

COGNITIVE THEORIES AND PARADIGMATIC RESEARCH POSTS IN THE FUNCTION OF MULTIMEDIA TEACHING AND LEARNING

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ABSTRACT

At present it is almost impossible to imagine formal and non-formal education without the use of computers and information and communication technology (ICT), and we can rightly say that modern education is increasingly taking place in a multimedia environment and relying on multimedia teaching and learning. In fact, multimedia with its existence and progress continually poses new challenges to educational technology, but also to the teaching process itself. As a result, classical traditional learning and teaching leaves classrooms, while parallel to that, multimedia becomes an unavoidable segment in the process of acquiring knowledge. The multimedia display provides a better understanding and understanding of teaching content that can be presented in many ways, and which gives a higher educational value. The focus of work is the importance and contribution of the theory of multimedia learning with a focus on activating cognition among students, as well as an analysis of the effectiveness of the use of media in teaching. Also, a special emphasis in the work is focused on the analysis of qualitative and quantitative research methods and techniques for examining the role, significance and efficiency of multimedia teaching and learning in the educational process.

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1. INTRODUCTION

Individualization, based on modern educational technology, is one of the models of the solution to the exit from the current crisis of the educational system. It requires individual contacts, taking into account all segments of individual differences, because in its application there are no ready templates and recipes, since each student is an individual for himself. It applies when the work is adapted to the individual or when a work type that is adapted to suit the needs, desires and way of thinking

of individuals participating in it is applied. A key segment, a form for successful implementation of modern teaching and school reform, lies in a winning combination, the essence of which is reflected in the correlative relationship and the achievements of pedagogical and psychological disciplines (didactics, methodologies, modern educational technologies, and especially pedagogical psychology).

Theories and models studying the cognitive learning possibilities of multimedia are relevant: communication theory, information theory, cognitive theory of multimedia learning, cognitive load theory, multiple intelligence theory, structuralism of the Berlin school, an integrated model of text and image understanding and a structural model of teaching. All of these theories relate to cognitive learning opportunities, the conditions in which learners and teachers learn, as well as on the results that various multimedia accomplish with students in the transfer of information.

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2. THEORY ORIENTATION – COGNITIVE LEARNING THEORIES

Teaching content should be available to students in such a way as to maximize meaningful learning. Understanding content does not only require understanding the key concepts of learning, but also the establishment of meaningful links to bring these concepts into a coherent whole with the knowledge that already exists in the learner's consciousness, their cognition. We are witnessing the occurrence of big changes in our educational system in the form of a conflict of the traditional approach to learning and new ideas. It is absolutely necessary to find the best solution for all new needs that have emerged as a result of the rapid development of science and technology. It is quite a question of how best to transfer this knowledge to pupils and to what extent they are able to adopt and apply it both in school and in everyday life (Stanković, 2017).

The theory, specifically concerned with cognitive development is Piaget's theory, and its impact on the educational process of children in the past decades has been enormous. Piaget's theory, in essence, is biologists because it claims that the basic cognitive structures, the so-called schemes and operations, innate patterns, and development consist in adapting these structures to the requirements of the environment through the processes of assimilation and accommodation. Schemes are internal representations of certain specific actions or behaviors that are present at birth, while operations are much more complex than internal cognitive rules. Schemes are internal representations of certain specific actions or behaviors that are present at birth, while operations are much more complex than internal cognitive rules. Assimilation is a customization of experience or subject to already existing strategies or concepts, while accommodating changes in existing strategies in response to new experiences or information. The balance between the process of assimilation and accommodation ensures the process of balancing, that is, the pursuit of equilibrium, which, according to Piaget (1971), is a general biological principle.

Russian psychologist Vigotski (1977) decides that pedagogy must be oriented to the future, not to the past of child development, because learning is only valid when it precedes development, since it initiates a whole range of mature functions that are in the "next

development zone". The advocates of the theoretical foundations of Vigotsky (Leontiev, Galjperin, Zaporozhek, Repkina, Eljkonjin, Davidov, etc.) proved in their research that the significantly changed teaching in relation to the existing (especially in the domain of content) positively affects the overall success in the department, but and each student separately, in the field of thought, as well as qualitative and quantitative knowledge. In order to create new cognitive ability in children, different conditions need to be met. First of all, the child should actively participate in the learning process and establish interaction with the adult who teaches. It is desirable to form a joint activity, which may be in the form of a task that is solved and which should be in the "next development zone", i.e. should be such that it requires the abilities and structures that belong to the next stage of the cognitive development of a child. An adult who teaches a child must gradually take control of the strategies they have jointly formed and enable the internalisation process.

In the process of solving a particular problem, going through the phases: preparation, incubation, illumination, verification, the individual needs to identify the inner ties and to understand the mutual dependence of the problem situation and its constituents in order to arrive at an adequate solution. According to gestalt theory, teaching materials should be structured so as to encourage students to transfer information presented in teaching content to a wider circle of different situations, to critically assess the truthfulness of facts outlined and to develop the creative-research methodology. Knowledge gained by insight has significant advantages over knowledge acquired through learning, and teaching materials must contain tasks that would be solved by insight. Bearing in mind the fact that the success of this type of learning is conditioned by the individual characteristics of students (earlier experience, skills and transfer power), teaching materials must be adapted to the individual needs of students.

These psychological basics are very important for modeling teaching (individualization, programmed, problem teaching, differentiated - teaching at a higher level of complexity, etc.). In that sense we can say that in these psychological bases lies the didactic-methodical and pedagogical character of teaching and learning a child. In contemporary didactics and methodology, the demands for teaching that will express the research character are increasingly emphasized as one of the

solutions for successfully overcoming didactic materialism. This is due to the weakness of classical teaching, which primarily requires the overcoming of a very extensive factual material, while at the same time neglecting the practical application of the learned and intellectual development of the individual.

The cognitive theory of multimedia learning evolved from the theory of information processing at the end of the sixties of the 20th century. The information processing theory is a simple and general learning model that consists of: irritation, attention, information retrieval and storage. *In multimedia learning*, when it comes to storing and archiving data and information, *three memory functions* are active: *sensory memory*, *working* and *long-term memory*. Words and images from the outside world, represented by a multimedia presentation, through the senses of hearing and sight, enter sensory memory. The main action of multimedia learning takes place in a working memory that temporarily retains this memory and manages knowledge in the active consciousness (Sweller and Chandler, 1991). The left part of the working memory shows the

raw materials that enter into working memory. The arrow from the sound to the image shows the mental conversion of sound to the visual image, while the arrow from the image to the sound represents a mental conversion of the visual image to sound. The cognitive theory of multimedia learning is based on a model that makes selection, organization and interaction of information through: selection of important words for processing in verbal memory, selection of important images for processing in the visual memory, organization of selected words in the verbal thinking model, organization of thought images in visual thinking model and the integration of verbal and thought presentations with previous knowledge. The cognitive theory of multimedia learning is based on the audiovisual learning model (Figure 1).

Technologically focused approach in focus has the technological functionality of a successful multimedia message transmission. With this approach, the main question is how to achieve a successful transfer of multimedia content to a recipient, where it seeks to make more efficient use of multimedia content technology.

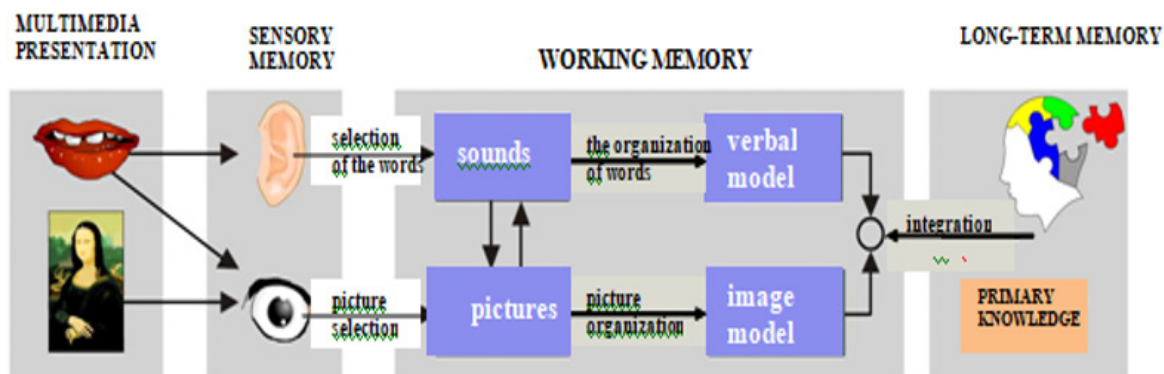


Figure 1. Cognitive model of multimedia learning (according to Hilčenko, 2012: 309)

The main cognitive process of multimedia learning is represented by arrows that indicate word selection, image selection, word organization, image organization, and their integration. These five cognitive elements of the process, facilitate learning through the procedure of small segments: select words and images from the first spoken sentence or the first few seconds of animation, organize and integrate them, and then repeat the procedure on a new case. Thus, by multimedia presentation of words and images, sound and iconic images from sensory memory are transformed into sounds and images in working memory, creating a verbal and image model in working memory, connecting them with previously

acquired knowledge from long-term memory. It's common to say that one image is worth more than a thousand words. However, we realized that one animation is worth more than a thousand images, because a thousand pictures, displayed at high speed in a series, represent a vivid picture: film, video, animation, illusion. If this animation is accompanied by speech (sound), we achieve an incomparable effect on learning. If we offer pupils with animation, supplemented by speech (sound) and the possibility of direct, practical work, manipulation, the results of such (obvious) teaching are incomparable (Figure 2). Knowledge suggests that the practice has confirmed these experiences.

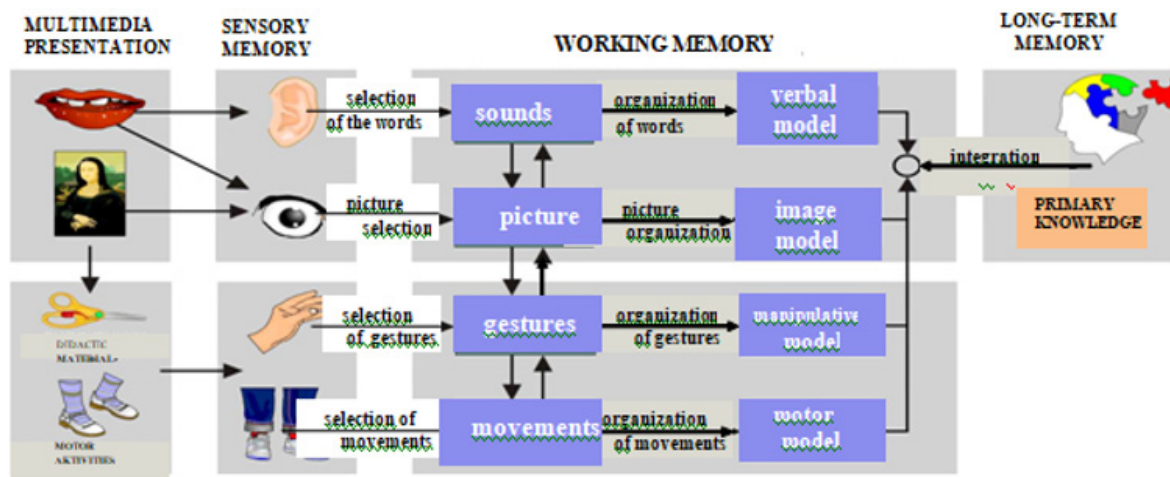


Figure 2. Cognitive model of multimedia learning complemented by manipulative-motor learning (according to Hilčenko, 2012: 310)

Comparatively, Mayer (2011) shows the learning with auditive, visual and audio-visual methods and lists three types of information processing: image processing, processing of spoken words and processing of printed words. It also draws attention to the respect of the general principles of multimedia teaching, which results in a better quality of learning, which should be followed in the phase of creating multimedia teaching content.

These are the following principles - *Multimedia principle*: students learn better through words and images, but only using words; *The principle of spatial constraints* - students learn better when the corresponding words and images are presented closer to one another than when they are on the paper or on the screen one further; *The principle of time constraints* - students learn better when words and images are presented at the same time, but when they are presented successively; *Principle of coherence* - learners learn better when irrelevant words, images and sounds are excluded, but when they are involved; *Principle of modality* - students learn better through animation followed by speech, but through animations and text on the screen; *Principle of Excellence* - learners learn best from animations followed by speech, but through animations, descriptions and text on the screen; *The principle of individual differences* - the effects of the message design process are stronger for pupils of lesser knowledge, but for those with higher knowledge and for free learners (extrovert), unlike those less free (introvert).

Majer (2009) also gives another more complete model, based on the following specific principles, which in contrast to the above mentioned, have more the character of the me-

thodical instruction in the phase of applying the multimedia teaching approach: *Multimedia Principle* - a combination of text with text-related images when students have modest prior knowledge, but sufficient cognitive ability to process both text and images; *The principle of spatial contact* - if the written text is used, it is interpreted in the spatial vicinity of the image; *Time-sharing principle* - if the text is used, it is interpreted with a picture in time closeness; *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 speech while combining it with the image, because the duplication is unnecessary; *Principle of coherence* - we do not use irrelevant or incomprehensible (foreign) words and images, and do not add unnecessary sounds or music; *The principle of sequencing the image-text* - if the written text and the image cannot be presented at the same time, then it is better to interpret the picture before the text, but vice versa; *The principle of structural display* - if the content can be visualized by different images in different ways, that they are information equivalent, we use an image with visualisation that best suits the adoption of future teaching topics; *The principle of general overcrowding* - we do not combine text and image if a student has a higher knowledge and cognitive ability to create a mental model from one source of information; *The principle of information processing control* - if the static image is combined with text, if the text is difficult to understand and learning time is not limited, then we prefer to use the written text rather than spoken.

Should not forget Skinner's contribution when it comes to cognitive learning theory. In

the frontal form of work, learning is informative, most often from teachers to students, and vice versa very rarely. The most productive is the teaching process that is organized as a permanent two-way communication from the knowledge source (teacher, textbook, teaching material...) to students and also in the reverse direction from pupils to teachers who gets information on whether they are and in which custom learners have adopted teaching content. The solution to this problem is safe in the programmed teaching. The basic principles of programs teaching can be described through the following principles: *The principle of small stages* - a feature of gradualness and system; *Principle of active participation* - this principle is difficult to achieve in traditional teaching, while inactivity is impossible in programming teaching; The principle of direct verification - realized only in programming teaching; *The principle of individual rhythm* where everyone progresses in accordance with their abilities, efforts, perseverance and pre-knowledge (Blagojević, 2012).

In multimedia learning and educational practice, programmed teaching has influenced positively to raising the general level of knowledge.

All of the aforementioned principles of special importance because they can serve as postulates in the creation and creation of educational software. With their respect, they create preconditions that, when applied in the teaching process, they are reasonably expected and provide qualitative and quantitative positive progress in the individualized learning process and the adoption of new teaching contents.

A modern teaching organization is unimaginable without introducing innovations. The didactic-methodical reform in teaching and learning implies the use of new didactic materials and teaching strategies. A multimedia approach in teaching does not change only the method and mode of work, but certainly the quality of knowledge (Stanković and Dimić, 2016).

Every day, novelties in science are being created. The scope of knowledge is increasing, and this knowledge needs to be internalized by both teachers and students. All this points to the need for continuous learning and improvement.

To conclude, multimedia technologies allow a new approach to teaching content and learning. Thanks to the large increase in application in education, today's students have the choice of fast and functional learning.

On the other hand, from the teacher's position "...If you do not have fun in this profession, you are not a good teacher" (Matasić and Dumić, 2012: 149). In order for the teacher to feel satisfaction in his classroom, based on the foregoing, it is quite clear that the teacher must be competent in the use of multimedia, to know the benefits of multimedia learning, but also to possess methodological-didactic and pedagogical-psychological knowledge.

3. POSTULATES OF RESEARCH PARADIGMS AND MULTIMEDIA LEARNING

In what do we identify the postulates of research paradigms in the study of multimedia learning?

Quantitative research is a research carried out in social sciences, relying on probability theory and statistics, the results obtained in the sample of respondents apply to the entire population. The aim of the research may be to describe the condition or to determine the cause-effect relationship between the individual components. This research group includes experiments, as well as field surveys. It starts from clearly defined, pre-set hypotheses that are tested by statistical analysis. The main goal is to verify theories and hypotheses, to detect causal relationships. The main goal is to verify theories and hypotheses, to detect causal relationships. This research is not carried out under natural conditions, but by isolating variables, by controlling external influences that can be accessed exclusively empirically.

The quantitative methodology starts from the assumption that there is only one truth, which is independent of the environment and the individual, and which can be quantified and subject to measurement. The researcher must not exert any influence on the subject and flow of the research, on the course of the research, on the respondents, and finally on the analysis and interpretation of the results. The most specific feature of the quantitative methodology is the position of the researchers in quantitative research because it seeks to separate from the subject of research, to be isolated in order to avoid bias in the research (Cohen, Menion and Morrison, 2007; Fajgelj, 2010; Kožuh and Maksimović, 2011).

Unlike a positivistic approach that seeks objective knowledge and explores phenomena which it believes to possess its "objective" image independent of the observer's view, a qualitative approach examines phenomena in

their natural surroundings, trying to understand them in relation to the meanings attributed to them by the participants themselves, because it is based on the assumption that subjective truth is the only thing that exists. Qualitative research in social-humanistic sciences is very close to the postmodernist approach to a scientific theory and methodology that has an explicitly interpretative dimension, followed by scientific skepticism and the re-examination of traditional positivistic epistemological positions (Brayman, 1988; Howe, 1988; Kožuh and Maksimović, 2011).

4. DISCUSSION

Would all media present today be present that they were not tried on hundreds of units or respondents? Each media that were present first was empirically tested by the testing technique, and then implemented in practice. These facts imply stability the postulate of quantitative research in the study of multimedia learning in education.

Furthermore, all the above mentioned theories, created by observing certain observations using observation protocols, anecdotal notes... It should not be ignored that these are all features of a qualitative methodology. Would all this be possible without the well-known paradigmatic basis qualitative and quantitative methodology, inductive and deductive procedures?

Table 1. Comparative overview of the characteristics and impacts of quantitative and qualitative methodology on multimedia teaching and learning

<i>Quantitative researches</i>	<i>Qualitative researches</i>
Clear questions (defined problems)	The world is not uniform
Rationally derived hypothesis	Hypotheses are not made before collecting data
Fully developed research procedures	Flexible research procedure
Control of external factors	Observing the research process
A large enough sample	Small sample
Analysis and interpretation are quantitative	Analysis and interpretation are descriptive
Processing of data based on the application of statistical procedures	Statistical procedures are rarely used
<i>Multimedia teaching and learning</i>	
Experimental researches	
Causal-comparative researches	
Descriptive researches	
Correlational research	
Historical research	
Mixed method research	

To summarize, the features, characteristics, the postulate of qualitative and quantitative research paradigms are numerous and there are many sources that can be studied. When we think that the war paradigm was long overdue, we see that this topic is still very actual in the last two decade (Creswell, 2014; Este, Sitter and Maclaurin, 2009; Freshwater and Cahill, 2013; Guba and Lincoln, 2005; Morgan, 2007; McGregor and Murnane, 2010; Mertens, 2010; Milas, 2005)...

Table 1 shows the basic characteristics of the quantitative methodology, which include: the set problem and subject of the research, the clearly set goals of the research, the setting of tasks and the hypothesis of the research, the clearly elaborated research procedure (methods, techniques and research instruments), large sample and statistical data processing. Qualitative research is the opposite of them and imply the uniqueness of studying the research problem, the individual approach to the study of the research problem, the hypotheses do not arise, the theory comes with detailed analysis and descriptions of what is being studied and does not imply statistical data processing.

When it comes to multimedia learning, they can be studied using different research paradigms (Mateljan et al., 2007; Nikolova, 2002; Petrović, 2016; Plass and Jones, 2005; Sholsh, 2012; Tomić et al., 2016) discuss the problems of multimedia learning in the educational process through various research paradigms and applying different kinds of research: experimental, comparative, correlation, descriptive, historical research. In addition, multimedia learning can be studied using mixed methods that have qualities in themselves and qualitative and quantitative methodologies. It is important to point out that these researches are just an example of the evidence of the application of different methodological apparatus in the study, the principles of designing educational multimedia learning, the study of multimedia learning in mathematics, grammar, language learning, e-learning, modeling of active teaching using multimedia and etc. It is obvious that multimedia are widespread in different scientific disciplines and fields, and the results of the research are presented in different ways (qualitatively and quantitatively) with the above characteristics of the research paradigms (shown in Table 1).

In order to better examine its subject, the task of pedagogy with its numerous disciplines is to carry out numerous research, respond to existing questions, but also ask new questions,

thus enriching knowledge of its subject, and developing itself and raising it to a higher scientific level, all based on its multidisciplinary scientific character.

5. CONCLUSION

Each research method used in the field of education is based on principles and rules that are narrower and broader in terms of practice. These didactic models are elaborated through principles where we can absolutely say that it has the research principle of induction and deduction. With their respect, preconditions have been created that, when applied in the teaching process, they are expected to provide qualitative and quantitative positive progress in the individualized learning process and adopting new teaching contents.

Projects for the production of high-quality educational multimedia content, requires a multidisciplinary team of experts, methodologists, psychologists, pedagogues, practitioners.

Implementation of multimedia in the teaching process leads to an increase in the active participation of students on time, facilitating interactive learning and improving success. Practice shows that multimedia has its place in our teaching, but for effective integration it is necessary to develop teaching materials in which beginner learners can quickly identify the primary goals of teaching. Information must be presented with clear explanations and there must be the possibility of learning / exercising skills and knowledge with feedback. With new empirical findings, we can always determine their suitability for implementation in our educational system. Empirical findings and implementation of something new is not possible without the use of qualitative and quantitative research.

The possibility of using multimedia as a functional integration of individual media allows to develop in a new way a methodology suitable for the training of students and to implement new and varied methods in the teaching process. Everything can be a contribution to the research of teaching methods for multimedia learning using techniques and instruments of qualitative and quantitative methodology.

Conflict of interests

The authors declare no conflict of interest.

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