	171	49.4

Studying the relationship of teaching tools, aids and independent variables, statistically significant results were obtained. *Through testing of relationship between teaching tools, aids and size of school attended by pupils*, a statistically significant difference was obtained between pupils who attend smaller, medium-size and large schools and choice of cassette with music, speech and sound effects, video-cassettes and balls, skipping rope, hand rings and vaulting buck in comparison with other teaching tools and aids offered (textbook, picture, poster, art equipment and material and computer) where no statistically significant results were found. Pupils of smaller, medium-size and larger schools differ in their media preference.

A statistically significant difference with regard to the size of school was obtained ($\chi^2=12.07$; $df=2$; $p=0.002$). Cassette with music, speech and sound effects was stated by pupils from larger schools, less with pupils of medium-size schools and the least with pupils of smaller schools.

Table 31: Value of χ^2 test for linkage between various teaching tools and aids in relation to the size of the school

<i>Variables</i>	χ^2	df	p
Textbook	0.58	2	0.748
Cassette with music, speech and sound effects	12.07	2	0.002
Pictures and posters	0.53	2	0.767
Computer	3.29	2	0.192
Video cassette	17.83	2	0.000
Ball, skipping rope, hand rings, vaulting buck	21.12	2	0.000
Art equipment and material	1.88	2	0.390

A statistically significant difference in relation to the size of the school was obtained ($\chi^2=17.83$; $df=2$; $p<0.001$). Pupils from larger schools mention video-cassettes the most, less from pupils of medium-size schools and the least from pupils of smaller schools.

A statistically significant difference in relation to the size of the school was obtained ($\chi^2=21,12$; $df=2$; $p<0.001$). The ball, skipping rope, hand rings, vaulting buck were mentioned by pupils from larger schools the most, less by pupils from medium-size schools and the least by pupils from smaller schools.

In smaller schools, there are fewer pupils in classes. The fewer the pupils, the greater the possibility for the teacher to individually devote himself/herself to pupils in musical activities of singing and playing.

The statistically significant difference obtained in relation to the usage of video-cassettes point to the fact that pupils of larger and medium-size schools have a greater preference for usage of video-cassettes than pupils of smaller schools. Larger schools are more often better equipped with audio-visual tools and aids and they are provided with more possibility of insight into the production of textbooks, teaching tools and aids, as representatives of publishing houses and stores often visit larger schools where professional workshops for teachers are organised. At such gatherings, they demonstrate and present their products and innovations from the area of teaching tools and aids usage, even donating to their buyers.

Larger schools are better equipped with sport equipment and appliances and the better equipped they are, the assumption is the more the sport equipment will be used. The more they are used, the more the pupils get used to them and like them more.

There are no statistically significant differences between size of school and textbooks, pictures and posters, computers and art equipment and material. Regardless of the size of school, pupils of all classes use textbooks for learning as they are obligatory, a basic teaching tool. The size of the school also does not affect the teacher's preference for pictures and posters as pictures and posters are often offered in the majority of class subjects to pupils of different size schools. The computers are attractive because of the many options for learning which they provide and regardless of the size of school, more and more pupils have them at home or use them in schools and at their friends' homes. Sport equipment is obligatory in all classes in physical education and in the majority of cases, pupils from all sizes of school like them.

8.2.1. Pupils' opinion on usage of teaching tools and aids

Parallel with questioning of teachers, the opinion of their pupils was checked on usage of teaching tools and aids in class. In a developmental sense, it is important to know the opinion of the pupils, as the teaching process is focused on them and their point of view should be a basic regulator of choice of teaching tools and aids. Pupils mainly explained that teaching tools and aids are used precisely as much as they are required (second grade (26%), third grade (17.3%), fourth grade (19%)), fewer explained that educational tools and aids are used more than they are required (second grade (12.1%), third grade (13.4%), fourth grade (13.1%) and the least number explained that teaching tools and aids are used less than they are required (second grade (4.2%), third grade (2.7%), fourth grade (2%)). Fewer than half of questioned pupils (47.6%) stated that teaching tools and aids should be used more often or less frequently. This, relatively high percentage of pupils, in our opinion, should be reduced in practice. Such a result is a reflection of an insufficient flow of information between the pupils and their teacher in the sense of non-reaction in choice of teaching tools and aids, in accordance with the pupils' needs of learning. Specifically, in this example, the cause of the problem is non-implementation or insufficient implementation of evaluation of teaching activities focused on usage of teaching tools and aids. Exactly because of this, the results

obtained from the pupils questioned, 47.6%, stating that teaching tools and aids should be used more often or less frequently supplement the results that 45.2% of teacher do not have any way of checking the effectiveness of this. A correct “dosage” of teaching tools and aids would speed up implementation of usage evaluation, which should lead to examination and respect for pupils’ opinion on choice of teaching tools and aids. From the above-mentioned, there is obviously a need for additional education of teachers in the area of evaluation of teaching activities.

Furthermore, frequency of usage of educational tools and aids was checked in relation to the class which pupils attend

Table 32: Frequency of usage of teaching tools and aids in relation to class

Class	Frequency of usage of teaching tools and aids							
	More than is req.		Less than is req.		As much as they are req		Total	
	f	f%	f	f%	f	f%	f	f%
2 nd grade	168	12.1	58	4.2	219	16	445	32.4
3 rd grade	183	13.4	37	2.7	237	17.3	457	33.4
4 th grade	179	13.1	28	2	260	19	467	34.2
<i>Total</i>	530	38.6	123	9	716	52.4	1,369	100

 $\chi^2=15.47$; $df=4$; $p=0.004$

The aim was to test whether there was a statistically significant difference in attitudes of pupils on the frequency of usage of teaching tools and aids in relation to class. A statistically significant difference was obtained among classes about what pupils think on the frequency of usage of teaching tools and aids in class, through cross-referencing the variables of frequency of usage of media and class. With a rise in grades/class pupils become more and more critical in their attitude with regard to time learning experiences in teaching activities and in relation to usage of teaching tools and aids; therefore, pupils of the third and fourth grade compared with second grade pupils, seek greater usage of teaching tools and aids than otherwise employed. Pupils of the third and fourth grades compared with pupils of the second grade

were less forthcoming in stating that the category of teaching tools and aids are used less than is required in class. On the other hand, as they move into higher grades, the satisfaction of pupils with usage of teaching tools and aids also rises.

Moreover, analysing the categories of greater or lesser usage of teaching tools and aids with pupils of all grades (second, third and fourth) who seek change in usage of teaching tools and aids, a greater need for their usage in class is shown. This supports the idea that in teaching, tools and aids should be used more often and media and multimedia which have not yet been used in class and which could also stimulate developmental needs of pupil should probably be introduced. There is not a greater need for reduction of media and multimedia which are used in class, which means that their usage in the majority of cases, does not lead to an overload.

8.3. EVALUATION OF EFFECTIVENESS OF MULTIMEDIA AND DIDACTIC CRITERIA FOR ASSESSING MULTIMEDIA

Part of the research which relates to evaluation of the effectiveness of multimedia is significant in order to obtain answers to the third research question: do teachers conduct evaluation on usage of multimedia? Apart from that, it is interesting to discover which didactic criteria teachers use in evaluating multimedia in their practical work, and this was also the fourth research question.

28.6% of teachers have a way of checking while 45.2% do not. If the fact that 26.2% of teachers who did not answer this question is added to this, 71.4% of teachers either do not have a positive answer or do not have any kind of answer for conducting evaluation.

It can be concluded that somewhat more than a quarter of teachers (28.6%) have a way of checking the level of effectiveness of multimedia with pupils.

Table 33: Method of checking multimedia effectiveness

<i>Method of checking multimedia effectiveness</i>	f	f%
Teacher has way of checking	36	28.6
Teacher does not have way of checking	57	45.2
Do not know	33	26.2
<i>Total</i>	<i>126</i>	<i>100%</i>

The fact that only 28.6% of teachers have a way of checking effectiveness level of multimedia is not at all encouraging data as the aim immediately becomes questionable and thereby the quality of multimedia usage with the remaining number of teachers.

It is symptomatic that 71.4% of teachers do not conduct evaluation on multimedia usage or from that number even 26.2% did not reply at all to this question, which points to the conclusion that in practice there is ambiguity and non-definition where the question of evaluation of multimedia usage is concerned. Non-verification on effectiveness of multimedia usage is a result of a lack of awareness on the part of the teacher as well as unsystematic usage of multimedia, which means that arrangements for their further education in the stated field should be organised.

Furthermore, the relationship between method of checking the effectiveness of multimedia and independent variables was examined: gender, age, years of working experience, educational qualifications, status, size and equipment of school. It was established that all answers are independent in relation to all independent variables. Not even teachers with university degrees have a greater possibility during Teacher Training study to acquire more information from this area, as the majority of university professors did not do practical work.

Therefore, replies are sought with teachers who carry out evaluation of multimedia usage in practice. The responses of teachers who carry out evaluation of multimedia in their work are separate. Those teachers check the impact of multimedia in various manners:

Teacher no 1: “On actual tasks on the check lists.

- “ 2: Pupils themselves show satisfaction with such work along with added interest and activity.
- “ 3: Written and oral checking.
- “ 4: Their reaction to the lesson, acquired knowledge.
- “ 5: They quickly grasp new contents, knowledge is more lasting.
- “ 6: Through monitoring, examining and marking.
- “ 7: Oral or written checking e.g. after watching a film.
- “ 8: Discussions with pupils.
- “ 9: Practical work, tasks in written form, demonstration.
- “ 10: According to satisfaction of children as well as personal assessment.
- “ 11: Feedback information of pupils.
- “ 12: Check-up on computer.
- “ 13: Monitoring children over a certain period.
- “ 14: Self-reflection i.e. group evaluation
- “ 15: Evaluation at the end of the teaching day and, if required, following the completion of certain teaching units.
- “ 16: Testing knowledge, abilities.
- “ 17: Discussing, retelling, describing, repeating...
- “ 18: Checking in media culture. Ability of communication with media. Participating in analysis of film, TV
- “ 19: Discovery of mistakes, “gap” in pupils’ knowledge, how to complete, correct, improve. Methods and techniques for gathering “insight”, personal introspection of studying pupils, keeping a file on pupils, action research.”

The main didactic criteria of checking their effectiveness with teachers who replied that they have a way of evaluating multimedia is the pupil. In this connection, the accent is on feedback information which is obtained through various didactic procedures of checking the pedagogical-educational achievement of the pupil. In checking effectiveness of multimedia usage, the authentic approaches of teachers are considered very positive as the future of teaching work along with multimedia usage is based on direct feedback information of pupils.

The results obtained confirm the hypothesis that from a total number of teachers who use multimedia in teaching, very few of them carry out evaluation (altogether 28.6% of teachers).

In reply to the question: how do they know that it is precisely the chosen multimedia which is more effective than some other, teachers gave various answers:

Teacher no. 1: "From experience.

- " 2: From the activity and interest of the pupils themselves.
- " 3: On the basis of diagnostic, formative and summative evaluation.
- " 4: I have checked those combinations and received positive results.
- " 5: According to the results of the check-up.
- " 6: I cannot be sure. Only further work will show the effectiveness.
- " 7: A combination of multimedia must be suitable for class units.
- " 8: According to reaction of pupils.
- " 9: It depends on the composition of the class, what we are doing, how pupils previously reacted to that media
- " 10: From working experience to date.
- " 11: Because I chose multimedia in accordance with the interest which the pupils showed.
- " 12: I know my pupils and I follow their activities.
- " 13: Because of interest.
- " 14: I don't know, I strive to make it effective.
- " 15: Direct feedback information from the pupils themselves.
- " 16: I know my pupils well and their possibilities and abilities.
- " 17: Because pupils look for different media and I see myself what is needed.
- " 18: Teaching situations require multimedia choice."

Teachers' responses were classified into several categories. Those categories of components are basic elements of multimedia choice criteria and relate to: pupil, teacher, multimedia and teaching strategies. Categories which relate to pupils are: pupils' activeness, their intrinsic motivation and developmental level. Categories which relate to teachers are their professional competencies where the basic guidelines lie in their working experience and awareness of multimedia. The category which relates to multimedia is the specific quality of its structure, while the categories of teaching strategies relate to: compatibility with the teaching aim and

evaluation of multimedia effectiveness. From the above-mentioned, it follows that teachers assess the level of effectiveness of multimedia on the basis of various didactic criteria. Here the link between teachers' responses and fixed criteria of multimedia choice in teaching in the theoretical part of the work can be seen.

Evaluation of multimedia efficacy is the last stage of teaching activity because at the end of the lesson, apart from other things, multimedia usage is assessed. Evaluation relates to the assessment of what has been done and achievement of the pupils with the aim of reaching a conclusion and new decisions in future planning of teaching strategies. An analysis of teachers' response confirm the hypothesis that in evaluation, teachers use heterogeneous didactic criteria. In this connection teachers achieve various individual approaches in assessing their efficacy aspiring towards multimedia which are more suitable to pupils and stimulate them more in their development. The pupils themselves are the most widely-applied didactic criteria in an ongoing quest for the best multimedia combinations, which point to a process as well as a productive activity.

8.4. SUITABILITY OF MULTIMEDIA FOR PUPILS

The fifth research question is: Do teachers consider that multimedia are equally suitable for all pupils or they are, to a certain extent, suitable for pupils of different achievement levels. The teachers' opinion was tested with regard to usage for all pupils or a specific group of pupils (average, above-average or below-average) given the developmental level of pupils. The majority of teachers (61.1%) consider that multimedia can be used in class for all pupils. This means that, in their opinion, multimedia satisfy the needs of pupils of all developmental levels. In second place are teachers who consider that multimedia is used for average pupils (15.9%), followed by teachers who consider that multimedia is used for above-average pupils (13.5%). The least number of teachers consider that multimedia is used for below-average pupils (3.2%).

Table 34: Usage of multimedia in relation to the developmental levels of pupils

<i>Usage of multimedia with regard to developmental levels of pupils</i>	f	f%
Multimedia is used for all pupils	77	61.1
Multimedia is used for average pupils	20	15.9
Multimedia is used for above-average pupils	17	13.5
Multimedia is used for below-average pupils	4	3.2
Don't know	8	6.3
<i>Total</i>	126	100%

It is true that multimedia can be used in teaching activities for all pupils in the class. However, in accordance with Mayer's (Mayer, 2005, page 105) results of research shown in the theoretical part of the paper, usage of multimedia with pupils of a lower level of knowledge has greater impact in learning. Therefore, it is important to explain to teachers the significance of multimage usage, especially for below-average pupils. One group of teachers (6.3%) did not know the response to this question, which indicates that in practice there is insufficient experience of their application as there is no formed opinion on multimedia usage.

As regards the pupils' understanding of multimedia messages, in a great number of responses (88.9%), teachers consider that pupils understand multimedia messages. This means that multimedia mainly favour pupils as with their specific qualities they enable understanding of teaching contents. In this itself, by and large, they are popular. Only one teacher responded that pupils do not understand multimedia messages but the cause of such thinking cannot be analysed from this viewpoint. The third category of teachers' responses (10.3%) was an open type and related to teachers' replies that pupil understanding of multimedia messages depends on certain conditions (e.g. age, previous knowledge, external and internal pupil motivation, how they are guided in class).

Table 35: Pupils' understanding of multimedia messages

<i>Pupils' understanding of multimedia messages</i>	<i>f</i>	<i>f%</i>
Pupils understand messages	112	88.9
Pupils do not understand messages	1	0.8
Various	13	10.3
<i>Total</i>	126	100%

An open type of teachers' response (various) in effect points to the fact that multimedia are in a proportional relationship with didactic criteria of multimedia choice i.e. the more didactic criteria of multimedia choice are respected, the more suitable they are for pupils. Therefore the question on multimedia usage in relation to the developmental level of pupils and pupils' understanding of multimedia messages are linked. From this, it can be concluded that the more pupils understand the multimedia messages, the more accessible multimedia will be as a teaching device to a greater number of pupils in class. Here there is the possibility of simultaneous usage of several different multimedia which, freely chosen by the pupil, fulfils the pedagogical-educational achievement of pupils.

If pupils' responses parallel with teachers' are analysed regarding their understanding of teaching contents, pupils gave different responses than their teachers. A great majority of pupils understand 67.1% or partly understand 31.2% teaching contents. 1.5% of them do not understand the teaching contents. Here also we can see the possibility of linking pupils' understanding of multimedia messages with school success as the more the teaching contents are understood, the greater the school success will be, it is assumed.

Table 36: Pupils' understanding of multimedia messages

<i>Pupils' understand of teaching contents</i>	<i>f</i>	<i>f%</i>
Pupils understand teaching contents	918	67.1
Pupils partly understand teaching contents	427	31.2
They do not understand	20	1.5
No reply	4	0.3
<i>Total</i>	1,369	100%

Teachers' and pupils' responses were compared. While 88.9% of teachers consider that their pupils understand multimedia messages, 67.1% of pupils state that they understand and 31.2% of pupils understand the messages partly. The stated assumption of proportionality of understanding of teaching contents with multimedia usage and school success of the pupil confirm the facts that the previous class 69.1% of pupils passed with excellent school marks although it must be taken into account that in class, apart from multimedia, many other teaching tools and aids are used which may affect school success of the pupil. Nevertheless, it can be concluded that pupils' responses are closer to the real situation i.e. the results of their school success. This means that teachers do not have the most accurate picture of their pupils and their understanding of teaching contents i.e. they have a better opinion than their pupils present. A solution to this problem is seen in the theoretical organisation and application of teaching strategies where attention should be paid to further usage of multimedia, media, individualisation, differentiation and problem approach in class activities. In further usage of multimedia, greater consideration should be paid to evaluation of those same didactic criteria of choice thereby speeding up understanding of teaching contents. Individualisation, differentiation and problem approaches in teaching activities impact on a more active relationship of the pupil towards learning in class.

Research has demonstrated (Mayer, 2005, page 105) that pupils with the lowest performance who achieve the greatest progress in application of multimedia in learning have the greatest benefit from multimedia. The assumption that the greatest number of teachers will not realise the differences of impact of application of multimedia in class with pupils of various abilities,

given the lack of contemporary insight into application of multimedia in teaching was confirmed. This is corroborated by the various results of attitudes of teachers and pupils on understanding multimedia messages. A solution is seen in additional education of teachers and in paying greater attention by them in discovering the cause of weaker understanding of teaching contents of their pupils.

8.5. ELEMENTS WHICH EMPOWER OR INHIBIT USAGE OF MULTIMEDIA IN TEACHING

The sixth question stated: To what extent are elements present which empower usage of multimedia in teaching and how are they connected with socio-demographic variables?

Since teachers are moderators in the teaching process, their attitudes on elements which empower multimedia usage in teaching were checked. Therefore, conditions of multimedia usage in teaching were monitored through several variables: professional competencies of teacher, acquisition of knowledge for multimedia usage, form of professional training for multimedia usage, self-censorship of teachers as well as level of equipment of school with teaching media.

Professional training of teachers for multimedia usage is a basic condition for multimedia usage in teaching. In answer to the question whether they were professionally trained for multimedia usage, more than half the teachers questioned consider that they are sufficiently qualified for multimedia usage; this was followed by teachers who consider that they are partly qualified (27.8%) and teachers who consider that they are completely qualified (13.5%).

Table 37: Professional training of teachers for multimedia usage

<i>Training of teacher</i>	<i>f</i>	<i>f%</i>
Completely qualified	17	13.5
Sufficiently qualified	74	58.7
Partly qualified	35	27.8
<i>Total</i>	126	100%

Through connecting the categories of sufficiently and completely qualified, 72.2% of teachers consider themselves trained for multimedia usage in teaching. However, those responses are disproved by the statement of 71.4% of teacher that either there is no way of checking the effectiveness of multimedia or there is no kind of response to carrying out evaluation. This means that all teachers who replied that they are sufficiently qualified, are nevertheless insufficiently trained as they lack an assessment of their own work. With regard to the fact that 27.8% of teachers consider themselves partly qualified for multimedia usage, the results point to the conclusion that for those teachers additional education, focused on further training, should be organised.

Table 38: Values of χ^2 test for linkage among dependent variables of trained teachers for multimedia usage and some independent variables

<i>Variables</i>	χ^2	df	p
Gender	0.24	2	0.886
Age	1.08	4	0.896
Years of working experience	2.63	4	0.620
Educational qualifications	4.78	2	0.091
Status	1.62	2	0.205
Size of school	2.49	4	0.646
Level of equipment of school	3.37	4	0.498

Checking the linkage between dependent variables of trained teachers for usage of multimedia and independent variables, no statistically significant results in either categories of independent variables were obtained. This means that there is no connection of trained teachers for multimedia usage and gender, age, years of working experience, educational qualifications, status, size and level of equipment of school. Training of teacher for multimedia usage does not depend on gender, which means that both teachers and pupils can be, in that sense, more or less trained. The training of teachers for multimedia usage does not depend on age, as young, middle-aged and older teachers can be more or less trained. The teacher's years of working experience do not impact on the training of teachers for multimedia usage, as teachers with more or less working experience can be more or less trained. Although the results from table 32 do not show statistically significant differences, the χ^2 educational qualifications signals that educational qualifications of teachers can have an impact on the level of teacher training for multimedia usage in class. The status of teachers does not have a link with their competencies for multimedia usage as the teachers and teacher mentors as well as teacher advisors can be more or less trained. The size and level of equipment of school does not have an impact on the competencies of teachers for multimed usage because teachers who work in larger or smaller schools as well as better equipped or badly equipped schools can be more or less competent. All of this leads to the conclusion that teacher training for multimedia usage depends on their individual characteristics and it would be interesting in future research to investigate some other variables on which the competencies of the teacher would depend.

Furthermore, it would be interesting to check the sources of help from which the teachers acquired knowledge on multimedia usage in class. In response to this question, the teachers were given the possibility of multiple answers. The information obtained was important because in accordance with the responses of the teacher, a solution for further education of teachers in the stated fields could be offered. Teachers acquired knowledge into multimedia usage mainly from their own experiences (73%), followed by professional literature (48.4%), professional upgrading courses (43.7%), teachers' university course (42.9%), from colleagues at work (29.4%), school's counselling staff (7.1%), nowhere (3.2%).

Table 39: Acquired knowledge on multimedia

<i>Knowledge on multimedia</i>	<i>f</i>	<i>f%</i>
From own experience	92	73
Professional literature	61	48.4
Professional upgrading courses	55	43.7
Teachers' university course	54	42.9
From colleagues at work	37	29.4
Counselling staff at school	9	7.1
Nowhere	4	3.2

It can be concluded that teachers in using multimedia mainly gain knowledge through their own experiences. Apart from own experiences from practice, teachers gained knowledge of multimedia usage from professional literature and professional upgrading courses. Therefore work needs to be done on enriching didactic-methodical literature and thematic interfusion of professional teacher conferences focused on new knowledge of multimedia. During regular teachers' university course and additional qualifications, teachers acquired knowledge mainly from the computer science course. Therefore, students of teacher training colleges for primary education should focus more on raising awareness of the significance of multimedia, not only through the course of computer science but also through other courses, e.g. methodics. Working on all stated levels, a holistic approach in raising awareness of the problem of teaching multimedia would be created. The link between university course as a way of acquiring knowledge on multimedia and some independent variables was tested. Studying their connection, it is concluded that between the university course as a way of gathering knowledge of multimedia and status, educational qualifications, age and years of working experience of teacher, there is a statistically significant difference as opposed to independent variables of gender, size and equipment of school where no statistically significant results were found.

Table 40: Values of χ^2 test for linkage between teachers' university course as way of knowledge on multimedia and some independent variables.

<i>Variables</i>	χ^2	df	p
Gender	0.00	1	1.000
Age	25.04	2	0.001
Years of working experience	23.29	2	0.001
Educational qualifications	13.26	1	0.001
Status	7.87	1	0.005
Size of school	0.48	2	0.787
Level of equipment of school	0.55	2	0.757

Through analysing the relationship of independent variables (status, educational qualifications, age and working experience) as well as teachers' university course as sources of knowledge, statistically significant results were obtained which showed that:

- With teacher status, teachers significantly more often state acquisition of knowledge through the university course than through teacher mentors and teacher counsellors ($\chi^2=7.87$; $df=1$; $p=0.005$). This is understandable because young teachers cannot immediately be promoted to a higher status and their knowledge acquired during university studies are „fresher“ while teacher mentors and teacher counsellors older than them did not have as much information on multimedia teaching during their university studies.
- Between subjects of various educational qualification, those with university level education ($\chi^2=13.26$; $df=1$; $p<0.001$) significantly more often state acquisition of knowledge through the Teacher Training study course than those with secondary and associate two-year degree, which is understandable because the knowledge which they obtained at the faculty is still „fresh“ and which could be incorporated in teaching only after the 90s of the last century.
- Between subjects of various ages, those who were younger than 30 years old and to a lesser extent those between 31 to 45 ($\chi^2=25,04$; $df=2$; $p<0.001$) significantly more often state knowledge gained through their university study than those

subjects who were 46 years and older. It is exactly those teachers up to 30 years old and from 31 to 45 years old who gained knowledge of multimedia because they were educated through regular university teacher courses or through additional education, compared to teachers aged 46 and more who do not have the need to educate themselves further because of the shortness of the working life remaining, which is the reason for the following statement.

- Among subjects of different working years' experience, subjects with working experience from 0 to 10 years ($\chi^2=23.29$; $df=2$; $p<0.001$) significantly more often state knowledge acquired on the university course than subjects who have 21 years and more working experience. It can be emphasised that during the period of studying with older teachers, there was not so much actual information connected to multimedia usage in class when compared to ten years ago.

The linkage between the university study for seeking information on multimedia with gender, size of school and equipment of school is not statistically significant. This means that there is no difference between male or female teachers in significantly more frequent mention of the university teacher study as a way of acquiring knowledge on multimedia. Also, there is no difference between teachers who work in different large or differently-equipped schools in significantly more frequent mention of university teacher study course as a way of gaining knowledge on multimedia.

The link with sources of knowledge on teaching multimedia is also made up of teachers' proposals on future education of multimedia application in class. Therefore, teachers' opinions on their future education as part of lifelong education was examined. *Forms of professional training for multimedia usage proposed by teachers are:* professional lectures in schools for all teachers (76.2%), individual forms of upgrading within the framework of obligatory permanent upgrading (50.8%), lectures at professional workshops (46%) as well as studying professional literature (37.3%).

Table 41: Proposal for teachers' professional upgrading form for multimedia choice and usage

<i>Professional upgrading of teachers</i>	<i>f</i>	<i>f%</i>
Professional lectures	96	76.2
Individual forms	64	50.8
Professional workshops	58	46
Professional literature	47	37.3

The premise is based on the fact that professional competencies of the teacher are of extreme importance for multimedia usage in class, as the person who has contemporary knowledge on multimedia and media generally has greater possibilities for more conscious impact in practice in stimulating pupils' learning. From the results stated, it can be concluded that teachers mainly give attention to „external“ education i.e. professional lectures in school. In this connection the following are extremely important: educational policies of the lecturer and his/her competencies for imparting knowledge, whether the lectures are held in school, at professional workshops or some other places as that education impacts on the level of professional qualification of the teacher. Half of the teachers questioned show independence and freedom of individual choice towards ongoing education. Analysing the Catalogue of Professional Upgrading of Teachers at professional workshops, it should be obligatory with this form of upgrading to include themes where multimedia usage in class is covered. The fact that teachers placed professional literature on the last place is interesting. This may suggest that teachers can find all needed information on the internet or that they prefer „the living word“ instead of reading, moreover because teachers at conferences have the possibility of exchanging ideas and experiences in teaching work.

The link between professional workshops as a way of gaining knowledge on multimedia and some independent variables was tested. Studying their connection, it is concluded that there is a statistically significant difference between professional workshops as a way of gaining knowledge on multimedia and the teacher's age when compared to independent variables: status, educational qualifications, working years' experience, gender, size and equipment of school, where no statistically significant results were found.

Table 42: The values of χ^2 test for linkage between professional workshops as ways of gaining knowledge on multimedia and some independent variables.

<i>Variables</i>	χ^2	df	p
Gender	0.46	1	0.497
Age	6.46	2	0.039
Years of working experience	4.81	2	0.090
Educational qualifications	2.56	1	0.109
Status	0.46	1	0.498
Size of school	0.89	2	0.639
Level of equipment of school	2.53	2	0.281

Among subjects of different ages, a statistically significant difference ($\chi^2 = 6.46$; $ss=2$; $p=0.039$) was obtained. Subjects between the ages of 31-45 significantly more frequently state training through professional workshops than subjects up to 30 years old, as certain knowledge was acquired during their university study. This means that teachers between 31-45 years old are aware that their younger colleagues are in a “better” position due to the fact that during university study they received information in accordance with technical-technological changes which did not exist in their study days. Therefore, they see a way out in further education at professional workshops.

The results obtained with years of working experience ($\chi^2 = 4,81$; $ss=2$; $p=0.090$) point to the possibility that years of working in the profession could be connected with professional workshops, taking into consideration the fact that teachers at professional workshops exchange work experience and have passed many different forms of organised permanent education.

Linkage between professional workshops as a way of gaining insight into multimedia with the status of teachers, their educational qualifications, gender, size and equipment of school, is not statistically significant, as teachers lay greater importance in professional lectures in comparison with professional workshops.

Through examining the elements which empower multimedia usage in class, attention is focused on the conditions in which teachers work. Therefore, the *teacher's attitude on level of equipment of primary schools* where they work related to level of equipment of school with teaching tools and aids. In the given table, it can be seen that the level of equipment of Croatian schools with teaching tools and aids is mainly good (61.1%). A fifth of teachers consider that they work under very good conditions given the level of equipment of the classroom with teaching tools and aids (20.6%).

Table 43: Level of equipment of school with teaching tools and aids

<i>Level of equipment of school</i>	<i>f</i>	<i>f%</i>
<i>Very good</i>	26	20.6
<i>Good</i>	77	61.1
<i>Poor or very poor</i>	23	18.3
<i>Total</i>	126	100%

A smaller number of teachers are not satisfied with the level of equipment of schools with teaching tools and aids as the level of equipment of schools with teaching tools and aids is poor or very poor (18.3%). Subjects who were questioned on level of equipment of schools with teaching tools and aids wrote the answer: poor or very poor level of equipment; they should have stated the reasons for poor level of equipment in schools. All consider that the reasons for poor level of equipment of schools is of a financial nature i.e. problem is in the lack of money to purchase same.

Linking the categories of very good and good level of equipment of school (81.7%) a satisfactory state can be seen. However, nothing is so good that it cannot be improved. If the result very good level of equipment of school with teaching tools and aids is underscored (20.6%), it can be concluded that only in one-fifth of schools is level of equipment of media very good and that with four-fifths of primary schools steps should be taken to improve same. The reasons for this state can be seen in changes in the social system of the Republic of Croatia which triggered changes in teaching tools. Many teaching tools were thrown out as

they had become unsuitable (e.g. geographical maps, musical examples, films, literary texts etc.) and not so many new ones could be purchased for financial reasons as well as allowing some time to pass before devising and shaping new teaching tools. Apart from that, many new technical innovations in the form of teaching tools and aids appeared, supplanting the old ones.

On the basis of the given results, the assumption proved to be correct that in providing multimedia usage in class the professional competence of the teachers had an impact along with their acquired knowledge, professional upgrading and level of equipment of school. However, practice can have a much greater impact on the quality of professional training of teachers, their acquired knowledge, professional upgrading and level of equipment of school where they work.

Which are the most common elements in using multimedia which teachers consider inhibiting in class was the seventh research question. This question was focused, in the majority of cases, on self-censorship. *Self-censorship of teachers represents elements which inhibit the teachers in using multimedia in class.* Self-censorship of teachers is in internal stumbling-blocks which inhibit them in a developmental approach to pupils. Therefore, causes of non-usage of multimedia can be found in inhibiting elements for multimedia usage. Analysing responses which relate to inhibiting elements, teachers come across the following obstacles which are ranged in order from the greatest to the least: lack of multimedia in school (50.8%), lack of time for usage of multimedia due to the scope of the curriculum (48.4%), a large number of children in subject's class (35.7%), unsuitable premises (28.6%), preparation for multimedia usage by teacher is too time-consuming (15.1%), subject is untrained for multimedia usage (14.3%), and poor state of media (7.9%). Not one teacher mentioned any other inhibiting element but chose what was provided. Only 11 teachers (8.7%) do not have inhibiting elements for multimedia usage in class.

Table 44: Inhibiting elements for multimedia usage in class

<i>Inhibiting elements</i>	f	f%
Lack of multimedia	64	50.8
Curriculum	61	48.4
Numerousness of children	45	35.7
Unsuitable premises	36	28.6
Time for preparation	19	15.1
Non-trained for usage	18	14.3
No obstacles	11	8.7
Poor state of media	10	7.9

On the basis of the results presented, it can be concluded that 91.3% of teachers questioned or 115 from 126 subjects, notice inhibiting elements in their work while only 11 teachers (8.7%) stated that there are no obstacles in using multimedia. Teachers who use multimedia in their teaching work without any inhibiting elements, demonstrate a different, more positive attitude than those who see inhibiting elements as problems which impact on multimedia usage.

Comparing the lack of multimedia as inhibiting elements for multimedia usage with level of equipment of school with media, 50.8% of teachers stated that lack of multimedia in school inhibit them while simultaneously 81.7% consider that their school is very well or well equipped with teaching media. The data obtained are not compatible as the school which is well equipped with teaching tools facilitates their usage from the viewpoint of the material (physical) environment in which teachers work. However, this fact can be interpreted in such a manner that classrooms are equipped with modern media but are not equipped or not sufficiently equipped with computer science equipment.

The link was tested between the greatest inhibiting element – lack of multimedia in school - and independent variables: gender, age, years of working experience, status of teacher, size and level of equipment of school. Studying their connection, it can be concluded that between lack of multimedia in school and educational qualifications, working experience, level of equipment of school, there are statistically significant differences in comparison with

independent variables: age, gender, status of teacher and size of school, where no statistically significant results were found.

Table 45: Values of χ^2 test for linkage between lack of multimedia in school and some independent variables

<i>Variables</i>	χ^2	df	P
Gender	2.75	1	0.097
Age	3.13	2	0.209
Working experience	6.27	2	0.043
Educational qualifications	11.70	1	0.001
Status	0.01	1	0.893
Size of school	0.20	2	0.902
Level of equipment of school	13.10	2	0.001

Among subjects of various educational qualifications a statistically significant difference ($\chi^2=11.70$; $df=1$; $p=0.001$) was obtained. Subjects with a university degree significantly more frequently state lack of multimedia in school as an inhibiting elements in work than those with secondary or an associate two-year degree. Subjects with a university degree had courses of computer science during their studies where they honed the skills of computer usage and so they spoke out more regarding lack of multimedia. Their educational qualification can also be linked with years of working experience as subjects with a university degree have working experience of 0 to 10 years and significantly more frequently state lack of multimedia in school as an inhibiting elements in work than subjects who have from 11 to 20 or 21 and more years of working experience (a statistically significant difference $\chi^2=6.27$; $df=2$; $p=0.043$). Therefore, there is a visible connection between subjects with a university degree and years of working experience. A statistically significant difference was obtained between subjects with various assessment of level of school equipment ($\chi^2=13.10$; $df=2$; $p=0.001$). Subjects who assess that level of equipment of their school is poor or very poor significantly more frequently state lack of multimedia in school as an inhibiting element in work than those who assess level of equipment in school as very good.

A link between lack of multimedia in school and independent variables: age, gender, status of teacher and size of school, is not statistically significant. Between subjects of different ages, no statistically significant difference in relation to lack of multimedia in school was obtained, which means that it was not noticed that teachers of a certain age were inclined more often than others to point out lack of multimedia in school. This means that teachers of any age can be inhibited by their own self-censorship in work. Between subjects of different gender, no statistically significant difference in relation to lack of multimedia in school was obtained, which means there was no reason that female teachers were much more likely than male teachers to highlight lack of multimedia in school. Male or female teachers do not determine the educational policy of their work. Between subjects of different status, no statistically significant difference in relation to lack of multimedia in school was found, which means that it was not noticed that teachers were much more likely than teacher mentors and counsellors to point out lack of multimedia in school. Between subjects of various size of school where they work, no statistically significant difference in relation to lack of multimedia in school was obtained, which means it was not noticed that teachers of smaller schools were much more likely than teachers of medium-size schools or larger schools to point out lack of multimedia in school, as smaller and medium-size schools can be better equipped than larger schools; this depends on the abilities of the head person of the school i.e. the principal, as well as management and marketing led by the same staff. The general conclusion would be that teachers of any age, gender, status or size of school where they work can be at a lower or higher level of impact, which depends exclusively on themselves.

In first place, teachers mention lack of multimedia which speaks about the poorer level of equipment of multimedia in the classroom as well as the lack of resolve to devise authentic multimedia. The scope of teaching contents is a huge problem for teachers i.e. inhibiting element of multimedia usage, which points to the fact that they are a slave to form. The great number of children in class should not be a problem in the era of contemporary teaching which includes various methods and techniques of work with larger numbers of pupils. This data points to the conclusion that the fewer children there are in the class, the easier it is to work and the teacher can have a more individual approach to children, so with the teacher there is resistance in relation to the numerosness of pupils in class. As regards unsuitable premises, this should be defined what it means to certain people. Unsuitable premises for multimedia usage can have several unfulfilled requirements: there are not enough sockets, weak supply of electricity which leads to short circuits during computer usage, insufficient number of

computers or multimedia educational back-ups in the classroom. The time required for teacher's preparation of multimedia usage is an individual category: some teachers need more time, some less. If the teachers themselves make the multimedia educational back-ups, then they need more time due to the process of creation and production. If teachers otherwise have problems with lack of time, they need to work on the skill of rationalising preparation time for class. Non-training for multimedia usage relates to the professional competencies of the teacher who can impact on its non-usage. With the possibility that a half-open type of question was provided where they could write concrete obstacles, not one teacher used the given possibility.

The expectation that the greatest number of teachers would state as an inhibiting element lack of multimedia in school as a basic problem was proved correct. For the greatest number of teachers (50.8%), lack of multimedia also represents the greatest inhibition in work.

8.6. ADVANTAGES AND DISADVANTAGES OF MULTIMEDIA TEACHING

The response to the eighth research question on the opinion of the teacher about the advantages and disadvantages of multimedia teaching will be laid out in the manner of interpreting the replies of the teachers on the advantages of multimedia followed by their disadvantages. Since the questions were open type, the original responses of the teacher are stated. *The advantages of multimedia usage* in the teachers' opinion are as follows:

Teacher no.1: „Better, more successful and interesting class.

- „ 2: Lucidity, greater motivation for work, sometimes better results in learning.
- „ 3: Economical quality, lucidity, systematisation, stronger experience (stimulation).
- „ 4: Dynamism of class, interesting features, systematisation, lucidity.
- „ 5: Drawing closer to children's interests, following contemporary technology, modernisation of educational system.
- „ 6: During multimedia usage children are more active, they research themselves.
- „ 7: The pupil has the possibility himself of determining and choosing the tempo of learning as well as teaching content which he wants and can master.
- „ 8: Quicker and easier connection and mastering of teaching contents by pupils.

- „ 9: Lucidity in teaching, encourages activity, additional motivation.
- „ 10: To enrich the child's experiences, sensory and cognitive development.
- „ 11: A more intense evocation and easier execution of theme, more entertaining atmosphere.
- „ 12: Develops oral skills, ability to produce and develop rhythm with pupil.
- „ 13: It is more interesting for the pupils and they do not have to look constantly at me.
- “ 14: Concretisation.
- “ 15: Children have opportunity to learn in harmony with the times in which they live and in which they will live.
- “ 16: Promotes manner of demonstration and learning.
- “ 17: Dynamism and interesting features of class....actively engaged pupils.
- “ 18: Widens new knowledge and adds to existing.
- “ 19: Curriculum is better carried out.
- “ 20: More interesting teaching..... pupils remember better teaching contents and apply what is learned in practice.
- “ 21: Activities are more dynamic....everything is more pictorially displayed and through multimedia the curriculum is shown in a more interesting way.
- “ 22: Activeness of all pupils during the lesson.
- “ 23: More effective mastering of teaching contents, teaching in line with learning style of pupil.
- “ 24: Children more easily master subject matter and remember it longer.
- “ 25: Better access to information, intercultural cooperation.
- “ 26: To offer opportunity to pupils who do not have possibility of using multimedia at home to keep abreast of developments in the world.
- “ 27: We teach pupils that the teacher is not the only source of knowledge, we teach them how to find and access information.
- “ 28: Simpler and more pleasant way of reaching goals.
- “ 29: Economic quality of teaching; different sources and stimulations have a positive effect on perceptions of pupils' abilities.
- “ 30: Those areas which children find difficult are more accessible.
- “ 31: Greater experience-linked values for pupils.
- “ 32: Able to explain teaching contents in several way and with several sources.”

The advantages of multimedia usage in teaching are focused on the responses which relate to class and pupil. Answers which relate to class are manifested in its characteristics: it is more interesting, higher quality, lucid, dynamic, systematic, modern as contemporary teaching strategies are used, concrete and economic. Multimedia offers the possibility of using several different methods. The teaching contents can be executed more qualitatively as well as pedagogical-educational achievements. The vividness of multimedia creates external motivation. From time to time multimedia takes over the role of teacher in leading pupils. Difficult-to-access reality is made easier. Multimedia teaching triggers external motivation, a creative atmosphere and a positive environment.

Responses which relate to pupils show that pupils are actively engaged in the process of learning, researching, they learn faster and more easily, knowledge is more lasting and they also develop abilities and skills. Multimedia stimulates the independence of the pupil. The rich source of information encourages pupils to strengthen their potential for information usage. A multimedia approach impacts on the audio-visual senses of the pupils and experiences are enriched. It impacts in a more diversified manner on developmental changes, aiming towards individual perceptive potential of pupils, the time-frame of acquiring information and towards their learning styles. In this way, pupils actively participate in the learning process.

Teachers stated quality of multimedia as an advantage that impacts on the modernisation of the teaching process. Through an analysis of their responses, two categories were observed which helped to classify them. Multimedia have advantages for pupils' achievement in learning and usage in class. From 32 teachers (25.4% of the total number of teachers questioned) who responded to an open type question on the advantages of multimedia in class, 23 teachers (responses of teachers under numbers: 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 15, 17, 18, 20, 21, 22, 23, 24, 26, 27, 29, 30 and 31) see the advantages in the process of learning with their pupils. Therefore, through their answers, the teachers confirmed the hypothesis that the advantages of multimedia are recognised through the impact on the level of knowledge and motivation of pupils, but also stated other advantages which relate to the pupil: activeness in class, independence, ease and speed of learning, development of various competencies of pupils, respect for pupils' learning styles as well as long-term memory of that learned. Twenty-three teachers (see teachers' response under numbers: 1, 3, 4, 5, 8, 9, 11, 13, 14, 16, 17, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30 and 32) see advantages of multimedia in the

teaching-strategic impact that creates a correlation between multimedia and other elements of the didactic-methodical field. The responses of teachers prove that there is a relationship between multimedia and other elements of the didactic-methodical field which is described in the paper under the heading: “The place of multimedia in various models of teaching within the frame of poly-factorial understanding of lessons”. Through multimedia usage the following is encouraged: usage of principles of systematisation and lucidity, more successful mastery of teaching contents, methods of demonstration and more successful achievement of the teaching aims. The meaning of multimedia as a teaching tool is in its interesting form of software as well as depersonalising the role of the teacher. When compared to the strategy of teaching, multimedia impacts on teaching at several levels. Multimedia also affects the creation of a positive class atmosphere.

The responses of teachers which relate to the *lack of multimedia usage* are:

Teacher no. 1: “Neglecting natural and direct experiences.

“ 2: Non-trained for usage.

“ 3: A certain social isolation (alienation), insufficient education (training) of pupils for usage of available multimedia.

“ 4: If there is bad choice of multimedia which are mutually excluded or they are not suitable for the age of pupils.

“ 5: If the contents are well chosen and suitable they are not available.

“ 6: Lack of time for usage.

“ 7: Too frequent usage.

“ 8: Is inaccessible to all pupils and teachers.

“ 9: Exaggerated usage creates overload.

“ 10: They can “draw” children to “research” on the internet which is harmful to them, etc.

“ 11: Not too long and exclusively.

“ 12: Less time spent in nature and the need for children to be active.

“ 13: Impossibility of school to purchase certain tools.

“ 14: Insufficient time given the curriculum.

“ 15: I don’t see any disadvantages except that all media do not impact equally on all pupils.

“ 16: Lack of communication between pupil – teacher.

“ 17: Lack of level of school equipment, impossibility for usage at a given moment.

- “ 18: It is not good if only multimedia is used in class. Everything in moderation.
- “ 19: Difficult to apply in class with a large number of children.
- “ 20: Certainly the teacher and his word, look, smile, movement, way of holding the class is important along with multimedia.
- “ 21: Lengthy preparation, unskilled.
- “ 22: Economical quality.
- “ 23: Pupils very often neglect the aim (educational tasks) and treat it as entertainment.
- “ 24: If they are an end in themselves – there is no benefit.
- “ 25: Exaggerated usage lessens the possibility of greater engagement of pupils in creating the lesson and covering some themes.
- “ 30: Lagging behind in following up advancement of modern technology and the rapid changes of knowledge.

The majority of stated disadvantages of multimedia usage in teaching depend on the competencies of the teacher. Whether multimedia will show an advantage or disadvantage mainly depends on the role of the teacher in devising and executing teaching strategies under conditions in which they work. A competent teacher has the power to: educate pupils for proper usage of multimedia, stimulate various social forms of work, choose suitable multimedia contents compatible with the curriculum, regulate the time of multimedia usage, exchange multimedia with other teaching tools and aids etc. The teacher is a person who is expected to educate pupils in using multimedia and learn along with them. Social isolation is not an acceptable disadvantage if multimedia encourage various social forms of work. For a “bad” choice of multimedia which are not suitable for the age of the pupils, the teacher is responsible as he did not choose an appropriate multimedia. A competent teacher will not allow “bad” multimedia which are not suitable for the pupils’ age to be used in class. Lack of time for multimedia usage is again self-censorship of the teacher because with proper organisation of teaching activities, a time frame for execution is foreseen. The teacher determines the scope and type of teaching contents, the time for mastering them and the length of time for multimedia usage, given the pupils’ previous knowledge, interest and concentration span, thereby excluding stereotypes and monotony. If that happens, they are replaced by more productive, more effective ones and that disadvantage is eliminated. The underlined disadvantage of multimedia that pupils spend less time in nature and that it limits the need of children for activity is correct. The question is asked, how many school teachers

from city centres spend time with their pupils in nature and how much of the children's need for activity is satisfied without multimedia usage? Apart from that, teachers can easily impact on this element with time constraints of multimedia usage, which again depends on the teacher's strategy and not on the multimedia itself.

The response of teacher no. 20 that along with multimedia the teacher is "important", "his/her word, look, smile, movement, way of holding the class....." does not distance the pupil from the teacher, neither does it lessen his/her values or communication; it puts the teacher in a different position of his/her activity in the sense that he/she teaches directly or indirectly. The remark that multimedia very often break down relates to the fact that in practice some schools get part of their computers through sponsorship of firm which donate old computers in order for them to purchase more modern ones. Therefore, the problem is that it is harder for an old computer to support multimedia educational back-up. Too frequent multimedia usage which leads to overload is not in fact a negativity of multimedia but relates to the person who organises and carry out the class. In other words, if proper "dosage" of certain multimedia is carried out, it will not cause overload. The stated response of teacher no. 23 that "pupils often neglect the aim (educational tasks) and understand it as entertainment" can be interpreted as a majort self-censorship of the teacher, since entertainment and learning is separated and he/she fails in the role of leader and guide of teaching work towards pedagogical-educational achievements.

Through an analysis of teachers' responses to open type questions of what the disadvantages of multimedia are in their opinion, a dissimilarity was noticed. Thirty teachers (23.8% of the total number of questioned teachers) replied very differently to the question. The assumption that lack of activity (response of teacher no. 12) and socialisation (response of teacher no. 3) would be the greatest problems in multimedia usage in class is partly true as lack of activity and socialisation are mentioned, not as the biggest or most common problems, but as one of several mentioned. The most common disadvantages of multimedia are time (response of teachers under numbers: 6, 7, 9, 11 and 14) and lack of multimedia in school (response of teachers under numbers: 8, 13, and 17). A link between these answers of teachers with the replies to the question: 'what obstacles do teachers have in multimedia usage' was noticed. Only 11 teachers (8.7%) stated that there were no obstacles in multimedia usage, which means that they use multimedia in class without any inhibition. With other teachers, the greatest inhibiting factor is lack of multimedia in school (50.9%).

Apart from those disadvantages, teachers state a poor choice of multimedia as regards unsuitability of contents, unskilled for application of multimedia, lack of communication between the pupil and teacher, neglect of direct experiences from nature, numerousness of children in class as well as indifference to aims. Similar to advantages of multimedia, a link and correlation was observed between lack of multimedia and elements of the didactic-methodical field, in accordance with the poly-factoral model of teaching.

8.7. TEACHERS' ATTITUDES ON SIGNIFICANCE OF MULTIMEDIA IN RELATION TO OTHER ELEMENTS OF DIDACTIC-METHODICAL FIELD

Through an analysis of the advantages and disadvantages of multimedia, according to teachers, their attitudes were examined within strategic activities, thereby obtaining clearer feedback information on their manner of multimedia perception. Teachers' attitudes were examined through: aim of teaching with pupils, aim of multimedia usage in class, impact of multimedia usage in class vis-à-vis its non-usage, opinion on the Curriculum, impact on multimedia teaching of pupil, influence on choice of multimedia, competencies of pupil which are honed through multimedia, types of intelligence which multimedia stimulate with pupils, types of class lessons where multimedia is used, possibilities of multimedia usage in classes, size of classrooms for multimedia usage as well as time required for preparing multimedia usage in class activities. In the previous sections of this paper, variables which also show teachers' attitudes were examined: empowering and inhibiting elements of multimedia usage, advantages and disadvantages of multimedia, professional training of teacher for multimedia usage and acquired knowledge on multimedia. All stated attitudes are their personal convictions. In this connection, attention is focused on those which perceive the relationship of multimedia with other elements of the didactic-methodical field.

Teachers' attitudes on aims of teaching were examined. Feedback information was obtained on what teachers found important in nurturing pedagogical-educational achievement. From the ranking obtained, shown in table 44, it can be seen that teachers place development of pupil in the first place (57.1%), this was followed by execution of the curriculum (36.5%) along with various others (6.3%). In the category of various others, teachers mainly responded:

Teacher no. 1: "Teaching and preparing pupils for lifelong education.

- " 2: Execution of curriculum as well as work on socialisation and teaching of pupil.
- " 3: To teach and educate them for life. To make their childhood the happiest part of life.
- " 4: To create a hard-working person – training for life.
- " 5: To sensitise the pupil for acquiring strategies and skills of learning whose aim is to improve the quality of living.
- " 6: To give them the feeling that they are accepted and loved as well as being unique and valued.
- " 7: Through execution of curriculum to influence changes in progress of pupil, develop and stimulate the pupil for independent thinking.
- " 8: To transfer knowledge to pupils in a clear manner which they will be able to apply with understanding.
- " 9: Collaborative learning, develop creative thinking.
- " 10: Stimulate pupils for active participation, trigger curiosity, interest.....
teach them.
- " 11: Develop critical thinking and creativity.
- " 12: Teach children how to learn, how to acquire new knowledge independently.
- " 13: Stimulate holistic development of each child.
- " 14: Harmonious development of all aspects of pupil's personality (intellectual, emotional, physical...).
- " 15: A combination of a (development of pupil) and b (execution of curriculum).
- " 16: To help children seek ways of solving any pedagogical or educational problem
- " 17: Contemporary teaching
- " 18: To teach and educate children.
- " 19: Training for life.
- " 20: Pedagogical impact, developing interest."

Although eight teachers responded only to open type questions, the replies of teachers who simultaneously circled individually provided responses are also stated. These open type responses point to the conclusion that teachers are focused on stimulating development of the pupil. The teachers emphasise the importance of training the pupil for life and lifelong education. Not one teacher wrote that the aim of teaching was to mark the pupil and so, as a result, this provided response was omitted from the table.

Table 46: Teachers' responses on the aims of teaching

<i>Teachers' responses on aims of teaching</i>	<i>f</i>	<i>f%</i>
Development of pupil	72	57.1
Execution of curriculum	46	36.5
Various	8	6.3
<i>Total</i>	126	100%

From the given results, it can be concluded that the largest group of subjects placed the development of pupil as the aim of teaching (57.1%). This result is not in accordance with some other responses of teachers who should also be focused on development of pupil. The fact that only 28.6% of teachers conduct evaluation of multimedia in class (table 31) and that (table 44) pupils' opinion impacts on multimedia choice with only 36.5% of teachers, are indicators of differences in relation to development of pupil as the aim of their work in teaching. Teachers felt what would be a desirable response and reacted accordingly.

Table 47: Aim of multimedia usage in class

<i>Aim of multimedia usage in class</i>	<i>f</i>	<i>f%</i>
Dynamics and interesting features of class	77	61.1
Influence on developmental changes of the pupil (flexibility of thinking)	29	23
Enriching classroom	14	11.1
Demonstration of multimedia	3	2.4
Various	3	2.4
<i>Total</i>	126	100%

Although three teachers provided only open type responses, they were joined by the responses of two teachers who also circled provided responses:

Teacher no. 1: “Enrichment of pupil, familiarising them with using and searching for new information.

“ 2: Developing all potentials of the child as well as senso-motoric, psycho-social and cognitive....

“ 3: Easier and more modern way of enabling acquisition of knowledge with children as well as application of that learned.

“ 4: Stimulates pupil’s curiosity and helps him/her to understand the purpose of learning.

“ 5: Enrich knowledge through (with the help of) different multimedia devices.”

These responses define the attitude of teachers towards stimulating development of the pupil and so teachers’ attitudes are the same in relation to the aim of multimedia usage in influencing developmental changes of the pupil, which altogether amounts to 25.4% of subjects. This is still incompatible with the previous 51.1% who place development of pupil as the aim of teaching, which means that half of the teachers in response to the question on aim of teaching replied mechanically because if they had a clearly defined stance, then this would show up in the percentage which relates to the response of the question of multimedia usage in class which is focused on the pupil. Taking into consideration that the focus in contemporary teaching is on the pupils, the teachers’ replies geared to class dynamics, enrichment of classroom and demonstration of multimedia represent formal elements.

Impact of multimedia usage in class in relation to their non-usage is the following examined variable. The greatest number of teachers (91.3%) consider that the impact with pupils is greater in comparison with teaching where multimedia is not used. This result shows the awareness of the teacher on the significance of multimedia usage. Just a minority of teachers (2.4%) are of the opinion that the impact of multimedia usage in comparison to its non-usage is the same or they consider that the impact is less (1.6%). Six teachers replied to this question in a free form:

Teacher no. 1: “It depends on the pupils, on the class. Multimedia are good to a certain extent

- “ 2: It depends on the individual, on the pupils’ experiences, interest of contents, age of the pupil.
- “ 3: It depends for what purpose multimedia is used; multimedia should be for the pupils, and not an end in itself.
- “ 4: Requirement: teacher’s knowledge and skill of applying multimedia in class.
- “ 5: It depends on the teacher.
- “ 6: It depends on contents and class subject.”

These six answers lead to the conclusion that those teachers see a link between multimedia with other elements of the didactic-methodical field as shown in the poly-factorial model of teaching. Teachers demonstrate awareness of “situational dynamics” which impact on a greater or lesser success of applying teaching strategies. It is precisely because of this that these six teachers consider multimedia usage variable in relation to its non-usage.

Table 48: Impact of multimedia usage in relation to its non-usage

<i>Impact of multimedia usage in relation to its non-usage</i>	<i>f</i>	<i>f%</i>
Impact is greater	115	91.3
Impact is same	3	2.4
Impact is less	2	1.6
Various	6	4.8
<i>Total</i>	126	100%

In the given answers, teacher no. 5 considers that impact of multimedia usage in teaching “depends on the pupil. “It is correct that inappropriate multimedia usage as well as impact on pupils does not have to be great. Therefore the response is complementary with the response of teacher no. 4 who states that for impact of multimedia usage in class “teacher’s knowledge and skill in applying multimedia in class” is important. “Teacher no. 3 points out that the emphasis is on the aim of multimedia usage and wrote: “It depends on what purpose multimedia is used, multimedia should be for the pupil and not an end in itself.” Teacher no. 1

wrote that the impact of multimedia “depends on the pupils, on the class, as multimedia are good to a certain extent” and points out that reception of information on the part of the pupil is important. The statement that “the impact of multimedia depends on the class” cannot stand alone as the teacher is not able only with class to influence multimedia impact with pupils.

The Curriculum for primary school is extensive and needs to be reduced is thought by 90.2% of teachers, while 9.5% of teachers consider that the Curriculum is not extensive. From 13 teachers who responded in a free form, eleven replied that they do not know i.e. they do not have an opinion of its extensiveness. Two persons gave their opinion (teacher no. 1: “it depends on the contents, teacher no. 2: we are working on relieving the workload, each teacher individually takes care of the pupil’s workload.”).

Table 49: Attitude of teacher on extensiveness of Curriculum

<i>Attitude of teacher on extensiveness of Curriculum</i>	<i>f</i>	<i>f%</i>
Curriculum is extensive	101	80.2
Curriculum is not extensive	12	9.5
Various	13	10.3
<i>Total</i>	126	100%

Starting from the basic attitude of the teacher related to the aim of teaching, 50% of teachers are slaves to form and have a traditional approach to teaching. Focus on execution of the curriculum is not good, as it is only a document which should be flexibly understood, in accordance with the potentials of class pupils and should not be blindly followed without a selective approach. This kind of traditional educational policy of teachers is a reflection of their overall work of teaching which is directly expressed in multimedia usage in class. Therefore, it happens that, for example, evaluation is not carried out of multimedia usage in class activities. Moreover, the traditional approach to teaching requires multimedia usage with the aim of executing the curriculum. This corresponds to the majority of teachers’ responses that the aim of multimedia usage is in creating dynamics and points of interest in class (no less than 61.1%), which is a reflection of a formal approach. Apart from this, the Curriculum

contains scant information on multimedia usage in teaching, which means that all initiative is left up to the teacher and this is fine if the teacher is focused on development of the pupil.

The results obtained connected with extensiveness of the Curriculum can be tied in with the aim of teaching and confirm responses to an even greater extent. The fact that 80.2% of teachers stated that the Curriculum for primary school is extensive and needs to be reduced belongs to traditional thinking, all the more so since teachers were not obliged to cover all given themes of the teaching program. One teacher stated that: “the teaching content in the Program should be changed piece-meal” but he/she did not define which part and from which subjects. The statement of the second teacher that “we are working on relieving the workload, each teacher individually takes care of the pupil’s workload” shows an attitude of care for the pupil i.e. that the teaching contents are subordinate to the needs of the pupil, which is a good attitude as it speaks for the awareness of the problems with teachers.

The next examined variable was: *Influence on multimedia teaching of pupil*. It was assumed that what influences multimedia teaching of pupil can become a didactic criterion for their choice. Ranking in table 50 shows that the greatest number of teachers (68.3%) consider that it is the pupils who influence multimedia teaching followed by the teacher, the multimedia and teaching strategy. As there was the possibility of circling a greater number of responses in this questionnaire, from certain influences on multimedia teaching of pupils, teachers mainly emphasised the influence of the teacher (30.2%), followed by the influence of multimedia (20.6%), teaching strategies (19.8%) and in last place the influence of pupils (19%). In this order, teachers see the greatest importance and responsibility for teaching pupils in the teacher; this is correct, as in the greater part of decision-making, the teacher is the leader of the teaching activities and in the long run rules on choice of multimedia and devises a teaching strategy.

Table 50: Influence on multimedia teaching of pupil

<i>Influence on multimedia teaching of pupil</i>	<i>f</i>	<i>f%</i>
Influence: pupil, teacher, multimedia and teaching strategy	86	68.3
Influence: teacher	38	30.2
Influence: multimedia	26	20.6
Influence: teaching strategy	25	19.8
Influence: pupil	24	19

From the results it can be seen that a greater number of teachers (68.3%) recognise the complexity of multimedia teaching in comparison with a smaller number of teachers (31.7%) who see individual influences on multimedia teaching of pupils. In this connection, teachers mainly point out the importance and responsibility of the teacher.

Moreover, teachers' responses to the question of what all the influences are on *choice of multimedia* were obtained. The influences on multimedia choice comprise didactic criteria which guide the teacher in using multimedia in class. In the first place is level of equipment of school (73.8%) followed by: teacher's ideas (69%), aim of class (62.2%), opinion of pupil (36.5%) along with the prevailing mood of the teacher (4.8%).

Table 51: Multimedia choice

<i>Multimedia choice</i>	<i>f</i>	<i>f%</i>
Level of equipment of school	93	73.8
Own idea	87	69
Aim of class	79	62.7
Opinion of pupil	46	36.5
Prevailing mood of teacher	6	4.8

The work of the teacher depends the most on what the school offers, which means that it is important how the school is equipped. But here lies the trap, as teachers should not have to base multimedia choice only on the existing situation but offer other solutions themselves. That is why it is good that “own ideas” are put in second place. The aim of class represents an important didactic criterion of multimedia choice as it outlines the teacher’s vision of what the teaching contents aim to achieve with pupils. However, there is again an important difference in the perspective of analysing the teaching aim from the viewpoint of the educational policy of the teacher. The pupil’s opinion is also an important didactic criterion because by respecting feedback information of the pupil, the teacher can qualitatively choose or adapt multimedia for future teaching activities. The prevailing mood of teachers certainly represents their self-censorship as: anger, rage, jealousy, fear, sadness.....does not necessarily have to be compatible with correct professional work. Professional work supports positive and not negative emotions.

In didactic criteria of multimedia evaluation which are presented in the paper, “level of equipment of school” belongs to other elements, “own ideas and prevailing mood” relate to the teacher as criteria of elements, “aim of class and pupils’ opinion” are part of the teaching strategies. Not one teacher used the opportunity in an open type of response to offer any other reply of what influences multimedia choice. This can be interpreted as limited information possessed by the teacher.

It was interesting to examine *which competencies do teachers develop with pupils in using multimedia*. From the given ranking, it can be seen that the greatest number of teachers highlighted knowledge, abilities, attitudes and habits as competencies which pupils master with multimedia. From individual competencies, knowledge is in the first place with teachers (33.3%), followed by ability of verbal expression (30.2%), ability of thinking in images (27.8%), attitudes (24.6%) and habits (19%).

Table 52: Competencies of pupils which are developed by multimedia

<i>Competencies of pupils which are developed by multimedia</i>	<i>f</i>	<i>f%</i>
Knowledge, abilities, attitudes and habits	86	68.3
Knowledge	42	33.3
Ability of verbal expression	38	30.2
Ability of thinking in images	35	27.8
Attitudes	31	24.6
Habits	24	19

It is important to point out that pupils' competencies are not only developed through multimedia but with other elements of the didactic-methodical field (methods, social forms of work etc.); however, their influence is important for the intensity of sensory experiences and stimulation of sensorial integration. It is good that the majority of teachers (68.3%) see the complexity of competencies which multimedia develop but with individual competencies knowledge is still given priority in comparison with all other given competencies.

In accordance with the theoretical part of the paper where the significance of Gardner's theory of multiple intelligence is highlighted, feedback information is received on the extent to which it is applied in practice in Croatian schools. Therefore, we formulated the question from *elements recognisable for various types of intelligence*. A greater number of teachers (57.1%) consider that all types of intelligence can be developed with multimedia. This is followed by: ability of verbal expression (34.9%), ability of thinking in pictures (34.1%), self-awareness of pupils' feelings, values and thinking (33.3%), ability of rhythm production and melody (32.5%), ability of recognising and classifying plants, animals and others in nature (28.6%) along with awareness of human existence, meaning of life... (28.6%), conceptual and abstract thinking (20.6%), ability of body movement control and manipulation of objects (15.1%), ability of establishing and reacting to others' moods, motivations and wishes (14.3%) and various (9.6%).

Table 53: Competencies of the pupil who develops by multimedia

<i>Development through multimedia</i>	<i>f</i>	<i>f%</i>
Ability of verbal expression, ability of thinking in pictures, self-awareness of pupils' feelings, values and thinking, ability of rhythm production and melody, ability of recognising and classifying, plants, animals and others in nature, awareness of human existence, meaning of life...., conceptual and abstract thinking, ability of body movement control and manipulation of objects, ability of establishing and reacting to others' moods, motivations and wishes.	72	57.1
Ability of verbal expression	44	34.9
Ability of thinking in images	43	34.1
Self-awareness of pupils' feelings, values & thinking	42	33.3
Ability of rhythm production and melody	41	32.5
Ability of recognising and classifying plants, animals and other in nature	36	28.6
Awareness of human existence, meaning of life....	30	28.6
Conceptual and abstract thinking	26	20.6
Ability of body movement control and manipulation of objects	19	15.1
Ability of establishing and relating to others' moods, motivation and wishes	18	14.3
Various	12	9.6

The ability of verbal expression is part of the verbal-linguistic intelligence and teachers mainly chose this (from individual usage of intelligence types) due to the fact that along with non-verbal communication, verbal expression is the most common form of communication, both in teaching as well as in everyday life. The ability of thinking in images is part of the visual-spatial intelligence. Self-awareness of pupils' feelings, values and thinking are specific for intrapersonal intelligence. Musical intelligence is manifested in abilities of producing rhythm and melody. The ability of recognising and classifying plants, animals and others in

nature is an integral part of natural intelligence. Awareness on human existence, meaning of life etc. is recognisable in existential intelligence. Logical-mathematical intelligence is based on conceptual and abstract thinking. Ability of body movement control and manipulation of objects is manifested in bodily-kinesthetic intelligence. Ability of establishing and reacting to others' moods, motivations and wishes, is an important feature of interpersonal intelligence. The least number of teachers (9.6%) stated the development of olfactory and taste senses, which point to the fact that teachers do not take into consideration computer multimedia since they cannot stimulate the senses mentioned. Although 57.1% of teachers responded that all types of intelligence are honed through multimedia, there is still room left to raise their awareness on development of all types of intelligence in pupils with the remaining percentage of teachers, because the structure of the class differs and so through combining stimulation of all types of intelligence the needs of all pupils in the class should be covered.

Stages of learning make up part of teaching strategies. Therefore, it was interesting to examine the *attitudes of teachers on types of classes carried out by them using multimedia*. In ranking shown in table 50, the majority of teachers (54%) consider that multimedia can be used in a combined type of activity i.e. that they serve for creating atmosphere, introduction into teaching contents, interpretation of teaching contents, repetition of teaching contents, evoking previous knowledge, testing, knowledge, abilities.... From individual types of classes, teachers mainly gave importance to the creation of atmosphere (41.3%), followed by introduction to teaching contents (38.1%) and interpretation of teaching contents (38.1%), repetition of teaching contents (7%), evoking previous knowledge (17.5%) as well as checking knowledge, abilities....(15.1%).

Table 54: Multimedia usage in types of classes

<i>Multimedia usage in types of classes</i>	<i>f</i>	<i>f%</i>
Creating atmosphere, introduction to teaching contents, interpretation of teaching contents, repetition of teaching contents, evoking previous knowledge, testing knowledge, abilities.....	68	54
Creating atmosphere	52	41.3
Introduction to teaching contents	48	38.1
Intepretation of teaching contents	48	38.1
Repetition of teaching contents	34	27
Evoking previous knowledge	22	17.5
Testing knowledge, abilities	19	15.1

Analysing the teachers' responses, feedback information on stages of learning which teachers deem important in multimedia usage in class activities was obtained. Somewhat more than half the number of teachers (54%) use multimedia in a combination of class types through which they create a holistic approach of learning from evoking previous knowledge to testing acquired knowledge with pupils. Such an approach favours pupils of all classes because it meets their developmental needs. Moreover, teachers (41.3%) see the significance of multimedia in creating atmosphere, which would mean that they pay attention to external pupil motivation. Introduction into the teaching contents precedes their interpretation so teachers by the same token listed them as important types of teaching activities for creating atmosphere. The smallest role of multimedia is seen by teachers in evoking previous knowledge and testing what has been learned. The reasons for the least frequent multimedia usage in evoking previous knowledge are due to the most frequent choice of method - conversation and media usage; as regards testing what was learned, the majority of teachers use the "standard" procedures of testing such as: oral and written testing with the help of conversation, assignments, tests, examinations, compositions etc.

Half of the teachers (49.2%) replied that multimedia can be used in every class. A smaller number (40.5%) answered that mulimedia cannot be used in every class. One tenth of teachers (10.3%) gave an open type answer:

Teacher no. 1: “With certain ones I can, and with certain others I cannot.

- “ 2: Yes, but not in my school.
 “ 3: Mainly.
 “ 4: Probably it can be done.
 “ 5: Mainly, almost every one.
 “ 6: Yes, if there are possibilities for that.
 “ 7: It could be done but would require a lot of preparation.
 “ 8: The majority – yes.
 “ 9: Maybe yes, I have thought about it.
 “ 10: Yes and no!
 “ 11: Maybe, I don’t have enough working experience to confirm it.
 “ 12: It can be done but it is not necessary.
 “ 13: For some there is no need.”

The majority of open type responses leaves a limited possibility that multimedia can be used in every class.

Table 55: Possibility of multimedia usage in every class

<i>Possibility of multimedia usage in every class</i>	<i>f</i>	<i>f%</i>
Yes	62	49.2
No	51	40.5
Various	13	10.3
<i>Total</i>	126	100%

A greater number of teachers (49.2%) consider that multimedia can be used for reviewing the contents of subjects in class, thereby confirming their methodical and computer science inclusion of multimedia usage in class. Teachers’ responses (40.5%) that multimedia cannot be used in every class suggest a certain limitation and detachment which those teachers have. From this perspective, it cannot be said what the exact cause of this is because there are

several potential (e.g. poor or insufficient level of equipment of school with multimedia educational back-up, lack of computer equipment, insufficient computer science competencies of teacher).

Teachers' attitudes were tested on suitability of classrooms for multimedia usage. Teachers' opinions on the size of classrooms where they work was obtained. The majority of teachers are satisfied with the classrooms and consider them large enough for multimedia usage (71.4%). A small but not insignificant number of teachers (27%) deem the classrooms too small. Only two teachers (1.6%) stated that the classroom for multimedia usage was too big.

Table 56: Suitability of classroom for multimedia usage

<i>Suitability of classroom for multimedia usage</i>	<i>f</i>	<i>f%</i>
Classroom is too small	34	27
Classroom is too big	2	1.6
Classroom is big enough	90	71.4
<i>Total</i>	126	100%

From the results obtained, it can be concluded that 71.4% of teachers have sufficiently large classrooms for multimedia usage, which means that it is suitable for the number of pupils in the class. A good quarter of teachers (27%) consider their classroom too small, which can indicate that either the premises where they work are too small or there are too many pupils in the class. Only two teachers consider that their classroom is too big from which we can conclude that they have fewer pupils in the class.

The time necessary for preparation of multimedia usage in class in relation to its non-usage, is experienced differently by teachers. The majority of teachers (73%) consider that for preparation of multimedia usage in class more time is necessary, fewer (19%) consider that for preparation equal time is needed and the least number (7.9%) think that for preparation less time is needed.

Table 57: Time required for preparation of multimedia usage

<i>Time required for preparation of multimedia usage</i>	<i>f</i>	<i>f%</i>
More time is needed	92	73
Equal time is needed	24	19
Less time is needed	10	7.9
<i>Total</i>	126	100%

Teachers in most cases deem multimedia usage a complex activity as careful selection of multimedia is needed as well as linking them appropriately to other elements of the didactic-methodical field. However, the personal viewpoint is that the length of time necessary for preparation of teachers is relative. It depends on the complexity of the pedagogical-educational achievements, personal and professional competencies of the teachers themselves and other.

9. CONCLUSIONS

Reviewing the situation in schooling at class level, the basic question is asked: How to create more effective teaching focused on developmental achievements of pupils? The answer should be sought in stimulating the awareness of all structures of the ecological system (macro-system, exo-system, meso-system and micro-system). Until activities at all stated levels are carried out, we are going round in a vicious circle. “Weak school success can be attributed, to a great extent, to methods of teaching, especially in schools which do not adapt to differences in pupils’ needs. Children learn differently, while schools favour certain learning and school work is focused on certain types of tasks. Generally, the school teaches, tests and marks logical mental tasks. Logic, sequence, calculations, categorisation and verbal skills in school are highly rewarded abilities. Intuition, feeling, vision, humour, rhythmic movement, imagination and other gestalt brain abilities in school are neither practised, nor tested nor particularly valued. It is only in the real world, outside the classroom, where success depends on entrepreneurship, imagination and insight that we start to appreciate the importance of the gestalt brain. School is very one-sided and many pupils suffer because of that bias, indulging in behaviour focused on survival.” (Hannaford, 2007, page 198)

On the basis of theoretical study of the problem of multimedia usage in class as well as the empirical results of research carried out in twenty-one schools of the Republic of Croatia, the following conclusions are drawn:

1. In the theoretical part of the paper, theory and models which study the process of processing information, significance and specific qualities of multimedia learning are separated. Special attention is paid to redefining the division of media and multimedia given the awareness and experience of scientists in the world, Europe and the Republic of Croatia to date. The leading ideas of the research are: constructivism, theory of information processing, cognitive theory of multimedia learning, theory of cognitive overload, theory of multiple intelligence, theory of ecological systems, structuralism of the Berlin school, integrated model of understanding text and images as well as structured models of teaching as they study possibilities of learning generally along with multimedia usage in class.

2. The division of media taking into consideration the sensory characteristics are most frequently reduced in didactic literature to auditory, visual and audio-visual. In contemporary

understanding of media, such a division is considered incomplete as attention should be given to all senses. Therefore, classification of media is shown with regard to manner of perceiving i.e. sensory experience acquired by pupils and this is divided into: auditory, visual, kinaesthetic, olfactory and taste. Media from all sensory areas are made up of various objects, material, machines, devices, animals, plants and people. Not all media are mentioned as it is impossible to list them all. This classification can be understood as conditional because of the kinaesthetic distinctive traits of media as one media can give more information of various senses (e.g. an apple has a certain colour, smell, taste and has a smooth, round surface).

The structure of multimedia is made up of individual media components. Each multimedia comprises two or more media. An example of media integration in computer multimedia is presented by Faulstich (2000, page 298) with the aid of static and dynamic media. Static media are: text, tables, graphics and images and they display information which is fixed. Dynamic media represent: sounds, music, film, video, animation and simulation and they present information which is constantly moving. Any form of connecting static and dynamic media makes up multimedia integration. Various combinations of media in multimedia teaching and learning impact on raising awareness of the personal capacities of the pupil as they encompass audio-visual sensory areas i.e. they correspond to the needs of various learning styles of pupils in class; however, in this connection attention should be paid to their suitability for the developmental age of the pupil. Multimedia usage stimulates sensory integration with pupils, thus impacting on success in learning.

3. The teaching process is based on a *poly-factorial model of teaching* which is made up of structured elements of the didactic-methodical field: pupil, teacher, other multimedia and media, curriculum, teaching principles, teaching aim, types of teaching activities, methods and techniques of teaching, social forms of work and spatial-physical (material) conditions. Such a model is understood to be flexible with a tendency for expansion (empty space is left for new elements). It is important to emphasise that teaching is observed in the context of a general system from micro-system to macro-system where mutual interaction and reflection of one on the other can be seen. . The basic blueprint for designing a poly-factorial model of teaching were the “Berlin” and “Hamburg” models as well as the theory of ecological systems. The relationship of multimedia and other structured elements in the poly-factorial model of teaching is in mutual interaction and complementarity. All structural elements of teaching are also components of teaching strategies. Teaching strategy is defined as the skill

of preparing, organising, leading and evaluating teaching activities with which we teach and educate pupils in order to achieve teaching aims. Teaching strategies respond to the basic questions: *who, what, when, where, how, why, with what, how to go further?* In practice, there are many authentic and unique teaching strategies. It can be concluded that no two same teaching strategies exist. Teaching strategies are flexible forms as the teachers and pupils are unforeseeable human factors and each differ in frameworks of various structured elements of the didactic-methodical field. In teaching strategies, there are numerous possibilities of multimedia usage in teaching. During teaching activities and school day, multimedia can be used: successively, simultaneously or a combination. Multimedia represents for pupils a teaching device for learning and a help towards learning.

4. In the theoretical part of the paper didactic criteria of multimedia evaluation were laid out. The basic elements of criteria are: pupil, teacher, multimedia, teaching strategies and other factors. With every element, further sub-categories of didactic criteria of multimedia evaluation were elaborated. Didactic criteria of multimedia evaluation focused on the pupil relate to: suitability of pupil's age, intrinsic motivation, developmental level of pupil, level of development of sensory-communicational competencies, learning styles and activeness of pupil. Didactic criteria of multimedia evaluation focused on the teacher relate to: personal and professional competencies of the teacher which is reflected on the educative policies which they represent. The characteristics of these didactic criteria are: daily development of personal competencies, insight into multimedia teachers' attitudes on multimedia, training of teacher in multimedia usage and qualification for using teaching strategies. Didactic criteria of multimedia evaluation focused on multimedia relate to sensory-communicational structure of multimedia, formation of multimedia, quantitative structure of multimedia information, qualitative structure of multimedia information and technical capabilities of multimedia presentation. Didactic criteria of multimedia evaluation focused on teaching strategies relate to: didactic communication, accordance with teaching aim, stages of learning teaching content, suitability of premises for multimedia presentation, form of mediation of multimedia presentation, suitability of learning and evaluation of effectiveness of multimedia in a narrower and teaching strategies in a wider context. Didactic criteria of multimedia evaluation focused on other factors are: organisational, economical and geographical conditions. The clearer the criteria of multimedia evaluation are, the higher the quality and easier the choice in teaching should be.

5. In the empirical part of the paper eight research questions are laid out. The first question stated: Is multimedia represented in the curriculum for teaching subjects in class as well as the programs of professional upgrading of Croatian teachers?

The existing concept of teaching in primary schools in the Republic of Croatia is based on the Croatian national education standard. The tendency of the Croatian national educational standard is to introduce a developmental approach to pupils of primary schools and targeted uniformity with the pre-school, secondary school and third-level pedagogical-educational system. The basic aim for the applicable Curriculum, printed in 2006, was to reduce the scope of teaching contents in all subjects, update them, link subject and inter-subject, distribute them in a balanced manner according to classes and define pedagogical-educational aims and tasks in accordance with developmental levels of pupils. Multimedia should be integrated into teaching subjects as a teaching device or tool serving the development of the pupil. Under the cover of media culture one can speak of multimedia, but in such a way that it is outlined piece-meal only in teaching the Croatian language. Due to its specific qualities, multimedia is acceptable in the teaching of other subjects. Multimedia is mentioned in the text, before individual programs of subjects, generally, indirectly, as a teaching tool in learning. The teacher's obligation for applying audio-visual tools and computer science equipment is also mentioned along with the task of the librarian to purchase multimedia sources of knowledge and form a multimedia school hub. As a term, multimedia is not mentioned in the curriculum of subjects from the first to the fourth class of primary school. Media culture is mentioned only in teaching the Croatian language as one of the teaching areas. The opinion is that media culture is observed within a narrow framework, through the accentuated role of film and television programs. Therefore, the need to make the problem of multimedia in teaching programs more topical can be seen.

After studying the Catalogue of Professional Conferences, it can be seen that multimedia as a term is not used in the plan and program of professional teacher upgrading. In the period from 2002 to 2009 multimedia was covered with themes on: computer, internet, Power Point, computer science in class and film. Some of the themes on multimedia mentioned were covered in ten counties (Primorsko-Goranska, Ličko-Senjska, Istarska, Osječko-Baranjska, Virovitičko-Podravska, Požeško-Slavonska, Brodsko-Posavska, Vukovarsko-Srijemska, Dubrovačko-Neretvanska and Šibensko-Kninska) from a possible twenty-one. It is precisely because the Catalogue on professional teacher upgrading is the most wide-ranging, the most

representative and obligatory form of teacher upgrading at the level of all counties of the Republic of Croatia, that these data are not satisfactory given the significance of multimedia in teaching. There are two basic reasons for insufficient inclusion of the theme on multimedia in the plan and program of professional teacher upgrading. The first reason for insufficient inclusion of the theme on multimedia lies in the fact that the Ministry of Science, Education & Sport one-sidedly determines the themes for professional teacher upgrading in order to be compatible with the national examinations in the fourth grades. Therefore, themes which more define the stated condition of compatibility are incorporated in the catalogue. The second reason for insufficient inclusion of themes on multimedia lies in the offer of themes from foreign agents for education as they have the possibility of incorporating some other themes. Only certain agents demonstrated sensitivity for themes on multimedia, and media in teaching generally. Therefore, inclusion of themes on multimedia in the program of teacher education is proposed. Suggestions for education in the Catalogue of professional teacher upgrading tend towards direct sources of information to the teacher about what multimedia is in teaching, what its essential characteristics are, how to use them in class, what role they have in the development of the pupil, didactic criteria for choice and evaluation of multimedia as well as formation of multimedia on the part of teachers, as they know best the needs of their pupils and those needs are authentic.

6. The second research question was: What are the types of media and to what extent does the teacher use them in class?

In his/her work, the teacher uses media from all sensory areas: visual, auditory, kinaesthetic, olfactory, taste as well as their various combinations. In this connection, the greatest priority is given to visual media (65.9%), followed by auditory (63.5%), various combinations of media (42.1%), kinaesthetic (34.1%), olfactory (11.9%) and taste media (7.1%). Examining the teachers' opinions on which teaching tool they like the most, the majority chose the computer and teaching tools and aids which are used in teaching physical education : ball, skipping rope, hand rings and vaulting buck. The responses obtained point to a difference in teachers' and pupils' opinions on choice of teaching tools in class. Added to that is the fact that 38.6% of pupils would use sources for learning more often, thus suggesting a deficiency in satisfying their needs for learning during class while 9% of pupils would reduce usage of sources for learning in class, which suggest an overload of their needs and these should be covered in some other way. Altogether 47.6% of pupils questioned make up subjects whose

sources for learning are not “tailor-made” to their needs and so choice of sources for learning should be carried out in accordance with the various developmental levels of pupils. Their answers should be an important didactic criterion of choice for learning sources in devising future teaching strategies.

Studying the relationship between teaching tools and aids and independent variables, statistically significant results were obtained between the relationship of teaching tools and aids and gender, class and size of school. Girls and boys like to learn from and with the help of various teaching tools and aids. Girls prefer more than boys textbooks, cassettes with music, pictures, posters and art equipment and material while boys prefer more than girls sport equipment: ball, skipping rope, hand rings, vaulting buck and computer. In line with their favourite teaching tools and aids, girls prefer: the Croatian language, music culture and art, and boys prefer physical education. It is precisely love towards the stated teaching tools and aids that creates love towards the class subjects wherein they are used. Given the preference of teaching tools and aids, simultaneously there is a preference for class subject. While girls give precedence to: the Croatian language, music culture and art, suggesting an inclination towards artistic activities, boys prefer using the computer i.e. they are attracted to technology, technical machines, devices but have a greater need for motoric activities.

Pupils from the second grade prefer cassettes with music and video-cassettes than pupils of the third and fourth grades. Pupils of the third and fourth grades develop more their attitude and individuality, have their idol (music, acting) and do not like media and multimedia which someone has chosen for them. They prefer themselves to choose and suggest material for listening and watching while pupils of the second grade are more under the teacher’s influence. The following statistical significance shows that pupils of the fourth grade like art less than pupils of the third grade as in the fourth grade, in line with the curriculum, they cover more a definition of art encompassing weekly one school hour of art.

Cassettes with music are preferred by pupils from larger schools (from 801 and more pupils); these are less preferred by pupils of medium-size schools (from 501-800) and least preferred by pupils from small schools (up to 500 pupils). In smaller schools, there are fewer pupils in classes. The fewer the pupils, the greater the possibility by the teacher of individually devoting herself/himself to pupils in music activities of singing and playing. Pupils from larger and medium-size schools prefer video-cassettes than pupils from smaller schools. Larger schools

are very often better equipped with audio-visual tools and aids and it is assumed that they will be used more, both auditory cassettes as well as video-cassettes in class. In larger schools, there is a greater possibility of access to textbooks and teaching tools and aids, as publishing houses and companies very often visit larger schools where professional demonstrations for teachers are organised. At these assemblies, they demonstrate and present their products and innovations from the area of teaching tools and aids, during which they donate their products to their buyers. The same applies to sport equipment. Pupils from larger schools prefer the ball, skipping rope, hand rings, vaulting buck while medium-size school pupils like them less and the least are liked by pupils from smaller schools. Larger schools are better equipped and the better equipped they are the more the equipment is used. The more the equipment is used, the more the pupils get used to it and prefer it.

The results of research show that there are no statistically significant differences between large schools which pupils attend and textbooks, picture and poster, computer and art equipment and material. Regardless of school size, pupils from all grades use textbooks for learning as they are an obligatory, basic teaching tool. Neither does school size influence the pupils' preference for pictures and posters as both pictures and posters are often offered as promotional material, from various publishing houses (e.g. Profil, Školska knjiga, Alfa...), in the majority of class subjects to pupils of various size schools. Computers are attractive due to the various options for learning which they provide and regardless of school size or equipment of school, more and more pupils have them at home or use them in schools and in the homes of their friends. Sport equipment is obligatory in all classes in physical education and in most cases pupils of various size schools like them.

In accordance with the stated results, the hypothesis which related to the claim that the least representation of media in teaching was expected with olfactory and taste and the greatest with audio and visual media confirmed its assertion. Therefore, the proposal would be towards choice of teaching media which stimulate all senses, thereby encouraging more various ways of perception with pupils who, in a one-sided media choice, are deprived of this. This specifically means that many more olfactory and taste media are proposed in teaching which would prompt greater variety of sensory integration. Likewise, more frequent multimedia usage is suggested. This proposal is compatible with pupil preference of multimedia in comparison with media and so in practice much more attention should be paid. It is interesting that with regard to preference of teaching tools and aids, there is

simultaneously a preference for the class subject wherein they are used. In future teaching, more consideration should be directed towards reconciling usage of teaching tools and aids to the satisfaction of both teacher and pupils, in line with their interests as well as elements (e.g. independent variables: gender, pupil's class, size of school) which demonstrated statistically significant results.

7. The third research question was focused on an extremely important segment of teaching i.e. whether teachers carry out evaluation of multimedia usage. Only 28.6% of teachers conduct evaluation on multimedia effectiveness.

The idea that 71.4% of teachers either do not carry out evaluation or wrote nothing as a response is worrying. It is obvious that there is ambiguity concerning evaluation as whatever is not known cannot be written. Pupils' opinion on multimedia usage in class was examined concurrently. 47.7% of them consider that multimedia should be used more or less than is used in class. Comparing teachers' responses and pupils' appropriate "dosage" of multimedia, would accelerate the undertaking of multimedia usage evaluation. This further means that with a systematic evaluation of multimedia usage, they would be chosen in accordance with pupils' needs.

Evaluation of multimedia effectiveness is the last stage of teaching activity as multimedia usage, among other things, is re-examined at the end of teaching. Evaluation relates to checking what has been done and the achievement of the pupils with the aim of making conclusions and new decisions in future planning of teaching strategies. Teachers who have a way of choosing and checking multimedia in class handle the reactions of their pupils. With different didactic procedures of checking pedagogical-educational achievements of pupils, direct feedback information is obtained on the basis of which a plan for future strategic work is created. Such authentic approaches of the teacher in checking the effectiveness of multimedia usage is considered very positive as future teaching is based on direct feedback information of pupils and, as a result, future multimedia usage.

The results obtained confirm the hypothesis that from a total number of teachers who use multimedia in class, a very small number of them carry out evaluation (altogether 28.6% teachers). In this connection, teachers should be made aware of the importance of multimedia usage evaluation in stimulating various abilities, skills, habits and attitudes of pupils, as the

didactic criteria of multimedia assessment for the creation of new teaching strategies is strengthened with evaluation.

8. Which didactic criteria for multimedia evaluation are set by teachers in their practical work?

Teachers who carry out evaluation of multimedia usage in class create different individual approaches in assessing their effectiveness, aiming for multimedia which are more suitable to pupils and stimulating them more in their development. Teachers' responses are classified into categories of basic elements of multimedia choice criteria which relate to: pupil, teacher, multimedia and teaching strategies. Pupil characteristics are activeness of pupils, their intrinsic motivation and developmental level. The professional competencies of the teacher influence the choice of multimedia on the basis of their working experience and insight into multimedia. The category which relates to multimedia is the specific quality of its structure, while accordance with teaching aim and evaluation of multimedia effectiveness are basic accompanying criteria of teaching strategies. From the above-mentioned, it follows that teachers check the level of effectiveness of multimedia on the basis of various didactic criteria. Here a link between teachers' responses, in the manner in which they mentioned some of the numerous stated elements which influence choice, and set criteria of multimedia choice in class in the theoretical part of the paper can be seen. An analysis of teachers' responses confirms the hypothesis that during evaluation teachers use heterogeneous didactic criteria, which is fine, as they develop authentic ways of evaluating multimedia usage. Their individual examples are characteristics of developmental heterogeneity of pupils in classes.

9. The fifth research question was: Do teachers consider that multimedia are equally suitable for all pupils or to a certain extent suitable for pupils of various levels of achievement? In accordance with this research question, teachers' opinions were analysed with regard to whether they use multimedia for all pupils or certain groups of pupils: average, above-average or below-average, given the development level of pupils. With multimedia usage possibility for all pupils in class in relation to their development level, 61.1% of teachers were forthcoming. The smallest number of teachers (3.2%) stated that multimedia can be used for below-average pupils. It is true that multimedia can be used for all pupils in class but the greatest achievements are with pupils who achieve weaker success in learning.

Teachers' responses and pupils were compared in relation to understanding multimedia messages and understanding teaching contents. While 88.9% of teachers consider that their pupils understand multimedia messages, 67.1% of pupils stated that they understand the teaching contents and 31.2% of pupils partly understand teaching contents. This means that teachers do not have the most correct picture of their pupils and their understanding of teaching contents i.e. they have a better opinion than what pupils show. A solution to this problem can be seen in devising and applying teaching strategies where attention should be paid to further multimedia usage, media, individualisation, differentiation and problem approach in teaching activities. With further multimedia usage, greater consideration should be given to evaluation and didactic criteria of choice of same, thus accelerating understanding of teaching contents. A more active relationship of pupil towards learning in class results from individualisation, differentiation and problem approaches in teaching activities.

Mayer points out (2005, page 105) that pupils with the lowest achievement, who attain the greatest progress with application of multimedia in learning, have the greatest benefit from multimedia. Given the lack of familiarity of teachers with contemporary insight into application of multimedia in teaching, in accordance with the hypothesis, it was confirmed that the greatest number of teachers did not recognise the difference of impact with application of multimedia in class with pupils of different abilities. This is corroborated by the various results of teachers' attitudes and pupils on understanding multimedia messages. A solution can be seen in additional education of teachers and in them paying greater attention to discovering the causes of weaker understanding of teaching contents by their pupils. This is supported by the applicability theory of cognitive overload where Sweller (2006, pages 294 – 298) gives precise instructions in forming multimedia for pupils of various levels of previous knowledge.

10. The sixth research question was: To what extent are elements present which enable multimedia usage in teaching and how are they linked with socio-demographic variables?

Elements which enable multimedia usage in teaching were examined through: professional training of teacher, acquiring knowledge for multimedia usage, form of professional training for multimedia usage and level of equipment of school with teaching media.

Connecting the categories of sufficient and complete training, the result was obtained that 72.2% of teachers consider themselves professionally trained for multimedia usage. Simultaneously, the question can be asked then, if teachers are sufficiently and completely trained for multimedia usage, why do 71.4% of them not have a way of checking multimedia effectiveness or there is absolutely no response to carrying out evaluation? Otherwise, teachers with a four-year university degree are more inclined towards further development, possibilities of learning and self-development than teachers with an associate two-year degree as they more frequently respond that they are partly trained, thus proving they are more open for new learning. Teachers acquired the most insight on multimedia through work, from their own experiences in class. Fewer acquired knowledge at professional upgrading, from professional literature and even fewer from colleagues at work, during their university studies and from counselling staff in school. Moreover, teachers with 10 years' working experience and up to 30 years old, more frequently than their older colleagues with more years' working experience, state that they acquired knowledge during their studies for teachers of primary education. Regardless of the fact that teachers in the majority of cases gleaned insight into multimedia from their own experiences, teachers are more inclined towards "external" education: professional lectures in schools for all teachers (76.2%), thereby proving the need for further education. The professional training of teachers is extremely significant for multimedia usage in teaching as the person who has contemporary knowledge on multimedia has greater possibilities of a more qualitative application i.e. more awareness in practice.

Professional training of teachers, acquired knowledge, professional teacher upgrading and level of equipment of school proved correct with the assumption that they influence multimedia usage facilitation in class. The teachers confirm that in practice there are conditions which enable multimedia usage. 72.2% of them consider themselves sufficiently or completely trained for multimedia usage while 71.4% state that either there is no way of checking the effectiveness of multimedia or there is no response to carrying out evaluation. This means that all teachers nevertheless are not sufficiently trained as they lack assessment of their own work. A statistically significant link was noticed between independent variables (status, educational qualifications, age and working experience) and teacher training study as sources of knowledge. Teachers with a four-year university degree, status of teacher, up to 30 years old and to a lesser extent from 31 to 45 years, working experience up to 10 years, more often state regular teacher training study or additional teacher education as sources of knowledge, as during the course of studies they had classes on the subject of computer

science. Here the question should be asked to what extent did teachers acquire knowledge on multimedia in teaching of individual methodics and didactics. Teachers from 31 to 45 years old significantly more often state training through professional workshops than teachers up to 30 years old. Teachers at professional workshops exchange their working experience and have fewer possibilities of acquiring knowledge on multimedia during their studies like their younger colleagues. It has already been stated that themes on multimedia should be more introduced in the plan and program of professional training of teachers. Very good or a good level of equipment of school is stated by 81.7% of teachers while 50.8% stated lack of multimedia as an inhibiting factor in work. Therefore, professional training of teachers, their acquired knowledge, professional teacher upgrading and level of equipment of school influence multimedia usage facilitation. In this connection, in practice the quality of professional training of teachers, their acquired knowledge, professional upgrading and level of equipment of school where they work can influence even more.

11. What are the most common elements in multimedia usage which teachers consider inhibiting in teaching was the seventh research question. There are several elements which teachers consider inhibiting for multimedia usage in teaching. Some of them, for example, level of equipment of the classroom with computers and multimedia educational back-ups, represent an objective obstacle while individual elements represent a subjective limitation of multimedia usage in class i.e. self-censorship. Self-censorship of the teacher is an internal stumbling block which inhibits the teacher in his/her professional work. Therefore the cause of multimedia non-usage lies in external elements and not in his/her personal work. Teachers stated that the greatest inhibiting elements of multimedia usage were lack of multimedia and scope of teaching contents, which points to the fact that they view their work in terms of content. Lack of multimedia is an indicator of inadequate level of equipment of school with multimedia as well as lack of enthusiasm in devising authentic multimedia. Apart from that, lack of multimedia in the classroom is not compatible with the statement of teachers (81.7%) that their school, in the majority of cases, is very well or well equipped with media. Other self-censorship relates to: a greater number of children in class, unsuitable premises, time required for preparation by teacher and non-training for multimedia usage. Given the time required for preparation, teachers who stated lack of time need to work on rationalisation of time required for preparation of class. Non-training for multimedia usage relates to the professional competencies of the teacher who can influence its non-usage. Whatever does not inhibit, in fact, potentially enables multimedia usage in class. In these responses lie the

solution that didactic-methodical competencies of the teacher can be observed as empowering or inhibiting elements for multimedia usage in teaching. If the teacher considers that there are no obstacles for multimedia usage in class, his/her attitude will enable usage. Otherwise, many reasons will be found to hinder or render impossible its application. Only 8.7% of teachers stated that there are no obstacles in multimedia usage. Teachers who use multimedia in their teaching without any obstacles demonstrate professional skill of usage. Therefore, it is precisely that class of teachers who are completely or sufficiently professionally trained for usage of didactic multimedia.

A school which is well equipped with media provides teachers and pupils with a wide possibility for using many didactic multimedia. A greater number of teachers, 81.7%, consider that schools are very well or well equipped with media.

The basic conditions for multimedia usage are: education of teacher and improvement of material equipment of school. On the basis of the results obtained, it can be concluded that primary schools are relatively well equipped with media but further work needs to be done on additional education of teachers towards removal of self-censorship.

It was expected that the greatest number of teachers would state lack of multimedia in school as the basic problem in inhibiting elements. The stated hypothesis proved to be correct. With the greatest number of teachers (50.8%), lack of multimedia represents also the greatest inhibition in work. Statistically significant differences were obtained between lack of multimedia in school and educational qualifications, working experience and level of equipment of school. Teachers with a four-year university degree and working experience up to 10 years, significantly more often state lack of multimedia as an inhibiting element. Teachers who assess that level of equipment of their school is poor or very poor compared to teachers who assess level of equipment very good, significantly more often state lack of multimedia in school as an inhibiting element in work.

12. What is the opinion of teachers on the advantages and disadvantages of multimedia usage in teaching is the last, eighth, research question. Multimedia have advantages for achievement of pupil in learning and applicability during class.

The advantages of multimedia in relation to pupils are: activity in class, independence, ease and speed of learning, development of various competencies of pupil, respect for pupils' learning styles and long duration of what has been memorised. Multimedia approach influences the audio-visual senses of the pupil and experiences are enriched. Multimedia facilitates individual perceptive abilities of the pupil and various times of mastering information. In that way, pupils are active in the teaching process. Through their responses, teachers confirmed the hypothesis that the advantages of multimedia are recognised through the impact on levels of knowledge and motivation of pupils but they also mentioned many other advantages.

Teachers' responses which relate to advantages of multimedia usage in class can be observed in the characteristics of teaching and achievement with pupils. Teaching is: more interesting, of a higher quality, comprehensible, dynamic, systematic, contemporary, on-target and economical. Multimedia provides the possibility for usage of several different methods. The teaching content can be executed in a more qualitative manner as well as the pedagogical-educational achievement. The imagery of multimedia creates external motivation. Multimedia occasionally takes over the role of the teacher in leading pupils. It facilitates hard-to-access reality. Multimedia teaching creates external motivation, a creative ambient and a positive atmosphere.

Listing the advantages of multimedia in teaching, it can be seen that there is an interactive relationship between multimedia and other elements of the didactic-methodical field compatible with the poly-factorial model of teaching (stated in the paper in the section: place of multimedia in various models of teaching within the framework of a poly-factorial understanding of teaching). Teachers' responses prove that there is a relation between multimedia and other elements of the didactic-methodical field. Through multimedia usage, the following are stimulated: usage of the principle of systematisation and lucidity, more successful mastery of teaching contents, methods of demonstration and more successful mastery of teaching aims. The significance of multimedia as a teaching tool is in the interesting form of software and the depersonalised role of the teacher. When compared to the strategy of teaching, multimedia speeds up the class on several levels. Multimedia also influences the creation of a positive class atmosphere.

If the disadvantages of multimedia are carefully analysed, it can be noticed that the responses are in fact focused on the persons who gave the answers, which means that one part of the problem is of an objective type while the second part relates to the attitudes of teachers towards multimedia. The majority of stated disadvantages are in fact teachers' self-censorship. Teachers' responses do not relate so much to multimedia as to the role of the teacher in devising and executing teaching strategies. From what has been stated, it can be concluded that the majority of disadvantages of multimedia usage are characteristics of teachers' competencies.

Through an analysis of teachers' responses to open-type questions on the advantages of multimedia in their opinion, it can be seen that teachers replied to the question very heterogeneously. The assumption that lack of movement and socialisation would be the biggest problems in multimedia usage in class is partly true: Lack of movement and socialisation are mentioned, not as the biggest or most common problems but as one of several mentioned. The most common disadvantages of multimedia are time and lack of multimedia in school. Apart from those drawbacks, teachers mention poor choice of multimedia as regards unsuitability of contents, non-training for application of multimedia, lack of communication between pupil and teacher, neglect of direct experiences from nature, numerousness of children in class and neglect of aim. As with advantages of multimedia, the link and correlation of lack of multimedia and elements of the didactic-methodical field, compatible with the poly-factorial model of teaching can also be seen. From the responses of teachers, the importance of focusing attention on multimedia choice in class can be concluded as the choice of multimedia is a proportional factor with the functioning of other elements of the didactic-methodical field. The "poorer" the multimedia choice, i.e. the more flaws it has, the more often other elements of the didactic-methodical field will "more poorly" function. Therefore, the disadvantages of multimedia, in the opinion of teachers, will be reflected in: neglect of the teaching aim, unsuitable teaching contents, non-training and long preparation of teacher as well as irregularities in algorithm multimedia usage. In this connection, the fact that it is precisely the teacher who has the main freedom and power of planning, creating, organising, executing and evaluation of teaching strategies which link the teaching subjects and elements of the didactic-methodical field should be taken into consideration. The reverse of this rule is also true: the more qualitative the multimedia choice is, most frequently the more qualitative the execution of other elements of the didactic-methodical field will be. It can be concluded that the majority of disadvantages or advantages of multimedia usage are

characteristics of teachers' convictions. Therefore, a whole scale exists of possibilities and combinations of relationships between multimedia and other elements of the didactic-methodical field.

13. In the last section, attitudes of teachers on the significance of multimedia in relation to other elements of the didactic-methodical field, the relationship of multimedia and other elements of the didactic-methodical field was examined. From other elements of the didactic-methodical field the following were chosen: aims (aim of teaching with pupils and the aim of multimedia usage in class), curriculum (scope of curriculum, possibilities of multimedia usage in classes), types of classes, material (physical) environment (size of classroom for multimedia usage). Along with the elements mentioned, the teachers' attitudes on the influence of multimedia on pupils were examined (impact of multimedia usage with pupils in relation to its non-usage, influence on multimedia pupil learning, competencies of the pupil who develops through multimedia). Elements of teaching-strategic planning which related to criteria of multimedia choice in teaching and time required for preparing multimedia usage in class activities were examined.

Teachers' responses (57.1%) that the aim of teaching was development of the pupil are not convincing as they are not compatible with their other replies, which should also be focused on pupil development. If only 28.6% of teachers carry out evaluation of multimedia in teaching, the quality of usage of future teaching strategies which stimulate pupil development is questionable. Pupils' opinions influence multimedia choice with only 36.5% of teachers so the question is to what extent teachers respect the opinion of pupils. Already a difference of opinion can be seen in comparison of teaching aim with the aim of multimedia usage in class.

Dynamics and interesting features of teaching represent for most teachers the aim of multimedia usage in class (61.1%). Given that in contemporary teaching the aim of teaching is to influence developmental changes with pupils, the responses of teachers focused on formal elements (dynamics of teaching, enrichment of classroom and demonstration of multimedia) can in no way satisfy the stated aim of teaching.

The curriculum for primary school is wide-ranging and the traditional viewpoint that it should be reduced is held by (80.2%) of teachers. This, traditional, educational policy of teachers, is directly reflected also on multimedia usage in class. Therefore it happens that, for example,

evaluation is not carried out of multimedia usage in teaching activities. Moreover, the traditional approach of teaching also requires multimedia usage with the aim of execution of the curriculum. This is in accordance with the majority of teachers' responses (as much as 61.1%) that the aim of multimedia usage is in creating dynamic and interesting features of class which is a reflection of a formal approach. Since a majority of traditional viewpoint responses were received from teachers, it is assumed that they will work in a traditional manner, in accordance with the patterns which they themselves adopted throughout their schooling.

Multimedia can be used for interpreting each class, a view held by teachers (49.2%), thus confirming their methodical and computer science inclusion for multimedia usage in class. Teachers (40.5%) who demonstrate a certain limitation and detachment express the position that multimedia cannot be used for interpreting each class. From this perspective, it cannot be said what the exact cause of this is as there are several potential ones (e.g. poor or insufficient level of equipment of school with multimedia educational back-ups, lack of computer equipment, insufficient computer science competence of teacher). Teachers (10.3%) who replied in the "various" category leave partial possibility that in each class multimedia can be used, which means that in their opinion there are conditions.

Analysing teachers' responses on stages of learning which teachers pay attention to in multimedia usage in certain types of classes, replies were obtained that more than half of teachers (54%) use multimedia in combination of class types with the aid of which they build a holistic approach to learning, from evoking previous knowledge to checking what has been mastered with the pupils. This approach unmistakably favours pupils of all classes as it meets the developmental needs of pupils. From certain types of classes the teacher sees the significance of multimedia in creating atmosphere, introduction to teaching contents, their interpretation, with the smallest role of multimedia played in evoking previous knowledge and checking what has been learned. A greater tendency by teachers who pay attention to certain elements for usage of teaching contents in relation to the developmental level of pupils (remembering and checking their achievements) can be noticed, which is a consequence of the educative policy which they represent.

Through examining teachers' attitudes on suitability of classrooms for multimedia usage, replies were obtained on the conditions under which they work. The responses were indicators of the size of premises in relation to the number of pupils in the class. Teachers were, in the majority of cases, satisfied with the size of the classroom and consider it sufficiently large for multimedia usage (71.4%), while a quarter of the teachers (27%) consider that their classroom is too small, which can be an indicator that either it is a question of cramped premises or the number of pupils in the class vis-à-vis the classroom. Only two teachers in class stated that their classroom was too large so it can be concluded that there are fewer pupils in class.

Teachers' responses (91.3%) that the impact of multimedia usage in class is greater in relation to their non-usage, show their awareness on the importance of usage. However, likewise, teachers (4.8%) stated the importance of conditions under which they work such as: competencies of the teacher and pupil and linkage with other elements of the didactic-methodical field. These teachers demonstrate consciousness of the "situational dynamics" which influence greater or lesser success through application of teaching strategies, which is correct as the outcome of application of teaching strategies is always uncertain.

The next task was to examine teachers' opinion on competencies of pupils which are developed through multimedia. It is important to emphasise that competencies of pupils do not develop only with multimedia but with other elements of the didactic-methodical field (methods, social forms of work etc.); however, their influence is important for the intensity of sensory experiences and stimulation of sensory integration. It is good that the majority of teachers (68.3%) see the complexity of competencies developed by multimedia but with certain competencies, knowledge is still given priority in comparison with all other stated competencies, which is part of the traditional approach.

Through examination of teachers' attitudes, feedback information was received on their opinion regarding components of criteria for multimedia choice in class, corroborated in research by: Plut, 1980, Bognar and Matijević, 2005, Blažič, 2007 and Nadrljanski, 2000. The choice of multimedia for teaching needs with the majority of teachers depends on the level of equipment of school (73.8%) as well as the teachers' own ideas, the aim of the class and to the smallest extent on the opinion of pupils (36.5%). All listed replies are part of the didactic criteria of multimedia assessment. It is believed that multimedia choice would be more

suitable if teachers, who do not have a way of checking its effectiveness, were to carry out evaluation of their work.

Time required for preparing multimedia usage in class is experienced differently by teachers. Teachers (73%) consider multimedia usage complex and require more time for preparation of teaching activities.

The majority of teachers (73%) consider that for preparation of multimedia usage in class in relation to its non-usage, more time is required. The length of time needed for preparation by teachers is relative. It depends on the complexity of the pedagogical-educational achievements and the personal and professional competencies of the teachers themselves etc. Therefore this justification is logical for teachers (19%) who consider that for preparation equal time is needed as well as teachers (7.9%) whose opinion is that less time is needed for preparation.

The basic significance of this doctoral thesis is in its contribution to scientific thought on applicability of multimedia in teaching with the aim of finding a solution for more qualitative learning. The results of the research's main ideas led to an awareness of the significance of multimedia in learning with teachers and the wider public at large (agents for education, parents etc.). Certain flaws were noticed which cause a weaker application of knowledge on multimedia in practical work, in such a way that under existing conditions better results could be achieved if the existing state were "noticed". For such a level of impact, the acquisition of additional knowledge is required which would enable further progress in the work of teachers. Therefore, new guidelines for future scientific research and work are opened:

- Raising awareness of the wider significance of media culture within the framework which we perceive multimedia. Media culture components are all class subjects and not only the Croatian language, which should be interpreted in future curricula for primary school;
- Raising awareness on the significance of multimedia in class with agents for education can be useful for future inclusion of these themes in the plan and program of professional training of teacher;

- Examination of the curricula of the Teaching Training Faculty of the Republic of Croatia which was not researched in this work, would give a more complete picture of education of the teacher population and training for their work in class;
- Didactic criteria for multimedia choice serve as help to teachers in selecting and forming multimedia but its applicability is also in evaluation. Forming multimedia and evaluation (e.g. connection of multimedia and effectiveness in achievements of pupils) also represent fertile soil for future research;
- Interactivity of multimedia with other elements of the didactic-methodical field in the poly-factorial model of teaching proves an all-encompassing picture of complexity of learning so it would be interesting to research guidelines for effectiveness of didactic strategies as alternatives to traditional teaching;
- Since there was scant literature on intermediality, it would be important to examine the relation between media and multimedia in a teaching dimension;
- The results of research point to the conclusion that training of teachers for multimedia usage depends on their individual characteristics and it would be interesting in future research to explore some other variables on which the training of the teacher would depend.

10. SUMMARY

The central problem of research in the doctoral paper is multimedia, i.e. application in traditional teaching from the first to the fourth grade of primary school. In accordance with the theme, theories and research of multimedia in the world and in the Republic of Croatia in the field of education, which are close to the contents of work, were mentioned: theories and models which make up the basis of multimedia usage in learning and in the empirical part of the work, multimedia usage in teaching of Croatian primary schools was examined. Along with constructivism, theories and models which study the cognitive possibilities of learning with the help of multimedia are stated: the theory of information processing, cognitive theory of multimedia learning, theory of cognitive overload, theory of multiple intelligence, structuralism of the Berlin School, integrated model of understanding text and images as well as a structured model of teaching.

Since the word multimedia is polysemic, special attention was focused on the didactic term of multimedia: terminological definition of multimedia, terms which make up the context of multimedia in teaching, its structure, taxonomy, features, film, television and multimedia usage of computers in teaching. Positive and negative influences of multimedia on children are analysed. Some of the possibilities of procedures through which children can correctly use multimedia are suggested. There is especially an explanation on multimediality in teaching which covers a wide possibility of choice of various media and multimedia and their combined usage.

For a clearer lay-out and better insight, the relation of multimedia and other structured elements of the didactic-methodical field was analysed in various teaching models (Berlin model, Hamburg model) on the basis of which the poly-factorial teaching model was devised. The poly-factorial teaching model has the following components: pupil, teacher, other multimedia and media, curriculum, teaching principles, teaching aim, types of teaching activities, methods and techniques of teaching, social forms of work and spatial-material (physical) conditions. All are elements in interaction and complementarity. The teaching strategy is defined as the skill of preparation, organisation, leading and evaluating teaching activities by which pupils are taught and educated in order to achieve the teaching aims and give answers to the basic questions: *who, what, when, where, how, why, with what, how to*

proceed further? Teaching strategies are changeable due to situational dynamics. Teacher and pupils are unforeseen human factors. Therefore teaching strategies mutually differ.

Multimedia choice is based on didactic criteria. These criteria relate to: pupil, teacher, multimedia, teaching strategies and other criteria. Each element has a further broken-down category. Didactic criteria of assessing multimedia focused on pupils relate to: suitability for age of pupil, intrinsic motivation, developmental level of pupils, level of development of sensory-communicational competencies, learning styles and pupil activeness. Didactic criteria of assessing multimedia focused on teacher relate to the personal and professional competencies as well as the educative policy of the teacher. Didactic criteria of assessing multimedia focused on multimedia relate to: sensory-communicational structure of multimedia, formation of multimedia, quantitative structure of information of multimedia, qualitative structure of information of multimedia and technical possibilities of multimedia presentation. Didactic criteria for assessing multimedia focused on teaching strategies relate to: didactic communication, accordance with the teaching aim, stages of learning, teaching content, suitability of premises for multimedia presentation, form of mediation of multimedia presentation as well as evaluation of effectiveness of teaching strategies. Didactic criteria of assessing multimedia focused on other factors are: organisational, economical and geographical conditions.

With empirical research, knowledge was gained on multimedia usage in all classes of primary schools in the Republic of Croatia towards enhancing the quality of class effectiveness. Therefore, the aim of this research was to establish what the attitudes of teachers and pupils are in relation to multimedia and in what way teachers can use multimedia in class. In accordance with the aim, all elements of research were elaborated methodologically: research tasks, research questions, hypotheses, methods, procedures, instruments, variables, populations and samples. Interpretation of results related to: existing concept of teaching by teachers in primary schools of the Republic of Croatia (CNES – Croatian National Educational Standard, Curriculum and Catalogue of Professional Conferences: Plan and program of professional upgrading of class teachers), types of multimedia which teachers use in teaching, evaluation of multimedia effectiveness and didactic criteria for multimedia assessment, suitability of multimedia for pupils, elements which empower and inhibit multimedia usage, advantages and disadvantages of multimedia and attitudes of teachers on

the significance of multimedia in comparison with other factors of the didactic-methodical field.

The scientific contribution is manifested in promotion of the teaching process at the level of class teaching focused on quality of learning. With inclusion of audio-visual senses in teaching and learning, a clearer and richer impression along with sensory interaction with pupils is created, thus impacting on awareness of their capacity. Through this, multimedia teaching and learning provide for all pupils in the class the possibility of being successful. The conclusions of the research show that multimedia usage in teaching implies many didactic transformations, of which the basic one is focused on developmental approach to pupils. Along with conclusions of research, guidelines for future research work are offered.

11. KEY WORDS

Media, multimedia, constructivism, theory of information processing, cognitive theory of multimedia learning, theory of multiple intelligences, theory of ecological systems, structuralism of Berlin school, sensory integration, didactics of media, didactic criteria of assessing multimedia, poly-factorial model of teaching, teaching strategy.

12. POVZETEK

Izbira in uporaba multimedijev pri pouku predstavlja novo problemsko področje raziskovanja v didaktiki medijev. To je bil eden od razlogov za opredelitev za tematiko multimedijev pri pouku, natančneje za proučevanje uporabe (multi)medijev od prvega do četrtega razreda osnovne šole. Večja pozornost proučevanju medijev in množičnih medijev se je pričela v drugi polovici 20. stoletja, medtem ko so multimedije začeli proučevati sistematično s pojavom računalnikov in multimedijske izobraževalne podpore v informativnem kontekstu od osemdesetih let 20. stoletja dalje. Tehnično-tehnološki napredek v gospodarstvu po preverjeni učinkovitosti se je odražal tudi pri pouku ter ga nujno spreminjal. Na žalost te spremembe v šolstvu pogosto kasnijo na vseh ravneh. Toda tudi v počasnem tempu se pedagoški proces posodablja tako z usposabljanjem učiteljev za uporabo učnih medijev in multimedijev, kot z zamenjavo zastarele učne tehnologije s sodobnimi učnimi sredstvi in pripomočki. Če je neka šola opremljena z najsodobnejšimi mediji in multimediji, to še vedno ne zagotavlja njihovo funkcionalno uporabo pri pouku. To je v veliki meri odvisno od osebnih in strokovno-profesionalnih sposobnosti učiteljev, od katerih je odvisno, kako in koliko bodo uporabljali medije in multimedije pri pouku. Osnovni smisel njihove uporabe je enakopravni razvoj učenčevih pravic in humanistične usmeritve kakovosti poučevanja. Zato moramo oblikovati učne strategije, s katerimi bi lahko dosegli celovit razvoj učencev. Izhodišče za učinkovito uporabo multimedijev pri pouku ima svojo utemeljitev v konstruktivizmu, teoriji obdelave informacije, kognitivni teoriji multimedijskega učenja, teoriji kognitivne obremenitve, teoriji mnogoterih inteligenc, teoriji ekološkega sistema, strukturalizmu berlinske šole in hamburškega modela.

Rezultat proučevanja navedenih teorij in izkušenj iz prakse je polifaktorski model pouka, ki vključuje učenca, učitelja, medije in multimedije, učno vsebino, učne cilje, načela, tipe učnih aktivnosti, metode in tehnike poučevanja, socialne oblike dela in prostorsko-materialne pogoje. Ta model prikazuje univerzalnost svoje uporabe, ker je uporaben v vseh družbah zaradi dejstva, da je princip delovanja isti. Večfaktorski model pouka prikazuje slojevitost in s tem tudi združenost in prepletenost multimedijskega poučevanja s tradicionalnimi oblikami poučevanja. Na horizontalni ravni lahko najdemo ustrezne temelje in teoretske povezave z Bronfenbrennerjevo teorijo ekoloških vsebin in prav tako v »berlinskem« in »hamburškem« modelu. Prikazuje povezanost vseh podsistemov nekega sistema, ki se odraža na učenčevih dosežkih pri učenju v okviru pouka. Razlika tega večfaktorskega modela glede na model

strukture okolja v teoriji ekoloških vsebin je v tem, ker ta model znotraj strukture okolja usmerja pozornost na elemente aktivnosti poučevanja ter detajlneje prikazuje in opisuje strukturo aktivnosti poučevanja kot tudi odnose elementov znotraj mikro in mezosistema. Povezanost tega večfaktorskega modela z »berlinskim« in »hamburškim« modelom je vidna v večfaktorskem prikazu strukturnih modelov elementov didaktično-metodičnega polja kot tudi njihova delovanja v širšem socialno-kulturnem kontekstu.

Izbira (multi)medijev temelji na didaktičnih kriterijih. Na osnovi ugotovitev domačih in tujih avtorjev, empiričnih proučevanj in racionalnega preverjanja lahko izpostavimo predvsem tiste didaktične kriterije, ki se nanašajo na: učenca, učitelja, (multi)medije, učne strategije in druge elemente. Vsak element ima nadaljnje razdelane kategorije. Didaktični kriterij ocenjevanja multimedijev, ki so naravnani na učenca, se nanašajo na: primernost učenčevi starosti, intrinzično (neodvisno od zunanjih vplivov) motivacijo, učenčeve razvojne ravni, razvitost čutno-komunikacijskih kompetenc, učnih stilov in aktivnosti učenca. Didaktični kriteriji ocenjevanja multimedijev, ki so usmerjeni na učitelja, se nanašajo na osebne in profesionalne kompetence ter učiteljevo edukativno politiko. Didaktični kriteriji ocenjevanja multimedijev se usmerjajo predvsem na: čutno-komunikacijsko strukturo, oblikovanost, količinsko strukturo informacij in tehnične možnosti prezentacije multimedijev. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na učne strategije, se nanašajo na: didaktično komunikacijo, skladnost z učnimi cilji, etape učenja, učne vsebine, primernost prostorov za multimedijsko prezentacijo, oblike posredovanja multimedijske prezentacije ter evalvacijo učinkovitosti učnih strategij. Didaktični kriteriji ocene multimedijev, ki so usmerjeni na druge dejavnike, so: organizacijski, ekonomski in geografski pogoji. Didaktični kriteriji za izbiro multimedijev uporabljamo kot pomoč učitelju pri selekciji in oblikovanju multimedijev, toda svojo uporabnost imajo tudi v evalvaciji.

Problem raziskovanja predstavlja raziskovanje stališč učiteljev in učencev o odnosu do multimedijev pri pouku in njihova uporaba. Raziskava sodi na področje aplikativnega raziskovanja, v okviru katerega smo želeli dobiti povratne informacije o uporabi multimedijev pri razrednem pouku v osnovnih šolah v Republiki Hrvaški. Raziskovanje je usmerjeno na izvajanje pouka v učilnici, v kateri so osnovni nosilci pouka učitelj in učenci od drugega do četrtega razreda osnovne šole. Razredne oddelke tvorijo heterogene skupine učencev (spol, različne razvojne zmožnosti učenja, učenje z različnimi stili...). Cilj tega empiričnega raziskovanja je pridobiti spoznanja o uporabi multimedijev na razredni stopnji v osnovnih

šolah Republike Hrvaške. Spoznanje o uporabi multimedijev pri pouku nameravamo uporabiti pri dvigu kvalitete učinkovitosti pouka. Zato je cilj tega raziskovanja potrditi, kakšna so stališča učiteljev glede multimedijev ter na katere načine uporabljajo multimedije pri pouku. Skladno s ciljem smo določili naloge, ki jih moramo opraviti v okviru raziskovalnega dela. Oblikovali smo naslednja raziskovalna vprašanja:

1. Ali so multimediji zastopani v učnem načrtu in programu učnih predmetov razredne stopnje in v programu strokovnega izpopolnjevanja hrvaških učiteljev?
2. Katere vrste medijev in v kolikšni meri jih učitelji uporabljajo pri pouku?
3. Ali učitelji izvajajo evalvacijo uporabe multimedijev?
4. Katere didaktične kriterije za ocenitev multimedijev postavljajo učitelji pri svojem praktičnem delu?
5. Ali učitelji ocenjujejo, da so multimediji enako primerni za vse učence ali so v različni meri uporabljeni pri učencih različnih ravni dosežkov?
6. V kolikšni meri so prisotni elementi, ki omogočajo uporabo multimedijev pri pouku in kako so povezani s socio-demografskimi spremenljivkami?
7. Kateri so najpogostejši elementi pri uporabi multimedijev, ki jih učitelji smatrajo za vezane na pouk?
8. Kakšno je učiteljevo mnenje o prednostih in pomanjkljivostih uporabe multimedijev pri pouku?

Skladno z raziskovanimi vprašanji smo postavili naslednje hipoteze:

1. Glede na to, da nismo odkrili raziskave, ki bi se sistemsko ukvarjala s proučevanjem učnih načrtov ter programi izpopolnjevanja hrvaških učiteljev, je prvo raziskovalno vprašanje eksploratorne narave. Zato ne bomo oblikovali specifične hipoteze.
2. Glede na dosedanja raziskovanja pričakujemo najmanjšo uporabo olfaktivnih in gustativnih, a največjo avditivnih in vizualnih medijev pri pouku.
3. Od skupnega števila učiteljev, ki uporabljajo multimedije pri pouku, zelo malo učiteljev izvaja evalvacijo.
4. Pri evalvaciji učitelji uporabljajo heterogene didaktične kriterije.
5. Glede na deficitarno seznanjenost učiteljev s sodobnimi spoznanji o uporabi multimedijev pri pouku pričakujemo, da večina učiteljev ne bo uvidela razlike učinkov uporabe multimedijev pri pouku na učence različnih sposobnosti.
6. Predpostavljamo, da na omogočanje uporabe multimedija pri pouku vpliva strokovna usposobljenost učiteljev, njihova dosežena spoznanja, strokovno izpopolnjevanje učiteljev in opremljenost šole. Glede na to, da niso odkrita raziskovanja povezanosti

učiteljeve strokovne usposobljenosti, njihovih pridobljenih spoznanj, strokovnih izpopolnjevanj, opremljenosti šole v učni praksi hrvaških šol od drugega do četrtega razreda in socio-demografskih spremenljivk, ne bomo oblikovali afirmativne hipoteze za to eksploratorno vprašanje.

7. Pričakujemo, da bo največ učiteljev navedlo kot ovirajoče elemente pomanjkanje multimedijev v šoli kot osnovni problem.
8. Predpostavljamo, da bodo učitelji prepoznali multimedije skozi učinke na ravni znanja in motivacije učencev. Nadalje, da bo pomanjkanje gibanja in socializacije največji problem pri uporabi multimedija v naravi.

Pri raziskovanju so bile uporabljene kavzalno-neeksperimentalna, deskriptivna metoda in analiza kontingencijske povezanosti nominalnih spremenljivk. Od postopkov za zbiranje podatkov in instrumentov so bili uporabljeni: analiza vsebine pisnih dokumentov (Učni načrt in program za osnovne šole Republike Hrvaške (2006) in Katalogi strokovnih srečanj učiteljev (2002–2009), anketa za učitelje razrednega pouka ter anketa za učence drugih, tretjih in četrtih razredov osnovnih šol. Zaradi jasnosti raziskave ter obdelave in interpretacije rezultatov smo v anketah spremljali odgovore preko neodvisnih in odvisnih spremenljivk. V vsakem okraju - županiji (zagrebška, mesto Zagreb, krapinsko-zagorska, sisaško-moslavaška, karlovska, varaždinska, koprivniško-križarska, bjelovarsko-bilogorska, primorsko-goranska, liško-baranjska, šibeniško-kninska, vukovarsko-sremska, splitsko-dalmatinska, istrska, dubrovaško-neretvanska, medžimurska) smo izbrali po eno osnovna šola, kjer smo anketirali učitelje in učence. Osnovne šole so izbrali z naključnim vzorcem. Raziskovalni vzorec je tvorilo 1495 anketirancev, od teh 126 učiteljev razrednega pouka in 1389 učencev njihovih razrednih oddelkov. Anketiranje je bilo izvedeno v letu 2006/07.

Na temelju teoretičnega proučevanja problema uporabe multimedijev pri razrednem pouku ter empiričnih rezultatov raziskovanja, ki so prikazani v doktorskem delu, smo oblikovali nasledne zaključke:

1. V teoretičnem delu naloge smo natančno proučili teorije in modeli, ki proučujejo proces obdelave informacij, pomena in specifičnosti multimedijskega učenja. Posebna pozornost je posvečena redefiniranju razdelitve medijev in multimedija glede na dosedanja spoznanja in izkušnje znanstvenikov v svetu, Evropi in v Republiki Hrvaški. Vodilne niti raziskave so: konstruktivizem, teorija obdelave informacij, kognitivna teorija multimedijskega učenja, teorija kognitivne obremenitve, teorija večstranske inteligence, teorija ekoloških vsebin, strukturalizem berlinske šole ter večfaktorski model pouka, ker proučujejo možnosti učenja na

splošno, posebej pa obravnavajo tudi uporabo multimedijev pri pouku in njihov vpliv na kvaliteto učnega dela.

2. Glede na čutne lastnosti so v didaktični literaturi učni mediji najpogosteje razdeljeni na avditivne, vizualne in avdio-vizualne medije. V okviru sodobnega razumevanja medijev se takšna razdelitev smatra za nepopolno, ker moramo dati ustrezno pozornost vsem čutilom. Zato je prikazana klasifikacija medijev tudi glede na način percipiranja, to je čutne izkušnje, ki jih pridobe učenci, in jih delimo na: avditivne, vizualne, kinestetske, olfaktivne in gustativne. Medije vsakega čutnega področja ustvarijo razni predmeti, objekti, materiali, stroji, naprave, živali, rastline in ljudje. Navedeni niso vsi mediji, ker jih je nemogoče navesti. To razdelitev lahko razumemo pogojno zaradi sinestetskih medijev.

Strukturo multimedijev sestavljajo posamezne medijske komponente. Vsak multimedij je sestavljen iz dveh ali več medijev. Primer integracije medija v računalniškem multimediju so razvili številni avtorji (gl. npr. Faulstich, 2000) s pomočjo statičnih in dinamičnih medijev. Statični mediji so: besedilo, tabela, grafikon, slike, ki prikazujejo mirujoče informacije. Dinamične medije predstavljajo: zvoki, glasba, film, video, animacija in stimulacija, ki prikazujejo informacije v stalnem gibanju. Katera koli oblika spajanja statičnih in dinamičnih medijev tvori multimedijsko integracijo. Različne kombinacije medijev v multimedijem proučevanju in učenju delujejo v ozaveščanju osebnih lastnosti učencev, ker obsega avdio-vizualna čutna področja, to je, odgovarjajo na potrebe različnih načinov učenja v razredu. Toda pri tem moramo biti pozorni, da so dostopni razvojnemu obdobju učenca. Z uporabo multimedijev dosežemo senzorne integracije pri učencu, s čimer vplivamo na uspešnost pri učenju.

3. Učni proces temelji na večfaktorskem modelu pouka, ki je sestavljen iz strukturnih elementov didaktično-metodičnega področja: učenec, učitelj, drugi multimediji in mediji, učni program, učna načela, učni cilj, vrste učnih aktivnosti, metode in tehnike poučevanja, socialne oblike dela in prostorsko-materialni pogoji. Tak model razumemo fleksibilno, s tendenco širitve (pušča se prazen prostor za vstop novih elementov). Pomembno je poudariti, da pouk opazujemo v kontekstu splošnega sistema od mikro- do makrosistema, v katerem se vidi medsebojna povezanost in vplivanje drug na drugega. Osnovna vzorca za izdelavo večfaktorskega modela pouka sta bila »berlinski« in »hamburški« model, prav tako tudi teorija ekoloških vsebin. Odnos multimedijev in drugih strukturnih elementov v večfaktorskem modelu pouka je v medsebojni interakciji in komplementarnosti. Vsi strukturni elementi pouka so prav tako sestavine učne strategije. To definirajo kot večščino pripravljanja,

organiziranja, vodenja in evalviranja učne aktivnosti, s katero vzgajamo in izobražujemo učence za doseg učnih ciljev. Učne strategije odgovarjajo na osnovna vprašanja: kdo, kaj, kdaj, kje, kako, zakaj, s čim, kako dalje? V praksi obstajajo mnoge avtentične in neponovljive učne strategije. Lahko zaključimo, da ne obstajata dve enaki učni strategiji. Te so gibljive oblike, ker so učitelj in učenci nepredvidljivi človeški dejavnik in se medsebojno razlikujejo po sklopih različno strukturiranih elementov didaktično-metodičnega področja. V učnih strategijah obstajajo številne možnosti uporabe multimedijev pri pouku. Skozi učne aktivnosti in učnega delovnega dne lahko multimedije uporabljamo: sukcesivno, simultano ali kombinirano. Multimedij predstavlja učencem učno sredstvo, o katerem se učijo in s pomočjo katerega se uče.

4. V teoretičnem delu naloge so postavljeni didaktični kriteriji ocene multimedijev. Osnovni elementi kriterija so: učenec, učitelj, multimedij, učne strategije in drugi dejavniki. Ob vsak element nadalje so razdeljene podkategorije didaktičnih kriterijev ocene multimedijev. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na učenca, se nanašajo na: primernost učenčeve starosti, intrinzično motivacijo, razvojne ravni učenca, razvitost čutno-komunikacijskih kompetenc, učne stile in učenčevo aktivnost. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na učitelja, se nanašajo na: učiteljeve osebne in profesionalne kompetence, ki se odražajo na edukativno didaktično strategijo, ki jo zastopajo. Značilnosti teh didaktičnih kriterijev so: vsakodnevno razvijanje osebnih kompetenc, znanje o multimedijih, učiteljeva stališča o multimedijih, učiteljeva strokovnost pri uporabi multimedijev in strokovnost uporabe učnih strategij. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na multimedij, se nanašajo na: čutno-komunikacijsko strukturo, oblikovanost, količinsko in kakovostno strukturo informacij multimedijev ter tehnične možnosti prezentacije multimedijev. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na učne strategije, se nanašajo na: didaktično komunikacijo, skladnost z učnimi cilji, etape učenja, učne vsebine, primernost prostorov za multimedijsko prezentacijo, oblike posredovanja z multimedijsko prezentacijo, primernost učenja ter evalvacijo učinkovitosti multimedijev v ožjem in učnih strategij v širšem smislu. Didaktični kriteriji ocenjevanja multimedijev, usmerjeni na druge dejavnike, so: organizacijski, ekonomski in geografski pogoji. Čim bolj so jasni kriteriji ocenjevanja multimedijev, tem bolj bi njihov izbor pri pouku moral biti kvalitetnejši in lažji.

5. V empiričnem delu naloge je postavljenih osem raziskovalnih vprašanj. Prvo vprašanje se je glasilo: Ali je multimedij zastopan v učnem načrtu in programu za učne predmete pri razrednem pouku in v programih strokovnega izpopolnjevanja hrvaških učiteljev? Obstoječa

konceptija učiteljevega poučevanja v osnovnih šolah Republike Hrvaške temelji na Hrvaškem nacionalnem izobraževalnem standardu. Tendenca tega dela je urejanje pristopa učencev osnovnih šol ter ciljna izenačenost s predšolsko, srednješolsko stopnjo vzgojno-izobraževalnega sistema. Osnovni cilj, vrednoten z Učnim načrtom in programom, sprejetim leta 2006, je bil zmanjšati obseg učne vsebine v vseh učnih predmetih, jih posodobiti, predmetno in medpredmetno povezati, uravnoteženo razporediti po razredih ter definirati vzgojno-izobraževalne cilje in naloge skladno z razvojno stopnjo učenca. Multimedij bi moral biti integriran v učne predmete kot učno sredstvo o funkciji učenčevega razvoja. V okviru medijske kulture lahko govorimo tudi o multimedijih, toda ne da se vpelje parcialno, samo pri pouku hrvaškega jezika. Zaradi svojih specifičnosti je multimedij sprejemljiv tudi pri pouku drugih učnih predmetov. Multimediji se navajajo v besedilu, prek posameznih programov učnih predmetov splošno, indirektno, kot učna sredstva pri učenju. Prav tako omenjajo tudi učiteljevo obveznost za uporabo avdio-vizualnih sredstev in informacijske opreme ter nalogo knjižničarjev za nabavo multimedijskih izvorov znanja in tudi formiranje multimedijskega središča šole. Multimedij ne navajajo kot termin v programih učnih predmetov od prvega do četrtega razreda osnovne šole. Medijsko kulturo navajajo edino pri pouku hrvaškega jezika kot eno od učnih področij dela. Zastopano je mišljenje, da se medijsko kulturo gleda v ozkem okviru, skozi naglašeno vlogo filma in televizijskih oddaj. Zato se kaže potreba po aktualizaciji problema multimedija v učnih programih. Po proučevanju Kataloga strokovnih srečanj se multimedij kot termin na splošno ne uporablja v načrtu in programu strokovnega izpopolnjevanja učiteljev. V obdobju od leta 2002 do 2009 se je (multi)medij interpretiral s temami o: računalniku, internetu, Power Pointu, informatiki pri razrednem pouku in filmu. Posamezno ali posamezne od navedenih tem o multimediju so bile interpretirane v desetih (primorsko-goranska, liško-senjska, istrska, osiješko-baranjska, virovitiško-podravska, požeško-slavonska, brodsko-posavska, vukovarsko-sremska, dubrovaško-neretvanska, šibeniško-kninska) od mogoče enainvajsetih županij. Prav zato, ker so Katalogi strokovnega izpopolnjevanja učiteljev najbolj zastopana in obligativna oblika izpopolnjevanja učiteljev na ravni vseh županij Republike Hrvaške, ti podatki niso zadovoljivi glede na pomen multimedija pri pouku. Dva osnovna razloga sta za premajhno vključenost teme o multimedijih v načrt in program strokovnega izpopolnjevanja učiteljev. Prvi razlog je v dejstvu, da Ministrstvo za znanost, izobraževanje in šport enostransko določa teme za strokovna izpopolnjevanja učiteljev zaradi skladnosti z nacionalnim izpitom v četrtem razredu. Zato v kataloge postavljajo teme, ki ga bolj določa pogoj skladnosti. Drugi razlog premajhne vključenosti teme o multimedijih je v ponudbi tem ponudnikov izobraževanja, ker

imajo možnost uvrščanja tudi nekih drugih tem. Šele posamezni ponudniki izobraževanja so pokazali občutljivost za teme o multimedijih ter o medijih pri pouku nasploh. Zato predlagamo vključitev teme o multimedijih v program edukacije učiteljev. Pobuda za edukacijo v Katalogu strokovnega izpopolnjevanja učiteljev gre v smeri neposrednega izvora informacije učitelju o tem, kaj je multimedij pri pouku, katere so njegove bistvene značilnosti, kako se uporablja pri pouku, kakšno vlogo ima v razvoju učenca, didaktični kriteriji za izbor in oceno multimedija, evalvacija multimedija ter učiteljevo oblikovanje multimedija, ker oni najbolj poznajo potrebe svojih učencev, ki so avtentične.

6. Drugo raziskovalno vprašanje je bilo: Katere vrste medija in kolikšni meri ga učitelji uporabljajo pri pouku? Učitelji pri svojem delu uporabljajo medije vseh občutljivih področij: vizualnega, avditivnega, kinestetskega, olfaktivnega, gustativnega kot tudi njihove različne kombinacije. Pri tem dajejo največji poudarek vizualnim medijem (69,9%), nato avditivnim (63,5%), raznim kombinacijam medijev (42,1%), kinestetskim (34,1%), olfaktivnim (11,9%) in gustativnim medijem (7,1%). Pri spraševanju o mnenjih učencev o tem, katera učna sredstva in pripomočki so jim najbolj priljubljena, so se večinoma opredeljevali za računalnik ter učna sredstva in pripomočke, ki jih uporabljajo pri pouku telesne in zdravstvene vzgoje. Dobljeni odgovori kažejo na razliko v mnenjih učiteljev in učencev o izboru učnih sredstev pri pouku. O tem govori tudi dejstvo, da bi 38,6 odstotka učencev večkrat uporabljalo vire za učenje, kar nakazuje na pomanjkanje zadovoljevanja njihovih učnih potreb pri pouku, medtem ko bi 9 odstotkov učencev zmanjšalo uporabo virov za učenje pri pouku, kar kaže na zasičenost njihove uporabe in bi jih morali uporabljati na drugačen način. Skupno 47,6 odstotka vprašanih učencev tvori populacijo, ki ji viri za učenje niso zamišljeni po »njihovi meri« in bi morali pristopiti k njihovemu izboru skladno z različnimi razvojnimi stopnjami učencev. Njihovi odgovori bi morali biti pomemben didaktični kriterij izbire virov za učenje pri uresničevanju učnih strategij.

Pri poučevanju odnosa učnih sredstev in pripomočkov ter neodvisnih spremenljivk so dobljeni statistično pomembni rezultati med odnosom učnih sredstev in pripomočkov ter spola, razreda in velikosti šole. Deklice in dečki se radi učijo tudi ob pomoči različnih sredstev in pripomočkov. Deklice imajo bolj kot dečki rade učbenike, kasete z glasbo, slike, plakate ter likovne pribore in materiale, medtem ko dečki bolj kot deklice imajo radi športne rekvizite in računalnik. Skladno z najpriljubljenimi učnimi sredstvi in pripomočki so deklice bolj navdušene nad predmeti hrvaški jezik ter glasbeno in likovno vzgojo, dečki pa telesno in zdravstveno vzgojo. Ravno ljubezen do navedenih učnih sredstev in pripomočkov ustvarja

tudi ljubezen do učnih predmetov, pri katerih jih uporabljajo. Glede na preference učnih sredstvih in pripomočkov se istočasno pojavlja tudi preferenca učnega predmeta. Medtem ko dajo deklice prednost: hrvaškemu jeziku, glasbeni in likovni kulturi, kar nam nakazuje nagnenje k umetniškim aktivnostim, dečki dajo višjo vrednost uporabi računalnika, to pomeni, da jih privlači tehnika, tehnični aparati, a imajo tudi večjo potrebo po motornih aktivnostih.

Učenci drugih razredov imajo bolj radi kasete z glasbo in videokasete kot učenci tretjih in četrtih razredov. Slednji bolj poudarjajo svoje stališče in individualnost, imajo svoje idole (glasbene, igralske), a ne marajo medije in multimedije, ki jih je nekdo izbral za njih. Raje sami izbirajo, predlagajo vsebine za poslušanje in gledanje, medtem ko so učenci drugih razredov bolj pod učiteljevim vplivom. Naslednja statistična značilnost se kaže, da je pri učencih četrtih razredov manj priljubljen likovni pouk kot pri učencih tretjih razredov, ker se v četrtih razredih, v skladu z učnim programom, bolj poudarja definiranje likovnosti, predvideno eno šolsko uro tedensko pouku likovne kulture.

Kasete z glasbo imajo radi učenci iz večjih šol (800 in več učencev), manj pa učenci srednje velikih šol (501 – 800 učencev), a najmanj učenci manjših šol (do 500 učencev). V manjših šolah je tudi manj učencev v oddelkih. Kolikor manj je učencev, toliko ima učitelj več možnosti, da se individualno posveti učencem in glasbenih aktivnostih petja in igranja. Učencem večjih in srednje velikih šol so bolj priljubljene videokasete kot učencem manjših šol. Večje šole so pogosto bolj opremljene z avdio-vizualnimi sredstvi in pripomočki, zato predpostavljamo, da bo večja uporaba tako avditivnih kaset kot tudi videokaset pri pouku. V večjih šolah obstaja večja možnost vpogleda v produkcijo učbenikov in učnih sredstev ter pripomočkov, ker so založbe in trgovine pogosteje prisotne v večjih šolah, v katerih organizirajo strokovne aktivnosti učiteljev. Na takih srečanjih demonstrirajo in predstavljajo svoje proizvode in novosti s področja uporabe učnih sredstev in pripomočkov, ob tem pa celo obdarujejo svoje kupce. Enako je s športnimi rekviziti. Večje šole so bolj opremljene in čim bolj so opremljene, tem bolj tudi uporabljajo rekvizite. Čim bolj uporabljajo pripomočke, tem bolj so učenci navajeni na njih in jih imajo tudi bolj radi.

Rezultati raziskovanja kažejo, da ni statistično pomembnih razlik med velikostjo šole, ki jo učenci obiskujejo, in učbeniki, slikami in plakati, računalniki ter likovnim priborom in materialom, ki ga uporabljajo učitelji pri pouku. Ne glede na velikost šole učenci vseh

razredov uporabljajo učbenike za učenje, ker jim je obvezno osnovno učno sredstvo. Velikost šole prav tako ne vpliva na učenčevo preferenco slik in plakatov, ker le-te pogosto ponujajo kot promocijske materiale razne tiskarne pri večini učnih predmetov učencem šol različnih velikosti. Računalniki so privlačni zaradi mnogih možnosti učenja, ki jih nudijo, ter ne glede na velikost in opremo šol jih imajo učenci doma ali jih uporabljajo v šoli ali prijateljih. Športni rekviziti so obvezni v vseh razredih pri pouku telesne in zdravstvene kulture ter jih v večini primerov učenci šol različnih velikosti imajo radi.

Skladno z navedenimi rezultati se je hipoteza, ki se je nanašala na trditev, da najmanjšo zastopanost medijev pri pouku pričakujemo pri olfativnih in gustativnih, a največjo pri aditivnih in vizualnih medijih, potrdila. Zato bi predlagali izbor učnih medijev, kjer se poudarjajo vsa čutila, s čimer bi podprli različne načine percipiranja pri učencih, ki so jih z enostranskim izborom medijev prikrajšali. To konkretno pomeni, da predlagamo precej več olfaktivnih in gustativnih medijev pri pouku, s katerimi bi učitelji vzbudili večjo različnost senzorskih integracij. Iz istega razloga predlagamo pogostejšo uporabo multimedijev. Tak predlog je skladen z učenčevo preferenco multimedijev v odnosu do medijev, zato jim moramo v praksi dati več pozornosti. Zanimivo je, da se glede na preferenco učnih sredstev in pripomočkov istočasno javlja preferenca učnega predmeta, pri katerem jih uporabljajo. V prihodnosti bi pri poučevanju morali več pozornosti posvetiti uskladitvi potreb uporabe učnih sredstev in pripomočkov v zadovoljstvo učiteljev in učencev, skladno z njihovimi interesi, toda tudi z elementi (npr. neodvisne spremenljivke: spol, razred, velikost šole), ki so pokazali statistično pomembne rezultate.

7. Ali izvajajo učitelji evalvacijo uporabe multimedijev, je bilo tretje raziskovalno vprašanje, usmerjeno k zelo bistvenemu segmentu pouka, in to je evalvacija. Samo 28,6 odstotka učiteljev izvaja evalvacijo učinkovitosti multimedija.

Skrb vzbujajoča je misel, da 71,4 odstotka učiteljev evalvacije ne izvaja ali pa niso nič odgovorili. Očitno je, da so nejasnosti okrog evalvacije, ker če nečesa ne znamo, ne moremo niti napisati. Vzporedno je bilo povprašano tudi o mnenju učencev o uporabi multimedijev pri pouku. 47,7 odstotka jih meni, da bi morali multimedije uporabljati več ali manj, kot jih pri pouku uporabljajo. Če primerjamo odgovore učiteljev in učencev, bi pravilno »doziranje« multimedijev pospešili z izvajanjem evalvacije njegove uporabe. To nadalje pomeni, da bi s sistemsko evalvacijo uporabe multimedijev le-tega izbrali v skladu z učenčevimi potrebami.

Evalvacija učinkovitosti multimedija je zadnja etapa učne aktivnosti, ker na koncu učnega dela preizkušamo poleg drugega uporabo multimedija. Evalvacija se nanaša na pregled narejenega in doseženega pri učencih s ciljem, da sprejmemo zaključke in nove odločitve pri prihodnjem načrtovanju učnih strategij. Učitelji, ki imajo izbiro in pregled multimedija pri pouku, se ravnaajo po reakcijah svojih učencev. Z različnimi didaktičnimi postopki pregleda vzgojno-izobraževalnih dosežkov učencev dobivamo neposredno povratno informacijo, na podlagi katere ustvarjamo načrt prihodnjega strateškega delovanja. Takšni avtentični učiteljevi pristopi pri pregledu učinkovitosti uporabe multimedija ocenjujemo zelo pozitivno, ker na neposrednih povratnih informacijah učencev temelji prihodnje poučevanje in s tem tudi uporaba multimedija.

Z dobljenimi rezultati potrjujemo hipotezo, da od skupnega števila učiteljev, ki uporabljajo multimedij pri pouku, zelo malo učiteljev izvaja evalvacijo (vsega 28,6 odstotka učiteljev). Pri tem bi pri učiteljih morali osveščati pomen evalvacije uporabe multimedija pri spodbujanju različnih sposobnosti, veščin, navad in stališč učencev, kar z evalvacijo osveščamo didaktične kriterije ocenjevanja multimedija zaradi ustvarjanja novih učnih strategij.

8. Katere didaktične kriterije za oceno multimedija postavljajo učitelji pri svojem praktičnem delu? Učitelji, ki izvajajo evalvacijo uporabe multimedijev pri pouku, ustvarjajo različne individualne pristope pri ocenjevanju njihove učinkovitosti, stremeč k multimedijim, ki so primerni učencem in jih bolj spodbujajo v njihovem razvoju. Učiteljevi odgovori so klasificirani v kategorije osnovnih elementov kriterijev izbire multimedija, ki se nanašajo na: učenca, učitelja, multimedij in učne strtegije. Učenčeva aktivnost, njegova intrinzična motivacija in razvojne ravni pripadajo učenčevim značilnostim. Učiteljeve profesionalne kompetence vplivajo na izbiro multimedija na osnovi njegovih delovnih izkušenj in vedenj o multimediju. Kategorija, ki se nanaša na multimedij, je specifičnost njegove strukture, medtem ko so skladnost z učnim ciljem in evalvacija multimedijske učinkovitosti osnovni pripadajoči kriteriji učnih strategij. Iz navadnega sledi, da učitelji preverjajo raven učinkovitosti multimedija na temelju različnih didaktičnih kriterijev. Tu se vidi povezanost med odgovori učiteljev in postavljenimi kriteriji izbire multimedija pri pouku v teoretičnem delu naloge tako, da so učitelji navedli neke od številnih navedenih elementov, ki vplivajo na izbiro. Analiza učiteljevih odgovorov potrjuje hipotezo, da pri evalvaciji učitelji uporabljajo heterogene didaktične kriterije, kar je dobro, ker učitelji razvijajo avtentične načine

evalviranja uporabe multimedija. Njihovi individualni pristopi so primerni značilnostim razvojnih heterogenosti učencev v razredih. Učenci so najpogostejši didaktični kriterij kontinuiranega iskanja najboljših multimedijskih kombinacij, kar nakazuje na procesno, a tudi produktno evalvacijo.

9. Peto raziskovalno vprašanje je bilo: Ali menijo učitelji, da so multimediji enako primerni vsem učencem ali so v različni meri primerni učencem različnih ravni dosežkov?

Skladno s tem raziskovalnim vprašanjem je bilo analizirano učiteljevo mnenje glede na to, ali uporabljajo multimedije za vse učence ali posamezne skupine učencev: povprečne, nadpovprečne ali podpovprečne glede na razvojne ravni učencev. Za možnost uporabe multimedija za vse učence v razredu glede na njihove razvojne ravni se je izjasnilo 61,1 odstotka učiteljev. Najmanj učiteljev (3,2%) je izjavilo, da multimedije lahko uporabljajo za podpovprečne učence. Točno je, da multimedije lahko uporabljamo za vse učence v razredu, čeprav so največji dosežki pri učencih, ki dosegajo slabši uspeh pri učenju.

Primerjali smo odgovore učiteljev in učencev glede na razumevanje sporočil multimedija in razumevanje učne vsebine. Medtem ko 88,9 odstotka učiteljev meni, da njihovi učenci razumejo sporočilo multimedija, 67,1 odstotka učencev izjavlja, da učne vsebine razumejo, a 31,2 odstotka učencev jih razume delno. To pomeni, da učitelji nimajo najbolj točno sliko o svojih učencih in njihovem razumevanju učnih vsebin, torej imajo lepše mnenje, kot ga prikazujejo učenci. Rešitev tega problema je v razmisleku in uporabi učnih strategij, v katerih bi morali usmeriti pozornost nadaljnji uporabi multimedija, medija, individualizaciji, diferenciaciji in problemskem pristopu pri učnih aktivnostih. Pri nadaljnji uporabi multimedija bi se morali osredotočiti na evalvacijo ter didaktične kriterije izbire, s čimer bi pospešili razumevanje učnih vsebin. Z individualizacijo, diferenciacijo in problemskimi pristopi pri učnih aktivnostih vplivamo na aktivnejši odnos učenca do učenja pri pouku.

Nekateri avtorji poudarjajo (gl. npr, Mayer, 2005), da imajo od multimedijev največjo korist učenci najnižjih dosežkov, ki naredijo največji napredek z uporabo multimedija pri učenju. Glede na deficitarno seznanjanje učiteljev s sodobnimi spoznanji o uporabi multimedija pri pouku, skladno s hipotezo potrjujemo, da največje število učiteljev ni prepoznalo razlike učinkov uporabe multimedija pri pouku pri učencih različnih sposobnosti. K temu spadajo tudi različni rezultati stališč učiteljev in učencev o razumevanju sporočila multimedija. Rešitev je v dodatnih edukacijah učiteljev in v večji pozornosti učiteljev pri odkrivanju vzrokov slabega razumevanja učnih vsebin pri svojih učencih. Sem sodi aplikativnost teorije

kognitivne obremenitve, s katero Swellwe (2006) daje natančne napotke pri oblikovanju multimedijev za učence različnih ravni predznanja.

10. Šesto raziskovalno vprašanje je bilo: V kolikšni meri so prisotni elementi, ki omogočajo uporabo multimedijev pri pouku in kako so povezani s socio-demografskimi spremenljivkami?

Elementi, ki omogočajo uporabo multimedijev pri pouku, so bili preizkušeni na spremenljivkah: strokovni usposobljenosti učitelja, združitvi spoznanj za uporabo multimedija, oblikah strokovnih izpopolnjevanj za uporabo multimedijev in opremljenosti šol z učnimi mediji.

S sestavo kategorije zadostne in popolne usposobljenosti smo dobili rezultate, in sicer: 72,2 odstotka učiteljev se ocenjuje za strokovno usposobljene za uporabo multimedijev. Istočasno se vprašamo, če so učitelji zadovoljivo in popolnoma usposobljeni za uporabo multimedijev, zakaj potem 71,4 odstotka učiteljev nima načina preizkusa učinkovitosti multimedijev ali nima nikakršnega odgovora za izvajanje evalvacije. Sicer učitelji z visoko strokovno izobrazbo bolj inklinirajo k nadaljnjemu razvoju, možnostim učenja in lastnega razvoja kot učitelji z višjo strokovno izobrazbo, ker pogosteje odgovarjajo, da so delno usposobljeni, s čimer so bolj odprti za nova učenja. Učitelji so največ vedenj o multimediju dobili z delom, iz lastnih izkušenj pri pouku, manj na strokovnih izpopolnjevanjih, iz strokovne literature, a še manj od kolegov v službi, pri študiju in od pedagoškega svetovalca na šolah. Učitelji, ki imajo do 10 let delovne dobe in do 30 let starosti, pogosteje kot starejši kolegi, ki imajo tudi več let delovne dobe, navajajo, da so pridobljena znanja dobili med študijem za učitelje primarnega izobraževanja. Ne glede kaj so učitelji v večini primerov dobili znanja o multimedijih, učitelji bolj inklinirajo k »zunanji« edukaciji: strokovnim predavanjem po šolah za vse učitelje (76,2%). S tem so pokazali potrebo po nadaljnjim edukacijam. Strokovna usposobljenost je izredno pomembna za uporabo multimedijev pri pouku, ker oseba, ki ima sodobna spoznanja o multimedijih, ima večje možnosti njegove kakovostnejše uporabe, to je zavestnejšega delovanja v praksi.

Predpostavka, da na omogočanje uporabe multimedijev pri pouku vpliva strokovna usposobljenost učiteljev, njihova pridobljena spoznanja, strokovno izpopolnjevanje učiteljev in opremljenost šol, se je pokazala za točno. Učitelji potrjujejo, da v praksi obstajajo pogoji, ki

omogočajo uporabo multimedijev. 72,2 odstotka jih meni, da so zadostno ali popolnoma usposobljeni za uporabo multimedija, medtem ko jih 71,4 odstotka izjavlja, da ali nima načina preizkusa učinkovitosti multimedija ali nima nikakršnega odgovora za izvajanje evalvacije. To pomeni, da vsi učitelji vseeno niso zadostno usposobljeni, ker jim manjka ocena lastnega dela. Opažena je statistično pomembna povezanost med neodvisnimi spremenljivkami (status, strokovna kvalifikacija, starost, delovna doba) in učiteljevim študijem kot izvora znanj. Učitelji z visoko strokovno kvalifikacijo, statusom učitelja, starostjo do 30 let ter v manjši meri od 31 do 45 let, delovni dobi do 10 let, pogosteje navajajo redni učiteljski študij ali došolanje učiteljev kot izvor znanj, ker so med študijem imeli učni predmet informatika. Tu bi morali preveriti, v kolikšni meri so prejeli znanja o multimedijih pri pouku metodike in didaktike. Učitelji v starosti od 31 do 45 let pomembno pogosteje navajajo usposabljanja preko strokovnih aktivov kot učitelji, stari do 30 let. Učitelji na strokovnih aktivih izmenjajo svoje delovne izkušnje in imajo manj možnosti pridobiti znanja o multimedijih med študijem kot njihovi mlajši kolegi. Navedli smo že, da bi v načrtu in programu strokovnega izpopolnjevanja učiteljev morali uvajati več tem o multimedijih. Zelo dobro in dobro opremljenost šol navaja 81,7 odstotka učiteljev, medtem ko jih 50,8 odstotka navaja pomanjkanje multimedijev kot ovirajoči dejavnik pri delu. Zato na omogočanje uporabe multimedija pri pouku vpliva strokovna usposobljenost učiteljev, njihovih doseženih znanj, strokovna izpopolnjevanja učiteljev in opremljenost šole. Pri tem se v praksi lahko še bolj vpliva na kvaliteto strokovne usposobljenosti učiteljev, njihova dosežena znanja, strokovna izpopolnjevanja in opremljenost šol, v kateri delajo.

11. Kateri so najpogostejši elementi pri uporabi multimedijev, ki jih učitelji ocenjujejo kot ovirajoče pri pouku, je bilo sedmo raziskovalno vprašanje. Obstaja nekaj elementov, ki jih učitelji ocenjujejo za ovirajoče pri uporabi multimedija pri pouku. Nekateri, na primer opremljenost učilnic z računalniki in multimedijskimi izobraževalnimi podporami, predstavljajo objektivno oviro, medtem ko posamezni elementi predstavljajo subjektivne omejitve uporabe multimedija pri pouku, t.i. avtocenzure. To so notranje zavore, ki učitelje ovirajo pri strokovnem profesionalnem delovanju. Zato vzroke neuporabe multimedija najdejo v zunanjih elementih, a ne pri svojem osebnem delu. Učiteljem so največji ovirajoči elementi uporabe multimedijev pomanjkanje multimedijev in obsežnost učnih vsebin, kar napelje na dejstvo, da vsebinsko pristopijo k pouku. Pomanjkanje multimedijev je pokazatelj nezadostne opremljenosti šole z multimediji, a tudi pomanjkanje volje, da osmislijo avtentične multimedije. Razen tega pomanjkanja multimedijev v učilnicah ni v soglasju z izjavo učiteljev

(81,7%), da so šole v večini primerov zelo dobro ali dobro opremljene z mediji. Druge avtocenzure so se nanašale na: večje število učencev v oddelku, neprimerni prostor, čas, ki ji potreben za učitelja, ter neusposobljenost za uporabo multimedija. Glede na čas, potreben za pripravo, bi učitelji, ki so omenili pomanjkanje časa, morali porabiti za racionalizacijo časa priprave na pouk. Neusposobljenost za uporabo multimedijev se nanaša na učiteljeve profesionalne kompetence, ki lahko vplivajo na njegovo neuporabo. Tisto, kar ne ovira, potencialno omogoča uporabo multimedijev pri pouku. V teh odgovorih se skriva rešitev, da se učiteljeve didaktične-metodične kompetence lahko pogleda kot omogočajoči ali ovirajoči elementi za uporabo multimedijev pri pouku. Če učitelj oceni, da ni ovir za uporabo multimedijev pri pouku, mu bo njegovo stališče omogočilo uporabo. V nasprotnem primeru bo iznašel veliko razlogov, zaradi katerih mu je njegova uporaba otežena ali nemogoča. Samo 8,7 odstotka učiteljev je izjavilo, da nima ovir pri uporabi multimedija. Učitelji, ki pri svojem pedagoškem delu uporabljajo multimedij brez kakršnih koli ovir, kažejo profesionalno umeščenost njegove uporabe. Zato je prav takšna populacija učiteljev v popolnosti ali zadostno strokovno usposobljena za uporabo didaktičnih multimedijev.

Šola, dobro opremljena z mediji, omogoča učiteljem in učencem široke možnosti uporabe mnogih didaktičnih multimedijev. Večji del učiteljev (81,7%) ocenjuje, da so šole zelo dobro ali dobro opremljene z mediji.

Osnovni pogoji za uporabo multimedijev so: edukacija učitelja in izboljšanje materialne opremljenosti šole. Na temelju doseženih rezultatov lahko zaključimo, da so osnovne šole relativno dobro opremljene z mediji, vendar je treba dodelati pri dodatni edukaciji učiteljev v smeri odklanjanja avtocenzure. Pričakovali smo, da bo največji del učiteljev navedel za ovirajoče elemente pomanjkanje multimedija v šoli kot osnovni problem. Navedena hipoteza se je pokazala kot točna. Največjemu številu učiteljev (50,8%) predstavlja pomanjkanje multimedija tudi največjo oviro pri delu. Statistično pomembne razlike so dobljene med pomanjkanjem multimedija v šoli in strokovno izobrazbo, učiteljevo delovno dobo in opremljenostjo šole. Učitelji z visoko strokovno kvalifikacijo in delovno dobo do 10 let bistveno pogosteje navajajo pomanjkanje multimedijev ko ovirajoči element. Značilno pogosteje navajajo pomanjkanje multimedija v šoli kot zavirajoči element pri delu učitelji, ki ocenjujejo, da je opremljenost šole slaba ali zelo slaba, glede na učitelje, ki opremljenost šole ocenjujejo kot zelo dobro.

12. Kakšno je učiteljevo mnenje o prednostih in pomanjkljivostih uporabe multimedijev pri pouku, je zadnje, osmo, raziskovalno vprašanje. Multimediji imajo prednosti za učenčeve dosežke pri učenju in tudi pri pouku. Prednosti multimedijev za učenca so: aktivnost pri pouku, samostojnost, lahkost in hitrost učenja, razvoj različnih učenčevih kompetenc, upoštevanje načinov učenčevega učenja ter dolgotrajnost zapomnenja naučenega. Z multimedijskim pristopom vplivamo na avdio-vizualna čutila učenca in doživljaji se bogatijo. Multimediji omogočajo individualne perceptivne sposobnosti učenca in različni čas usvajanja informacij. Na ta način so učenci aktivni pri učnem procesu. S svojimi odgovori so učitelji potrdili hipotezo, da prednosti multimedijev prepoznajo po učinkih na ravni znanja in motivacije učencev, a so prav tako navedli tudi mnoge druge prednosti.

Učiteljeve odgovore, ki se nanašajo na prednosti uporabe multimedija pri pouku, lahko spoznamo v značilnostih pouka in dosežkov pri učencih. Pouk je: zanimiv, kvaliteten, nazoren, dinamičen, sistematičen, sodoben, konkreten in ekonomičen. Multimediji omogočajo možnost uporabe več različnih metod. Učne vsebine lahko kvalitetnejše realiziramo kot tudi vzgojno-izobraževalne dosežke. Slikovitost multimedijev ustvarja zunanjo motivacijo. Multimediji običajno prevzamejo učiteljevo vlogo pri vodenju učencev. Približujejo težje dostopno stvarnost. Multimedijski pouk ustvarja zunanjo motivacijo, kreativno in pozitivno vzdušje.

Pri naštevanju prednosti multimedijev pri pouku je viden interaktivni odnos multimedijev in drugih elementov didaktično-metodičnega področja, skladno z večfaktorskim modelom pouka. Učiteljevi odgovori dokazujejo, da obstaja korelacija med multimedijem in drugimi elementi didaktično-metodičnega področja. Z uporabo multimedijev dosežemo: uporabo načela sistematičnosti in nazornosti, uspešnejše usvajanje učnih vsebin, metodo demonstracije in uspešnejše usvajanje učnih ciljev. Bistvo multimedija kot učnega sredstva je v zanimivem oblikovanju softvera ter depersonaliziranju učiteljeve vloge. V odnosu na strategije učnega delovanja se z multimedijem pospešuje učenje na več ravneh. Multimediji prav tako vplivajo tudi na ustvarjanje pozitivnega razrednega vzdušja.

Če pozorno analiziramo pomanjkljivosti, lahko opazimo, da so odgovori usmerjeni na osebe, ki so odgovarjale, kar pomeni, da je prvi del problema objektivnega tipa, a drugi del se nanaša na učiteljeva stališča do multimedijev. Večino navedenih pomanjkljivosti so pravzaprav učiteljeve avtocenture. Učiteljevi odgovori se ne nanašajo toliko na multimedij, kolikor na

učiteljevo vlogo pri uresničevanju in izvedbi učnih strategij. Iz navedenega lahko zaključimo, da je večina pomanjkljivosti uporabe multimedijev značilnost učiteljevih kompetenc.

Z analizo učiteljevih odgovorov na odprti tip vprašanja, katere so pomanjkljivosti multimedijev po njihovem mnenju, je opazno, da so učitelji zelo heterogeno odgovorili na vprašanja. Predpostavka, da bo pomanjkanje gibanja in socializacije bil največji problem pri uporabi multimedija pri pouku, je delno točen, ker pomanjkanje gibanja in socializacije navajajo, a ne kot največje in najpogostejši problem, ampak kot eden od več navedenih. Najpogostejše pomanjkljivosti multimedijev so čas in pomanjkanje multimedijev v šoli. Poleg teh pomankljivosti učitelji navajajo slabo izbiro multimedijev glede neprimernosti vsebine, neusposobljenosti za uporabo multimedijev, pomanjkanje komunikacije med učenci in učitelji, zanemarjenost neposrednih izkušenj iz narave, številčnost otrok v razredu ter zanemarjanje ciljev. Kot o prednostih multimedijev tako so vidne povezave in sožitje pomanjkljivosti multimedija in elementov didaktično-metodičnega področja skladno z večfaktorskim modelom pouka. Iz učiteljevih odgovorov lahko zaključimo, kako pomembno je usmeriti pozornost na izbiro multimedija pri pouku, ker je ta izbira proporcionalna veličina s funkcioniranjem drugih elementov didaktično-metodičnega področja. Čim slabša je izbira multimedija, to pomeni, čim več je pomanjkljivosti, bodo, najpogosteje, slabše funkcionirali tudi drugi elementi didaktično-metodičnega področja. Zato so pomankljivosti multimedijev, po mnenju učiteljev, imeli odraz v: zanemarjanju učnega cilja, neprimernim učnim vsebinam, neusposobljenosti in daljši učiteljevi pripravi ter v nepravilnostih pri algoritmu uporabe multimedijev. Pri tem se moramo zavedati dejstva, da vodilno svobodo in moč planiranja, kreiranja, organiziranja, realizacije in evalvacije učnih strategij, ki povezujejo učne subjekte in elemente didaktično-metodičnega področja, ima prav učitelj. To pravilo velja tudi obratno: čim bolj je kvalitetna izbira multimedijev, tako bo tudi najpogosteje kvalitetna realizacija drugih elementov didaktično-metodičnega področja. Lahko zaključimo, da je večina pomanjkljivosti ali prednosti uporabe multimedijev značilnost učiteljevih prepričanj. Zato obstaja cela lestvica možnosti in kombinacija odnosov multimedijev in drugih elementov didaktično-metodičnega področja.

13. V zadnjem poglavju, učiteljeva stališča o pomembnosti multimedijev v odnosu do drugih elementov didaktično-metodičnega področja, je raziskan odnos multimedijev in drugih elementov didaktično-metodičnega področja. Od teh elementov smo natančno proučili: cilje (cilj učnega načrta in programa, možnosti uporabe multimedija v učnih enotah), tipe učnih ur,

materialno zaokrožitev (velikost učilnice za uporabo multimedijev). Ob navedenih elementih so raziskana učiteljeva stališča o vplivi multimedijev na učence (učinek uporabe multimedijev pri učencih v odnosu na njihovo neuporabo, vplivi na multimedijsko poučevanje učencev, učenčeve kompetence, ki se razvijajo z multimediji). Preučevani so tudi elementi učnostrateškega planiranja, ki so se nanašali na kriterije izbire multimedija pri pouku, in čas, potreben za pripravo uporabe multimedija pri učnih aktivnostih.

Odgovori učiteljev (57,1%), da je cilj njihovega pedagoškega dela učenčev razvoj, niso prepričljivi, ker niso kompatibilni z njihovimi drugimi odgovori, ki bi prav tako morali biti usmerjeni v učenčev razvoj. Če samo 28,6 odstotka učiteljev izvaja evalvacijo multimedijev pri pouku, je vprašljiva kvaliteta uporabe bodočih učnih strategij, ki se spodbujajo učenčev razvoj. Pri samo 36,5 odstotka učiteljev vpliva na izbor multimedijev mnenje učencev, pa je vprašanja, v kolikšni meri učitelji upoštevajo mnenje učencev. Že v primerjavi učnega cilja s ciljem uporabe multimedija pri pouku opažamo večja razhajanja.

Cilj uporabe multimedijev pri pouku za večino učiteljev (61,1%) predstavlja dinamika in zanimivost pouka. Glede na to, da je v sodobnem pouku cilj poučevanja vplivanje na razvojne spremembe pri učencih, so odgovori učiteljev usmerjeni na formalne elemente (dinamika pouka, obogatitev učilnice in demonstracija multimedija), ki nikakor ne morejo zadovoljiti navedeni cilj pouka.

Učni načrt in program za osnovno šolo je preobširen in ga je treba ponovno razmisliti in korigirati, tradicionalno razmišlja večina učiteljev (80,2%). Takšna tradicionalna razmišljanje učiteljev se neposredno odraža tudi pri uporabi multimedijev pri pouku. Zato se tudi dogaja, da na primer ne izvajajo evalvacije uporabe multimedijev v učnih aktivnostih. Nadalje tradicionalni pristop k pouku pogojuje tudi uporabo multimedijev s ciljem realizacije učnega načrta in programa. To je skladno z večino odgovorov učiteljev (celo 61,1%), da je cilj uporabe multimedijev ustvarjanje dinamike in zanimivosti pouka, kar je odraz formalnega pristopa. Ker je dobljena večina tradicionalnih stališč učiteljev, predvidevamo, da bodo delovali tradicionalno, skladno z obrazci, ki so jih tudi sami osvojili med svojim šolanjem.

Multimedij lahko uporabljamo za interpretacijo vsake učne enote, menijo učitelji (49,2%), ki s tem potrjujejo svojo metodično in informativno umeščenost za uporabo multimedija pri pouku. Učitelji (40,5%), ki kažejo določene omejitve in odmik, izražajo stališče, da multimedije ne moremo uporabljati za interpretacijo vsake učne enote. S te perspektive ne moremo reči, kaj je točen vzrok temu, ker jih je nekaj potencialnih (na primer slaba ali

nezadostna opremljenost šole z multimedijskimi izobraževalnimi podporami, manko računalniške opreme, nezadostna informativna kompetenca učitelja). Učitelji (10,3%), ki so odgovorili v rubriki razno, puščajo delno možnost, da lahko v vsaki učni enoti uporabljamo multimedij, kar pomeni, da po njihovem mnenju obstaja pogojenost.

Ko analiziramo odgovore učiteljev o učnih etapah, ki jim dodajo pozornost pri uporabi multimedija pri določenih tipih učnih ur, ugotovimo, da nekaj več kot polovica učiteljev (54%) uporablja multimedije pri kombiniranih tipih učnih ur, ob pomoči katerih izgrajujejo celovit pristop k učenju od ponovitve prejšnjih znanj do preverjanja osvojenega pri učencih. Tak pristop izrazito zadeva učence razrednega pouka, ker upošteva razvojne potrebe učencev. Od posameznih tipov učnih ur učitelji vidijo pomen multimedija pri ustvarjanju razpoloženja, uvajanju v učne vsebine, njihovi interpretaciji. Najmanjšo vlogo multimedija vidijo učitelji v ponovitvi prejšnjih znanj in preverjanju naučenega. Lahko zaznamo večjo naklonjenost učiteljev, ki dodajajo pozornost posameznim elementom za uporabo učnih vsebin glede na razvojne ravni učencev (upoštevanje in preverjanje njihovih dosežkov), kar je posledica edukativne politike, ki jo zastopajo.

Z ugotavljanjem stališč učiteljev o primernosti učilnice za uporabo multimedijev smo dobili odgovore o pogojih, v katerih delajo. Odgovori so pokazatelji velikosti prosotora glede na število učencev v oddelku. Učitelji so v večini primerov zadovoljni z velikostjo učilnice in jih ocenjujejo za dovolj velike za uporabo multimedijev (71,4%). Medtem ko dobra četrtnina učiteljev (27%) meni, da je njihova učilnica premajhna, kar je lahko pokazatelj, da je govora o utesnjenem prostoru ali o večjem številu učencev v oddelku. Samo dva učitelja sta izjavila, da je njuna učilnica prevelika, zato lahko sklepamo, da imata v oddelku manjše število učencev.

Odgovori učiteljev (91,3%), da je učinek uporabe multimedija večji glede na njegovo neuporabo, kažejo njihovo ozaveščenost o pomenu uporabe. No, ravni tako so učitelji (4,8%) navedli tudi pomen pogojev, pod katerimi delajo, kot so: kompetenca učitelja in učencev ter povezanost z drugimi elementi didaktično-metodičnega področja. Ti učitelji kažejo svojo ozaveščenost »situacijske dinamike«, ki vpliva na večjo ali manjšo uspešnost uporabe učnih strategij, kar je točno, ker je izhod uporabe učnih strategij vedno nepredvidljiv.

Naslednje vprašanje je poskušalo ugotoviti mnenje učiteljev o kompetencah učencev, ki jih razvijajo z multimedijem. Poudariti moramo, učenčeve kompetence ne razvijamo izključno z multimedijem, ampak tudi z drugimi elementi didaktično-metodičnega področja (z metodami,

socialnimi oblikami dela idr.), toda njihov vpliv je bistven za intenziteto čutnih doživljanj in spodbujanje senzornih integracij. Dobro je, ker večji del učiteljev (68,3%) vidi kompleksnost kompetenc, ki jih razvijajo z multimedijem. No, pri posameznih kompetencah še vedno dajo prednost znanju glede na vse druge navedene kompetence, kar je del tradicionalnega pristopa.

S spraševanjem o učiteljevih stališčih smo dobili povratno informacijo o njihovem mnenju o sestavinah kriterija za izbiro multimedija pri pouku, ki imajo svojo podkrepitev v številnih raziskavah. Izbor multimedijev za učne potrebe je pri večini učiteljev odvisen od opremljenosti šole (73,8%), a tudi od učiteljevih lastnih idej, cilja učne enote ter, v najmanjši meri, od učenčevega mnenja (36,5%). Vsi naštetih odgovori so del didaktičnih kriterijev ocene multimedija. Verjamemo, da bi bila izbira multimedijev ustrežnejša, ko bi učitelji, ki nimajo namena preizkusiti njegove učinkovitosti, izvajali evalvacijo pri svojem delu.

Čas, ki je potreben za pripravo uporabe multimedijev pri pouku, učitelji različno doživljajo. Učitelji (73%) ocenjujejo uporabo multimedijev za zapleteno ter jim je potrebno več časa za pripravo učne aktivnosti.

Največ učiteljev (73%) meni, da je za pripravo uporabe multimedijev pri pouku, glede na njegovo neuporabo, potrebno več časa. Koliko časa je potrebno za pripravo učitelja, je relativno. Odvisno je od skupka vzgojno-izobraževalnih dosežkov, osebnih in profesionalnih kompetenc samih učiteljev ipd. Zato je to opravičilo logično za učitelje (19%), ki menijo, da je za pripravo potreben enak čas, in za učitelje (7,9%), ki so mnenja, da je za pripravo potrebno več časa.

Temeljni pomen tega doktorskega dela je v prispevku znanstveni misli v smeri uporabnosti multimedijev pri pouku s ciljem odkrivanja rešitve za kvalitetno učenje. Rezultati raziskovanja niso niti vodilo pri ozaveščanju pomena multimedijev pri učenju za učitelje in širšo javnost (ponudniki izobraževanje, starši idr.). Spoznane so določene pomanjkljivosti, ki povzročajo slabšo uporabnost spoznanja o multimedijih pri praktičnem delu, tako da bi celo v obstoječih pogojih lahko dosegli boljše rezultate, če bi le pozorneje opazovali učni proces. Za takšno raven delovanja je potrebno pridobiti dodatna spoznanja, s katerimi bi omogočili nadaljnji napredek pri učiteljevem delu. S tem se odpirajo nove smernice za prihodnja znanstvena raziskovanja in delovanja.

Znanstveni prispevek tega dela je usmerjen v izboljšanje kvalitete učenja in poučevanja na stopnji razrednega pouka.

Z vključevanjem elementov večpredstavnosti v učni proces se ustvarjajo jasne in bogatejše predstave in senzorske integracije pri učencih, s čimer vplivamo na osveščenost njihovih zmožnosti. S tem multimedijско poučevanje in učenje omogoča vsem učencem v oddelku uspešnejše sprejemanje, razumevanje, operativno uporabo in zapomnje znanja. Prikazali smo tudi klasifikacijo medijev glede na čutne izkušnje, osmišljen je večfaktorski model pouka in didaktični kriteriji za izbiro multimedijev pri pouku. Zaključki raziskave kažejo, da uporaba multimedijev pri pouku implicira mnoge didaktične transformacije, od katerih je osnovna delovanje v smeri razvojnih pristopov k učencem ter nadaljnja edukacija učiteljev za učinkovito uporabo multimedijev pri pouku.

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14. ATTACHMENTS

Attachment 1: Survey for Teachers

Attachment 2: Survey for Pupils

NOTE

Graphic formation of images made by Ivan Herceg.