BLENDED LEARNING MODEL WITH "VIRTUAL CLASSROOM MANAGER" AS A FACTOR IN EFFICIENCY OF EDUCATION SYSTEM IN ORDINARY AND EMERGENCY SITUATIONS

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Cuvânt înainte

Teza de doctorat a fost elaborată pe parcursul activităţii mele în cadrul Departamentului de Calculatoare şi Tehnologia Informaţiei al Universităţii Politehnica Timişoara.

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Foreword

Thesis was developed during my work in the Department of Computer and Information Technology of the University "Politehnica" of Timisoara.

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Timişoara, iulie 2014   Kristian Bereş

Bereş, Kristian

Blended learning model with "Virtual Classroom Manager" as a factor in efficiency of education system in ordinary and emergency situations

Cuvinte cheie: Blended learning model with, Virtual Classroom Manager, factor in efficiency, education system, ordinary and emergency situations,

Rezumat
PhD thesis deals with the issue of forming and implementation innovative teaching models (algorithmic and heuristic) on the example of teaching contents in IT education, which is based on the method of distance learning, with the ability to be used in emergency situations (pandemic influenza A1H1, earthquake, snowstorm, low temperatures, lack of fuels, heating breakdowns, floods, traffic interruption, accidents, etc.) and also to be used by a small group of students in rural areas. The objective of this study is to present the innovative learning models implemented in the model of distance learning, the process of forming initial idea to her final shape, with a special focus on limiting the circumstances during the implementation, in terms of their performance, as well as their empirical confirmation by measuring the success of students in mastering the appropriate teaching program and its application in emergency situations.

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Abstract

PhD thesis deals with the issue of forming and implementation innovative teaching models (algorithmic and heuristic) on the example of teaching contents in IT education, which is based on the method of distance learning, with the ability to be used in emergency situations (pandemic influenza A1H1, earthquake, snowstorm, low temperatures, lack of fuels, heating breakdowns, floods, traffic interruption, accidents, etc.) and also to be used by a small group of students in rural areas.

The objective of this study is to present the innovative learning models implemented in the model of distance learning, the process of forming initial idea to her final shape, with a special focus on limiting the circumstances during the implementation, in terms of their performance, as well as their empirical confirmation by measuring the success of students in mastering the appropriate teaching program and its application in emergency situations. The main hypothesis that has been developed and proved in this thesis leads to the conclusion that implementation of innovative teaching models (algorithmic and heuristic) of IT education in elementary schools, in the model of distance learning, has a statistically significant impact on the efficiency teaching process. In order to prove the hypothesis are applied the educational systems for distance learning: dLearn, suitable for teaching at the Technical Faculty "Mihajlo Pupin" in Zrenjanin and a free system for distant learning (ATutor / Moodle), which uses the center for the development and application of science, technology and informatics, Novi Sad. Also it's designed an electronic learning material which helps in teaching contents of IT education, which is a practical contribution to the theoretical part of the dissertation. The experimental part of a doctoral dissertation is related to an organized distance learning and heuristic teaching, using the Internet, the survey was conducted, also testing and measuring relevant parameters of its impact on the efficiency of this type of learning. The experimental program has proven its positive effects on raising student achievement in teaching technical and computer education in elementary schools.

Preamble

The most significant contribution of this PhD thesis is: formal specification of educational method sets and IT communication methods used for realization of distance learning models and innovative educational models (algorithmic and heuristic) in IT education, where as a starting point are used experiences of foreign countries, and also including the specific characteristics of elementary schools in Vojvodina and their surroundings that are being considered in the implementation of distance learning; evidence of better qualitative and quantitative results in learning. Practical contribution of dissertation is the design and development of electronic materials in the form of text, images and video tutorials that are following the selected subject areas. Developing creativity is a fundamental task in the development of society. In the teaching of "Technical an Information education" in the elementary schools, there has not been much publications from methodological aspect and from the aspect of building a system of distance learning in educational process that are studied , and especially, their applicability in emergency situations. Therefore, the material contained in this thesis has a special value and contribution to science. This study emphasizes the attempt to innovative models of teaching, presented and experimentally validated, show a gradual transition from a traditional to a new vision of teaching technical and computer education. It should be implied that the existing system of teaching is not wrong, so it shouldn't be completely replaced, but on contrary, on its basics should be created new, more efficient solutions that will work well in our educational institutions.

The thesis contains a motive that emphasize the fundamental concepts of distance learning applied to teaching technical and computer education and to fully contribute to the development of basic education and the educational system in general.

This dissertation should give a full contribution to the expansion of e-learning in our educational system, and to stimulate teachers to involve themselves in this type of education pupils / students. This type of education is greatly accepted in the world, and it's proven as a very successful. Considering that Web is dominated by educational contents in English language, this thesis is an attempt to present such materials to elementary school students.

1. INTRODUCTION

1.1.   Theoretical approach

Over the last two decades, modern technology has changed many aspects of our lives, including how we communicate and spend time. "We time in the time marked by the information and communication revolution and sensational developments in information technology. Technological innovations in these areas are so large that they define a new civilization era of information society._Everything is marked by computers and information. For example, modern society can be characterized with several criteria, such as: tool-work-computer; basic production-information; dominant technology-information processing; essential resources-information; weapon-information; success criteria- the speed of information processing. In this society everything will change, the values also. Thus, the non-material resources: knowledge and information will have the greatest value. [130]

We are at the crossroads of civilization when the industrial society, where the industrial mode of production is in dominant position compared to others, is transforming into an information society. The essence of the information society is in a symbiosis of science and technology, which in this sense, provides the further development of civilization. In the new socio-economic order, as a special measure of value is used knowledge. The fact is that the development of society is based on knowledge and information. With the help of modern knowledge, technology solutions and overall development of society, education helps in reducing the differences in the extent of educational content that students have to master and learn.

 Framework of education provided for projects of the European Union for the 21st century includes basically:

- Education for life;
- Education for participation in a democratic society;
- Education for the development of creativity, critical thinking and discovering talents;
- Education for independence and freedom in their work, as well as for self-education, and
- Education for civil society and public education.

In order to design successful technical and technological education for the future, very important is the knowledge of current issues and continuity in the development of this field from the beginning to the present day, when the technical and technological education is innovated by new information technologies, until the new phase of technological education for the active modern democratic society of the future.

Add to that the need to catch up with the rest of the world and speak out and re-connect with him, change, modernization and improvement of education becomes imperative.

Education is now faced with new and different tasks in preparing young people for life and work in the information and technology, not only changed, but unstable, unpredictable, challenging and uncertain conditions. The traditional concept of education based on the lecture and delivery of content, facts and information is no longer appropriate response to these tasks. In a world that is rapidly changing, and where knowledge is daily compounded and enlarged, and information sources

proliferate beyond expectation, the data, information and facts can become irrelevant and obsolete even before they are used.

On the other hand, the modern world of the future (post-industrial, technological, informational, global) is requiring trained, ready and capable people who will use the new complex instruments, quickly and efficiently acquire, construct and apply a variety of skills, actively and responsibly participate in a complex of social and economical relationships and processes.

However, by itself valuable fact (encyclopedic, declarative, etc.) knowledge, that so far has been concentrated as education in our country, it is not a sufficient basis for establishing, nurturing and developing these various and complex skills. More importantly, any exclusivity in this regard favors only one, and not the most important part of the population that is still in the process of development and education.

Efficient education has the task to provide the conditions for the harmonious development of individual potential, evaluating and nurturing autonomy and social and personal integrity, ethnic and other communities and groups in all situations, even in emergencies. Education that exceeds the limitations of declarative knowledge enabling young people for a functional and efficient communication, collaboration and teamwork, as well as a creative approach, both teachers and students, requires a new approach to the organization of teaching and learning in general.

Model of distance learning, algorithmic and heuristic approach to the problems of teaching, enables the realization of newly installed assignments in furtherance of education in accordance with the new concept and modern changes in our country and in the world, even in emergency situations. Discovering the new ways of solving problems by pupils / students and teachers as well as developing non-stereotyped plans and programs by teachers, represents an innovative model of distance learning with heuristic approach to the problems of teaching in general. Modernization of teaching and learning is a continuous process that involves improving the educational work in accordance with technological development in terms of privatization, the initial outline of a market economy, the reorganization of the public administration and education reform, on the one hand and the development of information technology on the other hand, require changes in the organization of teaching , strategic and operational planning, as well as the education of future professionals.

Technical and technological development, which has resulted with coupled communication networks of the modern world, has enabled the enhancement of globalization process of human society. Globalization presents a technical-technological, cultural, political, economic and communicational unification of human society as entity that operates on widely accepted standard principles. Globalism is reflected through penetration of all spheres of human existence and the connectivity to almost incompatible in the world.

Special attention should be paid to the research of new trends that shape modern world, and which are maintained by creating contours of a new society that is knowledge-based at all levels. This research is exactly on that route.

The process of change requires scientific and professional approach that is based on personal experience, the experience of countries in transition and countries with developed economies and successful, as well as local resources and opportunities.

Starting from the fact that new developments in society, and therefore in education, require a new approach in teaching, as well as the education and training of teachers and students in accordance with the new concept of teaching, which

requires teachers to explore and create the possibility of permanent improvement and application of new models, in order for pupil / student to express their individual uniqueness, the model of distance learning heuristic approaches to the problem of teaching polytechnic education which aspires achieving these requirements.

Today, the level of modern knowledge, technological solutions, and general trends in our society requires from education to comprehend and apply all forms, techniques, and mechanisms that are used in the learning process of teachers and students, in order to more effectively bridge the gap and balance the scope and content of teaching science that is experiencing an unprecedented trend in their development.

As the needs of our way of living and working environment has changed as a result of the new technological revolution, it is also necessary for the concept of acquiring knowledge and skills of children to be changed, helping them to become successful people. Technology, especially in the form of personal computers and the Internet, becomes the center of attention of educational policy and reform. The workplace is changing where employees accept a team approach to problem-solving, rather than working in isolation.

Employees are increasingly required to become able to filter large amounts of information, and communicate effectively in written and spoken form. Technology fulfills almost every work environment, which is why employees need to learn new skills throughout their working life. In order to be successful it is necessary lifelong learning. Internet resources can help in the education of students ready for the new information age in all situations, including emergencies. Contemporary workplace increasingly requires the ability of collecting, evaluating, synthesizing and applying information and discussing a number of possible solutions, rather than only one real solution. Pupils, students and citizens, therefore, throughout education should gather experiences in teamwork and a common problem solving. Teachers can assist students in formulating questions, selection of appropriate responses, to support their research and refer them to cooperate with other students, both in school and out of school. Lectures should be made in a way to get more attention to studying and modeling the higher levels of critical thinking. Classes should be conducted in a flexible environment, able to present information in different ways, with access to various information resources and maximum flexibility when it comes to the interaction between teachers, pupils / students and information. Model of distance learning and heuristic approach to the problems of teaching has that function.

In order to ensure the maximum flexibility, computer, video and networking technology must be combined. Because of the volume of involved technologies, it is necessary to continue to provide a technological connection between the traditional analogue / DC technology and the evolving digital / interactive technology. Many foreign educational institutions have attempted to satisfy all these development models of distance learning.

Distance learning implies that in the educational process, the user and instructor physically are separated, and technologies (Internet, radio, video, printed materials, computer data) are used to overcome this distance. The system of distance learning, no matter how much he is different from the traditional teaching, pays attention to fulfillment of basic didactic principles. Distance learning can enhance learning in many ways: it both students and teachers delivers a working experience from the Internet. Internet always provides new information to a student, which leads to conscious activities of the participants and the development and progress of the work. Distance learning provides an opportunity for students to gain new skills and qualifications, and to grow in new directions. Rationalization of teaching is conducted by rational changes in teaching methods in order to get better

performance and better results. The education by classical methods has some significant drawbacks. One of the biggest is need of attending the place of teaching. Another significant problem is that the teaching adjusts to the average student, which is deprived by those who do not belong to this category, whether it is the process of mastering the knowledge for them too slow or too fast. Expanding use of computers and the Internet have developed new techniques of education, which together we call e-learning (e-education and e-learning) and thanks to them mentioned problems can be successfully solved.

This PhD thesis deals with the issue of e-learning and the design and implementation of innovating models in technical and IT education in educational institutions. The basic idea of study is to show how teaching of technical and IT education organize forms of innovative models of teaching, and what effect they have on the student success and which dimension professor must consider in order to satisfy the demands of modern education, and which are possibilities of applying e-learning in regular and emergency situations. The aim of study is to present the innovative learning models (algorithmic and heuristic approach to the problems of teaching with emphasis on Heuristic model implemented as the model of distance learning), the process of forming idea, from initial idea to the final shape, with special emphasis on limiting the circumstances in its implementation, in terms of their accomplishments as well as their empirical confirmation by measuring the success of students in mastering the appropriate teaching program and implementation of the model of e-learning.

The main hypothesis that has been developed and proved in this thesis leads to the conclusion that implementation of innovative teaching models (algorithmic and heuristic) of IT education in elementary schools, in the model of distance learning, has a statistically significant impact on the efficiency teaching process. In order to prove the hypothesis are applied the educational systems for distance learning: dLearn, suitable for teaching at the Technical Faculty "Mihajlo Pupin" in Zrenjanin and system management department and teaching through e-learning in emergency situations, "Centre for Development and Application of Science, Technology and Information (CNTI)" from Novi Sad. It is also designed electronic material for learning-teaching contents of Technical and IT education, which is a practical contribution to the theoretical part of the thesis. In our country there is not much experimental efficiency research of innovative models of teaching technical and IT education, so one of the main objectives of the study is empirical testing of the original experimental curriculum of technical and IT education in basic education. The experimental part of thesis involves an organized distance learning system through the Internet, also a test and measurement of relevant parameters which affects the efficiency of this type of learning. Measuring the relevant parameters and analysis of results was performed by using the standard statistical methods (data were statistically analyzed by SPSS 8.5).

PhD thesis consists of seven chapters, references and attachments.

The **first chapter**, "Introduction," provides an overview of research theses and concepts that will be used in this doctoral dissertation, which can be seen as a group of concepts that are used in traditional educational technology and in information technology education.

The **second chapter** of the dissertation "Learning" analyzes previous knowledge and the current state of traditional education and distance learning with emphasis on its use in emergency situations (pandemic influenza A1H1, earthquake, low temperatures snowstorms, lack of fuel, termination of traffic accidents and etc.) due to which is interrupted educational process in schools. It presents the concise

historical overview and analysis of traditional teaching and developing of distance learning, as well as an overview of distance education. The concept and forms of distance learning are defined and described: from the point of the media on which teaching materials are based, from the point of organizational structure and on type of communication between the participants in education. It is also described the development of Internet and its implementation in education. Distance learning requires changing role of the teacher, and at the same time brings both advantages and disadvantages in the learning process, so these characteristics are presented in this chapter.

The **third chapter** "Innovations in teaching practice at our country and in the world," points experience and practice in developed countries such as Romania and Serbia, in the development and implementation of the concept of e-learning, with emphasis on the role of elementary school, Technical Faculty "Mihajlo Pupin" and "Center Development and application of science, technology, and information technology (CNTI)" from Novi Sad in the education of pupils / students and teachers to work in regular and emergency situations through e-learning. Models of teaching which has to be implemented in the model of distance learning are presented in this chapter.

The **fourth chapter** presents the methodological research framework, it informs on organization and implementation of the research, selection, size and construction of the sample. The research methodology includes: research problem, the case study, the aims and tasks of research; research hypotheses, methods, techniques, instruments, and sample surveys; scientific and social justification of study. The final number of students who participated in the study counted the 254.

The basic hypothesis: "The model of distance learning in combination with a heuristic approach to solving problem of teaching technical and IT education has a statistically significant impact on the efficiency of teaching in basic education."

The main hypothesis will be checked by means of special hypotheses:

1) Model of distance learning in combination with a heuristic model of teaching technical and computer education contributes improving the professional skills of the students during solving real problems;

2) Model of distance learning in combination with a heuristic model of teaching technical and computer education provides a higher level of development of intellectual abilities and skills of students, and at the same time provides the higher level of durability and immediate knowledge of the students with respect to conventional approach to learning;

3) Teaching technical and IT education based on the model of distance learning in combination with a heuristic model increases the motivation of students in the educational process with respect to conventional approach to learning.

In the **fifth chapter**, "Design and implementation of the model of distance learning," provides an overview of the significance and implementation methods of teaching technical and IT education in the country and abroad. The theoretical part of the study focuses on the analysis of innovative approaches to teaching technical and IT education, which required reference to theoretical assumptions of selected models (algorithmic and heuristic), a comparison of traditional and modern concepts of teaching technical and IT education, the emphasis on those teaching and learning strategies that are underrepresented in present teaching, and which are necessary in order to raise the level of knowledge and achievement of pupils / students and teachers. End of chapter presents an overview of national and international experience, showing the projects that are in progress or recently completed in the

area of distance learning, as well as the tendencies of the application of model distance learning. Also, this chapter includes principles of creating models of distance learning in teaching of Technical and computer education. This chapter was designed and implemented a system for distance learning "dLearn." It is a model of Web-based distance learning system with 9 modules (user management and permissions, administrative module, a module for managing user data, the module for maintenance of teaching materials, knowledge test module, a module for application testing / examination, module for sending emails, a module for generation of various reports, a module for publishing the SCORM - Shareable Content Object Reference Model - standard). Pupils / students and teachers are provided quick and easy access to the content system, which increases the efficiency and quality of the educational process. Teachers are enabled to successfully perform the activities necessary for implementation of distance learning in combination with a heuristic model: preparing the course content using the Internet, course design, creating and placing of learning content, monitoring and consulting with the student, assessment of students. Students are enabled to: access to courses, access to educational content, access to different resources on the Internet (digital libraries, online journals, etc..), communication with teachers and other students (various synchronous and asynchronous forms of communication), testing, and progress monitoring of knowledge acquisition. Based on the experiences presented in this chapter was implemented an experimental model of distance learning in combination with a heuristic model. Also analyzed the technologies used for the preparation, presentation, and multimedia communication in the process of learning and research.

The most significant scientific contribution of dissertation is presented in this chapter and refers to formal specification of a set of educational methods, information and communication technologies used for implementation of distance education at the Technical Faculty "Mihajlo Pupin" in Zrenjanin and the Centre for Development and application of science, technology and information CNTI-in Novi Sad and implemented experiment in elementary school "Djura Jaksic "in Zrenjanin. Set of suggested method includes: designing educational material using algorithmic and heuristic strategies, preparation the teaching content, communication in the learning process, methods and tools for distance learning. The attachment provides a complete description of construction and design of experimental program, and also were designed instruments - tests for the initial and final measurement of students knowledge, surveys of teachers and students in order to determine the level of motivation for the implementation of innovative models of teaching. Realization of model distance learning provides a creation of teaching contents and lessons in the form of electronic materials, as well as video tutorials, which presents a practical contribution to the theoretical part of dissertation.

Chapter six "Results and discussion" is devoted to measurement and analysis of results achieved in testing the implemented system. It includes a statistical analysis of results. The results are presented in the form of comparative analysis of users who realized the educational process through conventional teaching and users who realized the educational process through model of distance learning. In the interpretation results of research focus was on establishing a statistically significant difference in the student achievement of parallel groups. Results shows significant advantages of education based on distance learning model and heuristic model of teaching, which are presented and suggested in this PhD thesis.

The **seventh chapter**, "Concluding remarks" contains an overview and systematization of scientific contributions that have resulted from the research of

the doctoral dissertation. It is emphasized that the experimental program proved its positive effects on raising the level of student achievement and a need for innovation and technical education of teaching in elementary schools. The possibilities and directions for Advanced Study have been proposed within the theme, which was the subject of PhD thesis.

Because of the complexity and heterogeneousness of the process of education at the elementary school, there has not been much work in the educational process, in terms of construction of distance learning in combination with a heuristic model, which from the methodological point of view researched this area. In that sense, this thesis has a special value and contribution to science.

Most significant scientific contribution of this PhD thesis is formal specification of sets of educational methods and information and communication technologies used for implementation the model distance learning in combination with a heuristic model in the technical and IT education, as well as evidence of better qualitative and quantitative results in mastering the material.

Dissertation is conducted with the motive to emphasize the basic concepts of distance learning in combination with a heuristic model, applied in teaching technical and IT education and to fully contribute to development of education in elementary schools, taking active participation in the design and development of our education system, which should function in terms of specific situations, because modern trends of education seek to build quality and functional education. This study should give full contribution to the expansion of e-learning in our educational system, and to stimulate teachers to become involved in innovative teaching models and this kind of education pupils / students. Many countries in the world have adopted this way of educating pupils / students and it has proved to be very successful.

Literature contains a set of relevant reference and bibliography for the field of PhD thesis.

Separating some of the most important views which exist in the scientific literature and have directed subject of this thesis, leads us to the conclusion:

- Modernization of teaching has to be done in the direction of increasing achievements of pupils / students, or increasing the ability for applying knowledge of pupils / students;

- Modern methodological and didactic theory has a need for experimental verification of innovative models of educational organizations for the purpose to establish clear guideline to educational practice;

- The basis of professional development for teachers has to be: embracing innovation and improvement of competencies, especially in the area of effective instruction and classroom management, in order to develop desirable competencies of pupils / students for living in modern environment, and in order of gaining more effective teaching in all conditions and contemporary forms of learning with practice. [23]

1.2. Review of basic concepts related to distance learning, algorithms and heuristics

Humans communicate with the help of multimedia and because of this reason it is not surprising tendency to convey it to the educational process. Each distance-learning system should provide: a wide range of models of learning, to suit every personality, individualization of scale and complexity of teaching materials, methods and pace of its processing, the application technique of skipping, individualization of learning velocity, ability and personality characteristics pupil / student.

The term "e-learning" is one of today's most frequently used syntax in the process of modernization of education in the world. There are various definitions of e-learning. The definition of the American Association ASTD (American Society for Trainers and Development) for e learning says this is methodology to "teaching content or learning activities are delivered by electronic technology" (Eng. instructional content or learning experiences delivered or enabled by electronic technology) (ASTD, 2001). This unites all the different terms for e-learning E Learning, Web Based Learning, Web Based Instruction, Internet Based Training, Distribute Learning, Advanced Distributed Learning, Distance Learning, Online Learning, Mobile Learning, Remote Learning and others. In the new millennium and in our environment have begun to implement the idea of a new system of teaching, distance learning system and comprises the management module teaching materials in distance learning (UND) based on Internet technologies, with the use of multimedia educational software."

Learning with computers (Computer - Assisted Learning - CAL), training on the computer (Computer - Based Training - CBT), online learning, and now e-learning (e-Learning), are just some audible names which explain the ways in which computers participate in training and education. Courses were until recently distributed on floppies, but powerful personal computers and programs for the authorship (authoring packages) lead to the introduction of multimedia components and the recommended media distribution became compact disc and local area networks. The educational materials were, until recently, distributed on floppies, but powerful personal computers and programs for the authorship (authoring packages) lead to the introduction of multimedia components and recommendable media and therefore the main means of distribution have become compact disc and local area networks. The Internet is the perfect medium for distributing educational material. For a successful integration of computer technology into teaching hardware and software are not the problems. Students are generally enthusiastic to learn and accept the electronic educational material. Assuming you have selected the appropriate software and hardware, the success of this technology depends on how it is implemented. In our educational institutions, we still insufficient educational use of the Internet and computer software, because of the bad or inadequate hardware platforms, or relatively small number of such software on our market.

The system of distance learning (DL), with the use of educational software, will improve teaching and learning and it will help pupils / students with learning, as well as evaluating for teachers.

Establishment of a system DL in the educational process can be accomplished in several ways:

The traditional model - retains all the classic elements of teaching: a fixed place and time classrooms without computers, Internet is the additional resource that pupils/ students can use in the computer cabinet at a specific time or at spare time. The traditional model introduces the Internet into teaching and uses it as an alternative source of information for specific practical exercises.

Transitional model - retains the traditional elements of a fixed place and time, but the place could include regular planned visits to a computer cabinet. This model may also enable the teacher to eliminate the limitations of space by using e-mail or instant messaging software for synchronous or asynchronous exchanges (conferencing), in this way, pupils-students from distant locations can participate in the teaching. Transitional model introduces and continues to use the concept of the Internet during the class, and involves it not only as a supplemental resource, but as an alternative method of distributing training and cooperation. Teachers in the

transitional model can set up course material on the Web server. Also can enable pupils / students to submit exercises through e-mail or to cooperate with each other through the forum.

Distance learning model - exceeds the limits of traditional teaching on-line by placing the entire teaching materials, exercises and resources. Pupils / students are not required to come to school in a traditional class. Instead that they fully share ideas and information across the Internet. This model introduces and completely relies on concept of internet throughout the classification period. It enables pupils / students training to their own dynamics and individual consultations by e-mail, electronic conferencing, or on a local network or multi-user sphere. In this model, teachers can use video broadcast over the Internet in real time, which is becoming more accessible through technology development and its infrastructure. Using satellites can be said that the slogan "learn anywhere, anytime" applies in its full meaning. Actually, using new technologies pupils / students can participate in classes from any geographic location.

The last few years technological and information revolution have created new and effective ways of representing and organizing information. Computer, Internet and multimedia are becoming an integral part of the educational process. New technologies enable integration of visual, audio and written materials in order to transfer customer's information as efficiently as possible. If teachers have mastered the appropriate software, they would be able to easily transform their existing teaching materials into a multimedia material, organize and store electronic discussion exercises for their pupils/students. The benefit would be mutual. Lecturers throughout the specialized trainings should to gain knowledge about the general principles of operation and using the personal computer and the principles of the Internet and the use of Internet service, basic knowledge of multimedia, principles of designing electronic education materials well as a number of software packages, one of which will be drafted as part of this thesis. Time when schools have been organized as part of the class-lesson system gradually passes.

Through the implementation of distance learning system (DL) the whole world would be one flexible school class and there would not be separate school classes. Classes will not last forty-five minutes in the morning or afternoon shift and students will be able to learn whenever they want during the day.

Humans communicate with the help of multimedia and because of this reason it is not surprising tendency to convey it to the educational process. New achievements inspire our hope that the man soon will be able to activate all his senses with the assistance of computers.

Solution offered in this study is the application of distance learning system (DL) and innovative teaching models in the realization of teaching subject "Technical and Information Education" which has been implemented in elementary schools. Based on results which have been obtained in the survey, it can be concluded that the application of DLWM S (Distance Learning Web Management System) in combination with the updated models of teaching (algorithmic and heuristic): significantly affects on increasing educational effects of teaching, increase IT knowledge, affects the efficiency of teaching, facilitates the verification of acquired learning content and provides individualization of teaching.

The analysis of our problem through "Introduction and theoretical approach" mentions Distance Learning from **heuristic** approach to problems of teaching and identify it as an efficient system of education, which in combination with algorithm becomes rational, efficient and creative process-oriented. In defining the terms we studied a dictionary (foreign words - encyclopedia - "Vujaklija"), psychology,

didactics, pedagogy, didactics, IT and others. By the heuristic searching of Web documents on the Internet, we gathered the significant information about scientific developments in the field of **heuristics.** In this way, we used the opportunity that besides a large number of published articles of our productions, study international experiences in this field and conceptually define a heuristic teaching and heuristic model.

In the Encyclopedic dictionary of pedagogy (1963) **heuristic** conversation is defined as "a form of - Method of interview, in which the teacher ingeniously placing development issues leads pupils / students so that they with its own effort and on the basis of their own knowledge and experience of independent logical thinking, discover new knowledge, draw conclusions, find laws and regulations, and thus acquire new knowledge."

In the "pocket dictionary of foreign words" Professor Marijan Filipovic (1965) "**eureka**" is defined as "I found, I found it." While the term "**heuristic**" means "the science of finding new ways of scientific knowledge." [9]

Professor Brušlinski (1970) the term "**heuristic**" define as any method that helps to increase the efficiency of solving the problems. The term has long been used in psychology to indicate the problem of finding, exploring the unknown. [9]

In his book "Modelling the learning process" Radivoj Kvaščev mentioned **heuristic** concept which is defined (1971) in the dictionary of psychological terms English-English as: "Which leads to the discovery; specifically in terms of any argument for which it is recognized that is imperfect but for which is intended to stimulate further thinking and research; refers to a method of training that encourages pupil/students to seek solutions to problems, especially by Inductive methods." [48]

Jaroševski (1971) defines the term **"heuristic"** as the organizing principles and methods that contribute to shortening the average number of rehearsals in the course of solving problems. Heuristic is based on research, and does not warrant optimal solutions, but also suggests those solutions that can often be shown as quite good.[9]

Landa (1975) [77] believes that the successful resolution of complex tasks depends on the parsing of reasoning operations on elementary processes. He alleges the following example of heuristic model. In order to discover the connection between the known and unknown values, if we do not manage to do it right it is necessary to:

1. Recall some already solved related (analog) tasks with the same or a similar variable;
2. To ask yourself can you use its result? If not, then;
3. Try using an inclusion of auxiliary elements to make use of previous task possible.
4. If this does not succeed, then;
5. Attempt to formulate a different task, and etc.

Kvaščev (1978) states that in determination concepts of **heuristic model** that we have developed, we began with definition of heuristic: "Which leads to the discovery"; "encouraging opinions on research"; "refers to a method of training that encourages pupil / students to seek solutions to problems, especially by Inductive methods", "heuristic is based on the psychology of thinking - finding and exploring the unknown." [48]

Vujo Knezevic (1981) [46] believes that the model and modeling, unlike other tools and approaches in the study, provide significant and irreplaceable advantages. First

of all, allow for holistically, dynamically and comprehensively approach to the problem of learning and teaching.

Hotomski Dr Peter (1995) [62] defines **heuristic** as rule, method or strategy for increasing efficiency of system that solves complex tasks.

Heuristic model - is an adequate theory of reviews for solving a specific set of tasks. It is in fact "manner, method, rule or strategy for increasing system efficiency which solves complex tasks."

Sotirović Velimir et al (2002) [131] "**Heuristic models** are used in situations where using empirical rules is a satisfying solution to a problem, if for some reason it could not be found optimal solution".

Heuristic algorithms - term heuristic algorithm, mentioned L. N. Landa [77] in his study of "Theoretical issues of algorithmization and euristike in teaching," translation Pedagogy 4/1975, Belgrade. Explaining it at the time as "creative algorithm" and "algorithm of creative thinking", believing it not make sense, because has started from the basic characteristics of algorithm; that it completely and unambiguously determine solving tasks by the pupils / student and because its use does not require a creativity. This is only true if in detecting and creating algorithm does not participate pupils / students, and therefore it is typically necessary creativity.

Heuristic algorithmshave found wide implementation in the field of planning universal mobile telecommunications system. Eduardo Amaldi, Antonio Capone IEEE members and Federico Malucelli in its web publication "Optimization Models with Power Control and Algorithms" said- Optimization models with power control and algorithms, 2003[38]. Developed a heuristic algorithm that satisfies the highest frequency of requirements and if all requirements cannot be fulfilled. This sub problem is reduced to a special case of multi-packages problems which is difficult to solve optimally even though they need a good solutions processed in a relatively short time. The further evolution of authors have developed a heuristic algorithm met heuristic leading local tracker procedure in order to investigate solution space of optimization problems beyond local Optima. The idea is to be used history convenient tracking process through a memory scheme in order to prevent the cycle (running into performance solutions that have already been created), and to explore the region of solution areas which promise limits of the objective function.

Heuristic approach to the problem is an empirical search or optimization method, which commonly solves the problems, but there is no proof that mathematicians and physicists would accept. No one knows whether it will always give the best response (problem solution).

While meta-heuristics schematic method is applied for finding good heuristics for specific problems, heuristics is a concept that occurs frequently in machine learning, evolutionary (developmental) algorithms and fuzzy logic applications:

- "What kind of setup parameters to use in order to get good results when it is applied heuristic method X on problem Y?."

- "How do I customize the parameters X heuristics to get a better results of problems Y?"

- "Which is better, X heuristics or heuristics Y?"

Heuristics is quite good rule. Met-heuristic is a quite well rule for finding quite good rules. The most important thing to remember about the meta-heuristics is that "NoFreeLunch."For that reason it is very important to met heuristics to have its own proposition,"the NoFreeLunchTheorem." [38]

Distant education as a new area of research in computer science, involves the use of certain terms which describe the phenomena and relations in the distant education system. In the theses will be used many terms for which sometimes even in the literature does always not exist always a unique position in relation to their meaning. Here we present a brief definitions of most important terms used in this thesis.

• **Asynchronous learning** - Information transfer (student materials) and learning are conducted at different times.

• **Audio conference** - Technical frame in which the phones or similar audio devices that do not have to be held are connected in such a way that three or more people can communicate with each other.

• **Authoring systems** - software products which enable the development of e-learning materials. Similar to other authoring tools.

• **CAE (Computer Aided Engineering)** - Engineering assisted by computer.

• **CAM (Computer Aided Manufacturing)** - Computer aided manufacturing.

• **CAP (Computer Aided Planning) -** Computer aided planning.

• **CAT (Computer Aided Testing)** - Testing characteristics of objects and processes supported by computers.

• **CAQ (Computer Aided Quality)** - Computer aided control.

• **CIM (Computer Integrated Manufacturing)** - Computers integrated production, which includes the previously mentioned modules.

• **Life-long learning** - a concept in which learning is seen as a long-term process that begins at birth and continues throughout life and which satisfies learning needs of people of all ages, educational backgrounds and employment.

• **External studies** - teaching that is taking place off campus, and which includes a variety of delivery options of educational content.

• **Bulletin Board System** - Small computer system that allows its members to exchange messages, holds discussion groups, and downloads software.

• **E-learning** - a term that is certainly at this moment the most frequently used. One of the reasons of its popularity is certainly the fact that it fits into a number of terms which are in paste ten years used as examples of the application of modern information technology in different areas of society (e-society, e-government, e-business, e-commerce, e-agriculture, e-health, e-community, etc.).

• **Efficiency** - is the relationship between achieved results and resources used. Efficiency is interpreted as activity, performance.

• **Flexible learning** - learning that is flexible by aspect of its beginning, the components of the course, methods of learning, it is complete, because the pupil / student has the possibility of control and selection of the content, sequence, time, place and method of learning, including flexible evaluation process.

• **Forums** - Virtual rooms in which messages are exchanged between the teachers and pupils / students. Forums are organized by topics which includes informal discussions about various issues.

• **Hardware** - hardware represents the physical part of the computer that is a set of devices which able to perform specific activities in data processing (for example calculation with numbers, printing, data storage, etc.).

- **HTML (hypertext markup language)** - A protocol used to create documents for publishing and distribution on the World Wide Web.

- **Information (information)** - Data with structure and meaning; an ordered set of data that reduces our ignorance.

- **Information literacy** - the set of skills that allows the individual to determine if he needs information and to find it and effectively exploit.

- **Information System** - Information system is a set of methods, procedures, and resources designed to facilitate achievement of certain goals. The information system has four basic components: data processing operations, data processing methods, systems analysis, modeling techniques.

- **Internet** - a connection of millions of computers connected by using TCP / IP, and connections a number of individual (local) networks LAN, MAN, WAN, Intranet into a single network called "network of networks".

- **Online Learning** - Using the Internet to access educational materials, interaction with the content, the teacher and other students, as well as receiving support during the learning process, with the aim of acquiring knowledge, building our own opinions and progress through learning.

- **Intranet** - a network that is owned by companies based on Internet technologies, available exclusively to employees of the Company and is protected from external intrusions by combination of fire walls and other security measures.

- **Computer and computer system** - Electronic computer system or computer system is a device for the automatic data processing. The word "system" (which means a unit consisting of a number of components) indicates that a complex computer system that consists of a number of different components. The fact that data processing is "automatic" indicates that the machine fully automates the process of transforming inputs into outputs. The computer is physically the a limited concept of a computer system.

- **Computer** is complicity that includes the CPU and RAM.

- **Home study** - a form of learning that does not require from pupils / students to leave home to study.

- **Quality, quality improvement** - Capability of gathering the essential characteristics of a product, system or process to fulfill customer requirements, and other stakeholders. Quality improvement is a part of quality management focused on increasing the effectiveness and efficiency.

- **Guardian** - A person qualified to provide academic assistance to pupils / students, mostly through individual consultation.

- **Blended learning** - Using two or more different methods for training which often refers to a combination of traditional and interactive teaching.

- **Model** - is derived from the Latin word "modulus" meaning measure or form. It is a natural or artificial structure of a system of objects or phenomena. - The essence of the model is based on the observation of the similarity between two objects or systems. Similarity can be external (relating to the structural similarity of different external systems) or functioning (behavior).

- **Modeling** - the process imitation or representation of systems, processes, objects or phenomena that are analogues of its original.
- **Heuristics** - the science of finding new ways of scientific knowledge. Derived from the word "Eureka" - which means, I found, I found it.
- **Heuristic models** - models for the quick resolution of problems based on the idea that the velocity for resolution of certain problems is a composition of problem solving, their definition, design ideas for addressing and finding solutions.
- **Multimedia** - Display data using several different forms of their presentation (text, graphics, animations, video, and audio).
- **Teaching** - an organized form of learning in the school system, institution or organization.
- **Curriculum** - content organized program of study at an educational or training institution indicating the objects which are being taught, period of time allocated to each, and their sequences.
- **Validity** - strong evidence on correctness of a procedure.
- **Simulation** - imitation - converting, (testing of the model).
- **Strategy** - Determining the purpose and fundamental long-term goals and the acceptance of directions of activities for allocation of resources needed to achieve these goals.
- **Heuristic strategy** - the skills of conducting the educational process or course of action focused on finding all the possible solutions in order to achieve the set goals.
- **Heuristic Search** - search for the necessary data through the Internet needed to solve specific problems.
- **Evaluation in the heuristic teaching** - evaluation of overall knowledge about a specific problem domain (in terms of their use of heuristics).
- **Teaching polytechnic education** - organized form of learning in the educational system and educational institutions through regular classes of Technical education, free technical activities of pupils / students and optional programs of technological and Informational content.
- **Education** - all kinds of information that a human being receives from the social environment during his or her life, which leads to the proper adjustment to social rules and values currently accepted. System activities and impressions is focused on developing skills, knowledge, competencies, skills and attitudes designed to enhance global development of one's personality, the integrity of the company and the opportunity to intervene in the transformation of our society.
- **Distance education** - represents planned learning that normally occurs in a different location than the one where the lectures are held, and therefore requires special techniques of designing courses, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements; various forms of study at all levels which are not under the continuous direct supervision of a teacher present in the classroom with a pupil / students, but who nevertheless benefit from the planning guidance and supervision of educational institutions; Distance learning takes place

when a teacher and pupil / student separated by space, time, or both, and others; institutional, formal education where the student groups are separated, and where interactive telecommunications systems are used to connect pupils / students, educational content and teachers; The planning and systematic activity that involves choice, didactic preparation and presentation of teaching materials as well as monitor and support of student learning, and that is achieved by bridging the physical distance between the pupil / student and teacher through at least one relevant technical media; The application of telecommunication and electronic devices, which enables a pupil / students to use educational content that originates from a distant location; Acquisition of knowledge and skills through designed information and instruction, encompassing all technologies and other forms of learning distantly.

• **Educational content** - is the intellectual property and knowledge provided be transferred students. It consists of a brief description of the course, the text-based knowledge modules for learning and multimedia materials.

• **Educational software** - the term educational computer software include finished computer programs that can be used within the course content, and programs that assist and guide the individual learning phase.

• **Training** - The way in which education is provided as support of learning and teaching process learning new information, behaviors, skills, or actions that can be used to perform the activities of a specific job or training achievements; A process that is intended to improve the knowledge, skills, attitudes and / or behavior of a person, for the purpose of performing specific activities at work or achieving a certain goal.

• **Training by computer (CBT Computer Based Training)** - The name that includes all cases of using the computer for management and delivery of educational programs.

• **Training over the web (WBT Web-based training)** - educated content delivery through web browsers over the public Internet, a private intranet, or an extranet.

• **Learning platform** - The general term for a system of information and communications technologies that deliver and support learning.

• **Data** - The elementary unit within the information system that can be the basis for the creation of information.

• **Protocol** - A formal set of standards, rules or formats for exchanging information that provides a correspondence between computers and applications.

• **SCORM (Shareable Content Object Reference Model)** - One of the most widely accepted reference model for the development of standardized digital learning modules, if they are developed in this way, and can be applied in different learning management systems.

• **Synchronous learning** - learning within which pupil / student and teachers communicate in scheduled time via the Internet or other communication channels by applying different techniques such as virtual classrooms, video conferencing, and audioconference.

• **System for managing educational content (LCMS-Learning Content Management System)** - The system that is used for creating, storing, merging and delivery personified educational content for e-learning in the form of learning objects.

• **Learning Management System (LMS - Learning Management System)** - Software that enables the management and distribution of digital educational content; application which manages administrative tasks such as creating catalogs of courses, user registration, monitoring of users in courses, recording data (eg, test results) of students and reporting of the users.

• **Software** - the immaterial part of a computer system and presents a collection of instructions (the program) on the basis of which the computer works. Basically we distinguish two types of software: system and application. System software constitutes a basis for the computer and it creates a special professional instruction, and application programs created by users, or professional programmers. The basic system software is the operating system.

• **URL (Universal Resource Locator)** - Any web page is site that has its own address that could be found on the Internet. This address is called the universal source locator or URL. All URLs begin with http://. This stands at the beginning of the address, and indicates the protocol used for www documents, ie hypertext transport protocol, which is made in a way that supports hypertext links between different documents. http:// protocol designation is used when downloading data from a given location. Full name of this protocol is Hyper Text Transport Protocol, which is the most used protocol on the WWW World Wide Web, where extension html (or htm) reference pages written in Hypertext Markup Language, or HTML. Of course, today there are other extensions pages, eg shtml, but HTML is still the most common.

• **Learning** - The process by which people acquire new skills or knowledge in order to improve their performance; cognitive and / or physical process by which a person assimilates information, and temporarily or permanently acquires or improves the skills, knowledge, behavior and / or attitudes.

• **Distance learning** - a term whose meaning is often equated with distance education. If it is necessary to carry out their differentiation then distance learning represent a constricted external view of distance education, as seen by its users. In this case, the distance learning include functionality that is made available to the pupil / student while omitting those which are exclusively the responsibility of educational institutions, for example, plans and programs of distance education, creating educational materials, organization of courses and so on. A common feature of both terms is that they in no way connect education or learning for a specific technology. The choice to use a specific technology in the process of distance education, has led to a large number of new terms in the field. Distance learning has its synonyms: distance education, online courses, online teaching, web-based courses, web learning, web based instruction delivery, network learning model.

• **Learning on the computer (CBL - computer - based learning)** - The original name for various forms of education not networked applications using computing resources to student / pupil facilitate learning activities.

• **Web browser** - a software product that enables Internet users to access certain Web sites and review their content.

• **Video conferencing** - Technical set in which the video monitors, cameras and microphones are connected in such a way that three or more people can talk to each other and to be seen.

• **Virtual Classroom** - In a physical sense conceived space, but in the logical and physical way a mentor and students are connected and communicate over telecommunication line information on the Internet through an Internet service. The term virtual in this context means presence in software, rather than actually exists in physical form. Thus the term "virtual classroom" means a learning environment that is designed for providing computerized conferencing with specific software programs. It is the application of the Internet, which provides an interactive environment for learning and teaching that is recognized worldwide and is open 24 hours a day.

• **Virtual University** - Physically can represent space with a super computer and network access that computer over the Internet. Physical Virtual University may occupy a certain geographical area and location. In the logical and physical sense, computer programming includes interactive multimedia textbooks that teachers and students access with the different geographical places with the support and services using the Internet.

• **WWW (World Wide Web)** - Communication protocol for the Internet that manages text, audio and video material, graphics or other data, computer technology products.

• **Knowledge** - Information that has been shaped by its association with a specific purpose or set of values. In the selection of terms used within this thesis, the title includes using distance learning as a broader concept which will allow to be explored and analyze the presence of any of its modalities in higher education. In the section that relates to creation of models of distance learning was used during the term e-learning a term that best reflects the possibilities offered by modern information technologies in distance learning, but also a term that is at the moment the most commonly used in the professional and scientific literature; and in the official European and international programs dealing with this topic.

2. Distance Learning

Since the mid-twentieth century until today, the process of social development was greatly influenced by information technology. In the last 30 years development level of hardware and software, has enabled application of information technology to more or less extent in almost all areas of human activity. One of them is certainly the domain of education. For a long time the computer is used only for education learning IT disciplines or as an aid in the preparation of teaching. Recently, information technology is also used in the process of teaching, but it did not bring any fundamental change to a way of teaching process. In most cases, are not abandoned traditional methods of education that put pupils / students into the same dimension with the teacher in same time and space. Changes in education that have enabled some of the processes carried out in different places and different times in comparison to the regular teaching activity began to occur long before computers. First, as a form of correspondence education and then in other ways, the students were able to be educated without attending regular classes. The development of distance learning was initially occurred independently of the development of information technology, but in modern circumstances its further implementation is fully determined by the application of computers, software, computer networks, telecommunication channels, the Internet. Distance learning has limitations related to the technical level of applied information technology by those who offer this type of education, and the technical equipment of those who wish to use it. The success of distance learning is not related to the technical characteristics of information technology that is used, but also for willingness of educational institutions to embrace the changes that need to be completed to ensure the quality of learning at a distance. Development of modern society constantly imposes the need for changing the model of education, which are often quite slow because of the size and inertia of the educational system. On the other hand, globalization has led to the harmonization of different specific local educational models and thereby lifted above the national education process framework. Low standard forces the young people to get a job immediately after graduating from high school. Unable to attend school regularly, they would be happy to accept e-learning as a form of their further education. Some of them are not able to leave their communities and live in university centers. They would represent an appealing e-learning form of education. Because of the rapid development of technologies and techniques accepted concept of adult education and continuing lifelong education, is another element that supports the need for introducing some of the modern forms of distance learning. Initially, distance education was related to independent learning and is defined as follows: "*Independent learning is a way of learning where teachers and pupils / students fulfill their basic duties and responsibilities separated from each other, communicating in many different ways.*" [108] Distance learning, as defined by the "United States Distance Learning Association" (USDLA): [165] "*The training system*

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through the use of different types of technologies including: satellite, audio, video, graphics, computer and multimedia technology. Distance learning refers to teaching and learning in a conditions in which the teacher and pupil / student are separated place and era and therefore relies on printed and electronic materials as a medium of exchange instruction.„

„*Distance learning is acquisition of knowledge and skills through indirect methods of information and education, included in various technological and other forms of distance learning.*"

The concept of distance learning has been defined by the Distributed and Electronic Learning Group (DELG): *"Distributed and Electronic Learning can be defined as a spectrum that extends from the Internet supported education in which the student has limited physical contact with their mentors and other participants, and to the activities conducted instructor, based on the classroom. "*

Definition that emphasizes the communication and technological aspects:

"Distance learning means that the main carrier of communication between teachers and pupils / students is separation (at different times and places-separation between instructors - tutors from pupils / students). It must include two-way communication between teacher and pupils / students, which aims to facilitate and support the process of education. Technology is used as a mediator in the indispensable two-way communication." [49]

Some authors have defined distance learning from the aspect of technology:

"Distance learning based on telecommunications exceeds limits of classical learning. Lectures for the instructor and students / students occurs simultaneously - a mutually at the same time. When audio and / or video connection is established, there is an exchange teacher - pupil / student live, to allow space for instant response to questions and comments of pupils / students. Resembling the traditional classroom learning, pupil / student can request an explanation from the teacher at the time." [32]

"Distance learning is scheduled learning that commonly happen on different place from the one in which is created, and as a result requires special techniques of design, special instructional techniques, special methods of communication electronic and other technologies, as well as special organizational and administrative arrangements ". [198]

"Distance learning is a system and a process of connecting users with distributed educational resources. To realize the existing potentials of distance learning must perceive that it represents much more than a simple combination of innovative technology that is used for transferring knowledge. For implementation of information and communication technologies in education it is necessary to: accept individual differences, allow more capable and with more previous knowledge to progress faster and also to know the machine can do a good job if it contains a good application. We come to conclusion that education has to respond to changes and to become more efficient ("as fast as possible to learn more ")." [125]

2.1. The history of teaching

Teaching achieves education of young people which is one of most important conditions for living and work of individuals and society as a whole. Goals of teaching are clearly and precisely defined, from pre-school until university teaching. In order to achieve these objectives are defined teaching tasks that must satisfy and which are realized by implementing the programs and plans of educational institutions as well as implementation of the syllabus for each teaching subject.

"Teaching is organized educationally - educational activity is conducted according to an established syllabus as a unique social document stipulated by the Ministry of Education of the Republic. With this document teaching is provided the social character and function, specific goals and tasks ". [136]

Task of each teaching can be: physical, functional and educational.

The physical task of teaching - means acquiring knowledge about an objective reality of life being studied in some teaching subjects. In achieving this objective, students should acquire many facts resulting from teaching content, in order to prepare for living and work.

The functional task of teaching - includes development of various human abilities: sensory, mental, mechanical, expressive, and intellectual in the process of teaching. This task requires students to develop psycho - physical functions and prepare for life.

The educational task of teaching - involves developing and maintaining educational values and attitudes of the pupils / students. The goal of education is to develop positive qualities and attitudes of pupils / students, building advanced scientific view of the world, the adoption of necessary moral, social and creative values. Modern education must satisfy the fulfillment of all three tasks - knowledge, skills, and education. The fact is that knowledge is prerequisite for developing abilities of students / pupils, and having the ability is a prerequisite for acquiring knowledge. Interaction of tasks of teaching is a concept modern teaching.

The systemic education began thousands of years ago in ancient Sumerian, Egyptian and ancient Greek civilizations, but it was carried out for selected (for military use). In the early 17th century, some European countries begin mass forms education of young people and developed the first syllabus. [125]

Of the pedagogical methods Antique best known is called Socratic Method of teaching using questions, which are illustrated in Plato's "The Republic." Socrates is one of the most famous ancient Greek philosophers, and his method of dialogue is still popular, especially in the field of education with the so-called critical thinking and education in the legal profession. Socrates pupil / student Plato 387 year BC founded the Academy, which is considered as first institution of higher education. Plato's most famous pupil / student Aristotle suggested a division of knowledge into separate areas, each of which is supposed to have its own methodology and topic of the research. Aristotle 335 year BC opened the Lyceum in Athens, the first scientific research and educational, "Polytechnics" in world. Otherwise, to the greatest ancient

library in Alexandria, were stored numerous achievements of science and culture from the period of Hellenic civilization.

The first high schools after the ancient Greek civilization founded by the Arabs at the end of the first century AD in North Africa and the Peloponnesian peninsula (modern Spain). In those Muslim countries was developed education and there were numerous and various schools. Soon after the high school in Muslim world, also appeared the first medieval universities in Western Europe, the first of which is 1088. Year University was founded in Bologna, and the University of Paris founded in 1119th, and in Oxford 1167. The first colleges were international and interconnected, so many teachers and students were moved from one to another college. It is interesting that many of the earliest university lecturers were paid by their pupils / students and specifically appreciated were those teachers who have been able to attract more pupils / pupils. Thus, the pupil / student could influence the curriculum and teaching methods, and unsuccessful teachers were losing job. At that time it was especially popular scholastic method of interpretation of texts and combine ideas in a complex ways, and the method of oral hearings. The beginnings of modern pedagogy associated with the operation of Czech educator John Amos Komensky (1592-1670). [125] His proposals, among others, were related to the school system that would have specified subjects, a special book as a source of knowledge for each teaching subject and precisely set beginning and work plan for the year, monthly, weekly and daily teaching. Komensky is especially emphasized the principles of gradualism (for example "from easier to more difficult" and "from the known to unknown"). In history of pedagogy has an important role Johann Friedrich Herbart (1776-1814) [125], who tried to bring the teaching process in line with the psychological laws, and also introduces the concept of teaching unit with a precisely defined structure-based and didactic lesson. According to Herbert, the learning process is based on the following four stages: **"clarity"** that helps the attention of pupils / students, **"association"** or connecting the new content learned with those who have been adopted before, for example. through discussion with the students, with comparison and find the connection between the old and new content, **"the system"** or connecting knowledge in general, **"method"** that connects to the activity of the pupils / student and practicing and practical application of acquired knowledge. For introducing new forms of teaching is particularly important activity of Kerschensteiner George (1854-1932) [125], which emphasizes the importance of learning, as opposed to the process of teaching. Instead of verbal presentations of teachers Kerschensteiner emphasizes the usefulness of independent work of pupils / students and efforts to acquire knowledge work. Schools should have a space that will enables pupils independent practical work, laboratories and workshops, a method of teaching to a greater extent should engage pupil / students so that learning is conducted in groups, pairs or individually, rather than frontal teaching ex cathedra. Among the reform pedagogues is also Helen Parkhurst, (1886-1971) who developed pedagogic ideas during her high school, in a small town of Dalton (United States) which was later named after her. Her "Dalton Plan" provides an opportunity that in depending on ability, students choose between several different tasks in weight. Students themselves determine which will work pace. With each pupil / student is arranged in a way that will work.

Students receive written instructions for self-study. There are monthly and weekly tasks and new tasks are achieved only after the completion of the previously assumed. Therefore, students can more quickly prosper from one teaching subjects in relation to others, and classes organized according to age of children are more

difficult to overcome the majority of teaching subjects. Students work in specific work areas, and subject teachers assist them in coping with own teaching assignments.

In particular, great turn in the relationship between teacher and pupil / student initiated Alexander S. Neil (1883-1973) [125] called. Summerhill School is characterized by freedom of pupils / students and his awareness of the importance of privacy and social needs. Students have equal right to make decisions as well as teachers, who lose their many privileges and position of authority. Instead of mandatory school attendance, discipline and punishment, trying to pupils / students attract to school and interesting programs, and free play activities to encourage them to acquire knowledge. The emphasis is on learning in a group, working together and having fun in different activities, many of which are recreational.

Among the many pedagogical models should be emphasized design method which was developed by John Dewey (1859-1952) and William H. Kilpatrick (1871-1965). [125] Dewey wanted to form a school in which students will explore, create and experiment. A school that educational programs formally divide into study areas, lessons, topics, facts and tasks. Dewey's school- laboratory to pupils / students stimulate to work independently in workshops and laboratories, as well as in natural environment. Pupil / student learn contemplating about problems and trying to solve them. Emphasizes the importance of overcoming the problems that exist in the community, mutual support and integration into the community and educational activities should be guided by intuitive and impulsive activities of pupils / students.

Society in which we live is rapidly changing society, whose economy is based on knowledge, which is often called information society. There are many demands that are placed in front of the education sector: the higher coverage (more pupils / students per capita), easier access (flexible, organized instruction), inclusion (inclusion people with special needs), efficiency (better services for less funding) and much more.

There is also a number of new capabilities that are valid not only for the pupils / students and but for every employee, and that in the information society have become part of the professional knowledge of any kind. These are primarily communication skills, the ability to self-learning and self-education, social skills, teamwork, ability to adapt to change, flexibility, critical thinking, and the ability to find and process information. Overall, it will be required a high degree of media and information literacy. Future education systems will be based on the capacity for self-study (that is its most important element), and e-learning has an important role here.

2.2. History of Distance Learning

Distance learning is a form of education that was created primarily to overcome various obstacles (time, space, modest financial means) and meet the particularly marginalized groups (e.g. women), which in the former educational system did not have an adequate access to educational contents. At that time technology was significantly different. Letters were transmitted by chariot, and they were content to learn, what we would call today the teaching materials. Individuals could register to receive those letters. Generations of missionaries and educators in this way spread information and knowledge. [125]

Distance learning has always been an alternative, often contested and rejected. That stance is changing, primarily in Western Europe and North America, where the concept of distance learning contains an option of modern information and

communication technologies (ICT). From about the beginning of the nineties the combination of distance learning with the use of ICT was given the name and form of what we now call the on-line of distant learning. Even though today all the research and discussion about distance learning related to modern information technology, the application of the first forms of distance learning is related to period for over than a century that preceded the appearance of the first computer. The University of London in 1858, allowed taking an examination without visiting lectures, and so established the first official form of distance learning in the form of correspondence courses.

Following these first steps committed in England was followed by other examples: [94]

- In 1873. in Boston, Anna Eliot Ticknor founded the Society for the encouragement of learning at home, within which the next twenty years, educated more than 10,000 pupils / students;
- from 1,883th until 1,891th in New York, W. R. Harper is in the Chautauqua College conducted correspondence courses humanistic sciences;
- 1,886th in Sweden H. S. Hermond began correspondence program of learning English, to be 1,898th years Hermod became one of the largest and most influential institutions in the world of distance learning;
- 1,891th, T. J. Foster offered a correspondence course and prevention of mining accidents in mining, that in 1900. founded the International correspondence school;
- In 1892. Year education program for farmers, and has grown into now known Penn State's World Campus. A characteristic of correspondence courses is that students received textbooks than independently learned and occasionally sanded tasks to their mentors.

The target group of correspondence courses has been employed with certain social and family commitment. With the advent of radio and later television opened a new era of learning. From the 1920s radio began to be used as a medium for distance learning, and his role was taken over by (or supplemented) television thirty years later. Thus, for example, in the U.S. the University of Wisconsin in Madison, after in 1922 began to broadcast radio, already in 1952, year started, and educational television program WHA-TVI. From the initial two hours of broadcasting for quite a small circle of spectators led to the program 18 hours a day in 1987. The program was followed in the neighboring states of Illinois and Iowa and has become one of the leading educational programs in the country. During this time, as additional learning materials besides books appeared and audio tapes and after them, and videotapes. At the same time, in some cases are used the existing postal infrastructure to as particular method of distance learning held an audio conference that allowed professor - pupil/student communication and exchange of ideas among the pupils / students. With the development of telecommunication systems there was no significant change in the structure of the distance learning program but the constantly expanding the number of potential pupils / students. That is how the emergence of satellites to provide distance learning through television can be

performed in the most remote parts of the continent. The first of these systems was implemented in 1980 in Alaska. In the same period began the implementation of computer networks enabling the communication between participants in distance learning programs to an even higher level. This is particularly evident in cases where the computer communications carried over fiber optic links. Back than were possible and one-way video conferencing, as well as two-way audio conferencing. Learning was supported and the use of optical storage media (CD), which allowed the first appearance of multimedia educational materials. The biggest progress in distance learning certainly brought the Internet and technologies that are related to it. The Internet has enabled the use of modern communication technologies pupil / student in the distance learning program does not feel so "far" as it was the case prior to its occurrence. Communication that took place earlier mainly in the direction lecturer- pupil/student has now become much more diverse and even that of the highest quality in audio-visual form. With the help of Internet are provided the following relations: pupil / student-educational materials, lecturer-pupil/student, pupil/student - pupil/student, pupil/student-lecturer, pupil/student and educational material in other locations, the pupil/student and other lecturers etc. Internet and multimedia enabled to get the concept that is the focus of a teacher turned to the concept that is based on pupils / students and his intellectual and other preferences that give him the educational material close to the most flexible way, both in terms of presentation and from learning. Good example of developmental course of distance learning is the British Open University - an institution that has long been providing education at a distance, which was founded in 1969. University in the UK in the past was often disputed because of the high costs that the state had, and that same university now has a great reputation not only in Britain but in the world. Distance learning means physical distance between teachers and pupils / students and for transcendence the distance is required media. The media can be very diverse - from mentioned chariots until today's Internet is often forgotten the whole list of media between these extremes that can be used in the educational process. Also, we should not forget that every medium is good for Educational process if it enables achieving educational aims. Distance learning exists more than 150 years, during which time its development depended on available communication media. The first forms of distance learning were based on letters and mail. With the advent of new communications medium there is a different possibilities of using distance learning.

2.2.1. Delivery modalities of educational materials

Distance learning has developed simultaneously with the development of technology. The development of Internet technology has enabled the temporal and spatial separation of learning and teaching, and the development of multimedia technology enables the realization of teaching material with interactive elements. We can observe three generations of distance learning:

The first generation of distance learning - information and communication technology of the first generation of distance learning have been written and printed materials distributed through the postal system, which developed in the late nineteenth century. At that time they were known as correspondence courses and pupils / students were equipped with instructions for learning, printed books and supplementary reading lists. In these courses the pupils / students were expected to answer questions that distant lecturer then reads and evaluates. Although correspondence courses have not disappeared, but continued to spread in many countries, after the invention of the radio 20's and 50 television of the twentieth century were applied to distance learning in the form of radio and TV courses. Sometimes also included the press and local groups of pupils / students;

The second generation of distance learning - the establishment of the Open University in 1969 in the UK marks the beginning of the second generation of distance education. It was used printed materials but also for the first time has begun use of multimedia technology. The Open University has been known for developing large amounts of high quality materials, designed specifically for the needs of distance education. There was also a one-way (from universities to pupils / student, in the form of printed materials, audio tapes and transfer of information over the radio) and two-way communication (between teachers and pupils / students, through correspondence classes, lectures "face-to-face" and short courses in a given place through telephone, video and computer conference);

The third generation of distance learning - the system of distance learning used information and communication technologies which have a major role in the transfer of information and exercising easier communication between teachers and pupils / students and each other. Two-way communication is either synchronous ("at the time" - video and audio conferencing) or asynchronous ("at different times" - e-mail or discussion forums via the computer). [98] Since the beginning of the implementation of distance learning and until today there have been changes the modalities of delivery of educational materials, from printed material through to videoconferences. [91]

Printed material (asynchronous communication) - printed material is the oldest and cheapest way to deliver educational material to distant students. It includes brochures, books, case studies, assignments for the exercises, practice, etc. In the initial stage of development of distance learning (distance education) this was practically the only form of delivery of educational material. The same kind of material is used in the opposite direction, when students returned completed surveys or tasks for the exercise. Printed material is still prevalent form of presentation materials for learning and conventional education. Textbooks are printed at affordable prices even in publications in color with a high-quality paper. The biggest disadvantage of printed books is that new or changed publications appear after 2 to 4 years. During that period, it is possible that there are any significant changes in this way will not be shown through textbook material. On the other hand, the text material that is stored in a digital format is much easier to update in order to be more in accordance with the changes. Another big

disadvantage of printed material is the exchange of documents between the teacher and the pupil / student by mail too time-consuming, especially if the distance pupils / students of the great educational center. Within the e-learning, although most of the educational material presented in a digital format, it is still a small part published in the form of printed materials. Advantages: low cost, no need to become familiar with the new technology, students can use this to send materials to educational institution. Disadvantages: extensive documentation, slow transfer etc.

E-mail (asynchronous communication) - Electronic mail (e-mail) after the file-sharing is first form of communication between dislocated computers that appeared in the early stages of establishing a computer network. For the performance of this communication today is necessary to have: Account for the ISP, dial-up modem and telephone line (order can be obtained through some portals, such as Yahoo.) or a network card account and if there is a direct connection (via xDSL modem or similar) with server on which the account is opened. In addition to these hardware prerequisites for using email need to install the appropriate software (Netscape Messenger, Outlook Express ...). Basis of email makes short text messages without using any special formatting. It can be tied files (attachment) to any content (formatted text, graphics, sounds, videos ...). In the composition of such messages should be kept in mind that the transfer of larger files takes a long time if the communication takes place via traditional telephone infrastructure. One of the main characteristics for the communication by electronic mail is its asynchronous perform. This means that the message is retrieved by the addressee at the times when he initiates, which usually do not tally with the time of sending it. Meanwhile, messages are stored on the mail server, waiting to be downloaded. On the one hand this is positive since the transfer of messages is determined by the simultaneous presence of the participants in communication. On the other hand, if both the sender and recipient of a message at the same time in addition to their own computers, messaging will be unnecessarily slowed traffic through the mail server and the operations of the e-mail software. For this reason were developed other forms of communication similar to an email account from which the most famous is the Instant Messaging that allows instant transfer of messages from the sender to the recipient. It is in fact a text message on the keyboard in real time. To conduct such communication is necessary to use one of the following software tools: AOL Instant Messenger, MSN Messenger, ICQ ... Any form of electronic mail is very important for the performance of e-learning programs. Although the basic form of communication is limited to asynchronous connection it allows to overcome all the problems related to the performance of the classical form of consultation which requires arrival of pupils / students to the educational institution, on the other hand the presence of teachers in the office for a certain period of time. E-mail certainly has its limitations, mainly related to the size of messages that can be exchanged, but in the context of service for the exchange of short messages it is an excellent tool for maintaining regular communication between all participants involved in the distance learning program. Conducting a consultation with the teacher, delivery term and other papers, ask questions, individual exchange ideas with other pupil /

students and many other asynchronous activities can take place through e-mail. Advantages: widely available service enabled instant messaging, service known to pupil / student. Disadvantages: in the case of many e-mail messages may consume a lot of teacher time.

Electronic bulletin boards (asynchronous communication) - an electronic bulletin boards (BBS - Bulletin Board System) represents a digital space in which it is possible to leave text messages, photos, short videos, programs, or some other form of digitalized data. Access to electronic bulletin boards is achieved mostly through the Internet, where at certain sites for participation in discussions that requires registration when is obtained a user name and password. Electronic bulletin boards are often divided into different areas of interest of its visitors and therefore are form discussion groups that deal with given topics. Each participant attaches its comment and when it appears, username, date and time of sending the message, sometimes running and other details (e-mail, for example). Within the program of distance learning electronic bulletin boards provide an excellent way to organize a discussion of pupils / students in the subject. Each participant can read attached texts of their colleagues at a time when it suits him and if he wants to follow up on them. On the other hand, if the participants agree to access the site at the same time if they have fast enough connection, electronic bulletin boards are approaching the synchronous type of connection. Advantages: flexible form of discussion, not necessarily at the same time presence of discussants, discussions can be later analyzed.

Disadvantages: have to limit participants by using usernames and passwords; it also requires supervision of discussion attachments in order to prevent contradiction to ethical and legal standards.

Chat (synchronous communication) - "Chat" is one of the most popular ways to exchange text messages in real time. It is in fact a form of electronic mail, which allows multiple participants in a conversation gather at the same time. Each of them has its own user name that is always associated with the message they send. In addition to all see each submitted message is possible to achieve and specific connections between individual participants in a chat that are visible only to them. Although it is usually related to the instant entertainment on the Internet, this tool can be used very effectively in the learning. If we want to be part of discussions take place in real time, then "chat" is a great replacement for the electronic bulletin boards that represent asynchronous type of communication. Advantages: real-time communication enables the participation of several participants, the ability to store messages for later analysis.

Disadvantages: All participants must at the scheduled time connect the Internet, requiring supervision discussions in real time that messages would not be in conflict with the ethical and legal standards.

Audio conference (synchronous communication) - represent a form of Internet based audio conferencing which encompasses transmits only the sound. For their performance is necessary to use a microphone and speakers connected to the computer at all locations wishing to participate in audio conference. Very often it is only part of the audio conference for multimedia communication over the Internet (Web conferencing) so it is always possible and simple their combination with other forms of communication (video, graphics, documents ...). The sound quality depends on the type of connection that is being used. Advantages: the ability to avoid high telephone costs related to long-distance and international calls, and simple concomitant use of other communication tools. Disadvantages: when

connections are slow sound can be lower quality compared to traditional telephone lines, limited application to communication that requires only an audio signal.

Whiteboard (synchronous communication) - Whiteboard is the concept of the Internet conference, which provides that one part of the screen in a separate window, perform display of graphics. This enables, in case of audio conference to be displayed illustrations that would help better understanding of concepts that are presented by speech. This technique also allows modification of graphical content. In some cases, intervention of each participant is marked in a different color which adds an extra quality of Whiteboard-in.

Videoconferencing (synchronous communication) - videoconferencing provides audio and video communication and the ability to exchange data between distant users, which in practice can be achieved by using different technologies. For these reasons, video conferencing can be maintained in various forms, depending on the number of participants, the technology used to receive and transmit video and audio signals, available space, required quality of picture and sound. First of all, it is necessary to point out the fact that the video and audio material is extremely challenging for storage and transmission. In case that we decided for videoconferencing and we want at the same time to keep quality of picture and sound is necessary to make a large investment in equipment. Without taking consideration to their manifestations which may be different in quality audio and video, required financial investment and simplicity of use, videoconferencing is certainly modality of delivery of educational material that each institution should have.

Figure 2.1. Videoconferencing

Advantages: the establishment of Audiovisual Communication (talk face to face) individuals from different locations, the ability to use different media for communication, saving transportation costs, time and energy that would certainly be higher if the participants in the meeting had to be found at the same location, within the company the ability to use equipment for other purposes such as for example training sessions. Disadvantages: their implementation requires large initial financial investment in this area is still feeling the lack of existence of a certain

standard to establish communication that requires a combination of various communication channels can be a major problem, the problems of network connectivity which is certainly in the first place is the issue of security , connecting participants residing in time zones which are the distant making it difficult to find date for a meeting that would suit everyone. Implementation of videoconferencing is conducted through two basic forms: group videoconferencing systems and desktop video conferencing systems.

-Group video conferencing systems - these systems are the best and most expensive. Depending on the number of participants in these systems are used in the conference halls or rooms. Group systems usually consists: two screens (screen or TV screens) one of them presents distant location and the other is used to display the content presented by the speaker, two cameras, one facing the teacher and other facing audience, speakers and microphones for audience , an interactive white board (whiteboard), a special camera to view the documents or objects, the control unit that enables camera operation, the volume of the input audio signal, the establishment and termination of connections, device that sends an output signal to a distant location (camera, computer, document...), additional devices for recording and playback of audio and video materials (VCRs, DVD / CD players, tape recorders ...), the codec unit. Group videoconferencing systems can link the two stations (point-to-point) or more than two stations (multipoint); where in the other case would be required additional equipment for managing of videoconference. Group videoconferencing systems are also different according to whether they used in video conference rooms or halls or on mobile, where in this case the equipment is placed on the gurney so that it could be transferred to the appropriate room. Advantages of group system: allow more participants (in two or more locations), provide a sense of closeness to participants in a real-time even at distant locations. Disadvantages of group systems: it is often necessary mid-career personnel providing technical assistance in managing cameras, lighting, sound and other elements included in group videoconferencing systems, these systems require a large financial investment; passive audience can substantially reduce the positive effects of group systems videoconferencing.

Figure 2.2 Example of group videoconferencing

- Desktop videoconferencing systems - these systems require far less investment in equipment, but we have a poorer performance. For their performance are used the desktop PCs which shall be accompanied by: a small camera, usually set on top of the monitor, microphone, speakers, video conference equipment for processing

signals, the software that controls the videoconference. Within the desktop videoconferencing systems is possible to use some additional tools, such as shared whiteboard, file transfer, shared applications, instant messaging...

Their use is determined by performance of desktop videoconferencing systems. These systems allow the transmit video signal which consists of 15-16 frames per second, which is insufficient for high-quality picture, and often the picture and sound are not synchronized. Since these systems are often used over telephone lines, there may be interruptions that prevent continuously performance of videoconferencing.

These deficiencies are not so important for the particular domain of application of videoconferencing systems and their relatively low price provides them appropriate position in the video and audio communication market. Videoconferencing signal processing can be done in two ways. In the first case, this can be done with the help of software. The camera is then connected to the USB or FireWire port. These systems are less expensive but with their use all the processing video signal is transferred to the computer processor. The quality of videoconferencing signal is very meager and the number of participants has been limited to maximum of 2 on each side. Another way of video signal processing is performed hardware. In this case, the quality of the video and audio signals is better but the price is higher. Hardware-based desktop videoconferencing systems represent the good temporary solution for those who want a better quality of software-based desktop videoconferencing systems and have no sufficient financial resources to obtain group videoconferencing systems. Advantages of desktop system: less financial investment compared to group systems, easy to use.

Disadvantages of desktop systems: insufficient quality of audio and video signals, a limited number of participants to a maximum of two to three on each side, the communication between the two sites (Picture 2.3).

Figure 2.3.Desktop videoconferencing system

Web seminars (synchronous communications) - represent the events and training for business partners, customers, various brochures, through the Internet.

An application that offers a high-quality audio, internet, webcam, functionality and allows integration of different modalities (chat, whiteboard, audio and video conferencing) is Adobe Connect Pro. Adobe Connect Pro provides easy access and participation in a web seminar. With one click, you can watch, listen, speak, be seen, engage in conversation, ask questions, and more.

2.3. Internet and its application in education

Era of information overload has long begun. In many commercial systems, the greatest amount of information is on paper media as business information systems run on single-or traditional computer network systems that are accessed by only one employee who on their computers have the appropriate software. Because of incompatibility of files, software, hardware and the like exchange of knowledge between the employees is often impossible. In today's informational era the decision must be made instantly because there is no time to search many paper documents to obtain the information.

The disadvantages of traditional business methods:
- Large amount and slow distribution of paperwork (it is hard to make a contract with a international company computer if the documentation is not supported)
- Access to essential information too late (late response to the demands of consumers and employees)
- Slow movement of information within the project team or between managers and employees (leading to slow business system reactions to changes in the market),
- The existence of different file formats and operating systems, which hinders the exchange of digital information (which again leads to the application of paper documents).

In the early nineties have been developed computational methods for exchanging information within the program, but also between different programs within a single computer system. A particular phenomenon is a communication network by Internet and Intranet. The advantages of using this type of communication are very important to the designer, if one keeps in mind the increasing competition and tighter deadlines must be respected. The appearance Internet has brought a revolutionary change in the way of doing business. Technically speaking, the Internet is a network of computers. Internet is a network, software, and above all drive change, a new culture, a new way of thinking. Internet technology is from its beginnings to the present day progressed extremely quickly. There are number of services that are offered to improve both qualitatively and quantitatively, so today's software could be available to provide the ability to connect to a computer located at any location in the world. Today timely information can be obtained from any every part of the planet, and it contributes significantly to accelerating the implementation of (sub) project for which the engineer is responsible and synchronized operation of the project in collaboration with the design team.

2.3.1. Internet Development

The emergence of the Internet is associated with the late '60s of the last century. U.S. Department of Defense has decided to unify the work of its scientists and research groups, thus forming a team that will work focused on military projects. But for implementation of this decision was necessary to solve the problem of

experts from across the country and to allow exchanging computer files. That is how the Arpanet (Advanced Research Projects Agency), was created which represent communication network through telephone lines, and it combined all the computers in a military-industrial complex of the United States. Aparnet soon began to connect in one unit industrial centers, academic institutions, businesses and others. Over time, the expansion of computer networks has become globalized, and as such today is an international computer network at the global level - the Internet. Subsequently, other networks appeared, many of which were connected to Arpanet. The army separated from Arpanet in 1983. Years and has established its own network Milnet, which is included in the Defense Data Network - DDN (military data networks). The National Science Foundation (NSF) in the 1980s founded a network called the Internet, which is seven years later connected to the Arpanet / DDN networks and that led to development of NSFNET. Simultaneously in 1978 and 1979 was spread Usenet, conference system whereby pupils / students and teachers of American University exchanged opinions on various topics. IBM in 1977 founded Bitnet network, in which was first joined to university computers in the United States, and later (project EARN) in Europe and other parts of the world. Computer networking was interesting for commercial organizations which during the eighties connected in various ways. It was necessary to connect EARN that existed in many countries, JANET in Britain, the Scandinavian countries NORDUnet, Funet in Finland and so on. That is how the internet that we known today.

This has caused the emergence of the Internet and its management. Internet, in fact, no owner, that is, no state or private institution does not have authority over his whole. Some states and companies are owners of pieces of communication channels and equipment that is used, but on the Internet there is actually only one property: each is the owner of the PC that is connected to the network and has the unrestricted right to use the computer and he wants to keep him on the contents which he considers necessary.

The Internet is a global worldwide network based on TCP / IP (Transmission Control Protocol - a protocol for transmission control; Internet Protocol). The protocols are procedures that computers provide instructions on how to exchange information. Today, the Internet rightly referred to as the "network of networks". Main feature of Internet is access to an immense amount of information multimedia character (text, images, sounds, videos). Another important feature is communication and exchange of information (e-mail, news). All of these benefits are available to users through the Internet and its services. Services and Internet services are organized according to client - server principle. Server is special software on a computer network that serves the requirements of the users. Those making the request shall initiate appropriate program, called client on every computer. The client application that wants a service, says to server sending the message that describes the task. Server serves the request and responds to the client of your messages.

2.3.2. Internet services

Applications for support of group work can be divided, depending on the needs of the simultaneous presence on network, asynchronous and synchronous. Internet applications for asynchronous operation could be applied on communication in which other networks do not necessarily mean a participant in the communication. For this type of application is a not necessary time synchronization activity. This allows easy cooperation of the participants working in different time zones. The best-known Internet services for asynchronous work associates in the group are:

- **WWW (World Wide Web)** - can be defined as a distributed multimedia service. IT allows users to access multimedia content. Certainly the most attractive Internet service and the service that is being most developed. A variety of multimedia content stored on Web servers around the world are accessible through a Web browser (browser), and universal user interface. Modern software tools allow relatively easy to create and maintain a Web server, so that it becomes possible to associate groups of documents required for teamwork exchanging through the web server.

- **E-mail** - e-mail service. Service includes the transfer of text documents that contain messages using email to distribute (mail server) to an electronic mailbox (mailbox) of an individual. Other than exchange messages between two people, the service includes mailing and discussion lists, sending files and other. E-mail service has an important role in distance learning, which is reflected in the time-independent communication between professor and pupil / student.

- **News** - conferencing system or a system discussion groups where users exchange views and opinions on a particular topic. Discussions are organized into thematic units. Discussion groups are popular Internet service that can significantly improve the exchange of experiences as well as to raise the productivity of the entire group.

Internet applications for synchronous operation are used for immediate communication of group members in real time. This type of application requires time synchronization of activities and all participants have to be on the net. The best-known applications of synchronous group work are:

- **Electronic Meetings Systems** - systems for electronic meetings, use computers to connect all participants in the meeting in order to simultaneously communicate and share ideas. The meeting focuses on computer screen and / or projection screen, which all participants can see.

- **White boards** - whiteboards enable two or more people at different locations simultaneously observe and / or update the electronic document displayed on screens of their computers. Using these software tools, it is possible for two engineers at different locations jointly design and update a drawing, by simultaneously access through the Internet.

- **Videoconferencing (Video Conferencing)** - a service that allows video and audio communication over sides. This service uses hardware (cameras, microphones and sound cards) and special-purpose software. High-quality video conferencing systems require high throughput.

2.3.3. Internet and Education

The first significant effect of the Internet, which can be regarded as positive, but it can also have serious consequences, lies in simplifying and facilitating the daily activities which include administrative processes. Work operations are restricted, complex organizations are broken and time saving are registered. Company personnel work directly on their computer and transfer their data and texts to colleagues, clients, policy orders; documents can be easily archived, re-use at all

times by others. View active e-mails (the ones coming out from a business or educational system) enable communication and work of high efficiency, significantly reducing time intervals due to the inefficiency of intermediation. Direct, proximate, memorizing, re-used, portable work with the Internet and electronic networks prejudice to very existence of certain positions in companies such as Secretary, dactylographic, etc.. Other factor of Internet often spectacular, is the reduction of costs, especially the costs of communication and manipulation of information or data cost. It is now known that it can be reduced the costs of telephone, fax, and photocopies thought using the Internet. Related also to simplification of tasks of organization, this cost reduction will be felt at the level of general operating costs. Nevertheless, it is clear that the decrease of marginal costs is possible only if they have been realized; on the other side are necessary investments for network equipment (at the state level and at the company level). Thanks to the advances of technology and the advantages of the Internet, teachers are also able to improve their knowledge, to better conceptualize their teaching, and to compare their methodology with the work of their colleagues anywhere in the world. One of the great advantages of the Internet is their "relationship" with the world. Teachers, pupil / student, and administrative staff of schools, colleges, can constantly monitor new developments in the field of education. Constant contact with their counterparts around the world teachers learns new teaching methodologies, find out news from the field of work, they teach and thus provide their pupils / students the latest information. Pupils / students can also try to expand their knowledge in a particular area thanks to Internet. Based on the foregoing we can see that the possibilities offered by the Internet are huge and that in an age of constant technological progress, almost no progress is possible without its use. Use of Internet facilitates the work professors, because they have the ability to very easily access any university in any part of the world and compare their methodology with the work of their foreign counterparts, to share personal experiences and thereby improve their work. If there is a domain of activities that benefit especially from the Internet it is the domain of research and development of knowledge, because it is created in the scientific communities in order to stimulate cooperation in this area. The innovation process represents basis of research and development activities. According to the modern understanding of the innovation process it is usually defined as a combination of two sub-processes: invention and exploitation. Inventive process is a collection of those stages which take place in the process of creating new ideas and solutions, while exploitation represents development of inventions, ie its implementation in the market (from prototype to mass production). Internet itself represents an innovative process, on the other hand more and more entering the field of scientific research themselves, as an essential source of information and communications.

The main requirements of scientific research are:
- Quickly finding and acquisition of scientific, technological and business information,
- Easy and simple communication between researchers,

- Enabling the implementation of part of scientific research and experimental research on distant destinations.

Applying multimedia technology leads to integration of images, sound and text, all in a digitized form which provides all those possibilities offered by modern computer and communications technology: storage, processing, transfer and use. Information technologies have provided, through multimedia, new forms of communication and the formation of scientific and technological information, increasing communication, science and technical fields to a new, higher quality and richer level. The so called "Electronic conferences" with the use of multimedia technologies enable communication between participants that are physically separated. Consequently, new types of computing and communication technologies create "virtual presence" that goes so far that even surgery may be performed with the advice and guidance from the experts who are thousands of miles away from the operating room.

Multiplication of web sites and electronic forums dedicated to the scientific activities in the near future will lead to a significant improvement of our knowledge. It is a new vision of scientific and technical communication that is connected to the new practice of publishing and data exchange. With regard to education we should expect a lot from generalization using the Internet. Firstly, there is the possibility of expanding universal access to knowledge. It also allows reconsidering education, learning, pedagogy (learning, training companies, etc).   Interesting area of education that gains in importance whit use of Internet is distance education.

The classic method of teaching is based on the model of a teacher and a number of pupils / students. This model has proven to be a very simple and efficient and hence its representation in education. But among pupils / students is one of the less efficient models. It turned out that the students are always motivated to actively participate in class, because attention is often focused on learning. With the development of multimedia systems approached the attempt to simulate the "natural" way of learning and thinking using a computer. A great advantage gives the possibility to every pupil / student to work independently on a single computer, which allows maximum activity and regular learning.

By connecting the computer system is enabled to a classical lecture in the classroom passes into individual research through computer networks. EDICS is an interactive multimedia application made to the Massachusetts Institute of Technology (Technical Communications in Mechanical Engineering) designed for the engineering design of computer systems. Pupils / students of MIT have made comparison of traditional ways of learning through books and learning using the first version of EDICS's. They came to the conclusion that the medium - paper or computer did not significantly affect the results of learning. It should however be noted that the study by computer greatly shorten the time of knowledge transfer, which has opened the way for further exercise of other forms of instruction (for example, practical work in laboratories, nature, etc.).

Multimedia systems are applicable and useful to education because: visually represent knowledge (a picture is worth a thousand words), are a basis of available data, provide research learning, have the ability to simulations, provide lessons based on insight, research and discovery of cause-effect relationship by means of group communication network provides simulation and interactive discussions.

This type of education involves separation of teachers and pupils / students, and the use of educational media that connect teachers and pupils / student up loaders lessons. The forms of education of such are: printed correspondence, audio-graphic method, instructing through television, teleconferencing, audio and video

conferencing, computer conferencing, IRC (interactive communication), electronic mail and other computer services, WWW (World Wide Web).

2.4. Standardization, the criteria and the role of teachers in the distance learning

2.4.1. Standardization of e-learning

The fundamental part of standards in the implementation of e-learning is to decouple the development of standardized data models and standardized structures of educational content enabling their use regardless of tools that have created them and the environment in which they are used. Standardization process is providing the following details of the program of electronic learning:
• Interoperability, which ensures the possibility of exchanging electronic materials between LMS systems
• reusability, which involves the use of educational materials in different courses or by different pupils / students regardless of authoring tools used to create them and LMS systems within which they are delivered,
• Manageability, where is observed ability of the system to memorize relevant information about the student / student and program content,
• Accessibility, which indicates the possibility of the author and pupils / students to from any location can access contents of eLearning program and
• Durability, providing the functionality of the system in the case that is being upgraded and improved.
The creation of standards is often a lengthy process that takes place through the following four iterative steps: research and development in order to find possible solution of the problem, development of specifications, testing and activating pilot programs and accreditation by official institution. Development of standards in the field of e-learning is the activity of many organizations, institutions and initiatives such as AICC (Airline industry CBT Committee), AIMS (IMS Global Learning Consortium), ADL (Advanced Distributed Learning) ALICE (Advanced Learning Infrastructure Consortium), ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe), CEN (Committee European de Normalization, the European Committee for Standardization), IEEE (Institute of Electrical and Electronics Engineers), ISO (International Standards Organization), GESTALT (Getting Educational Systems Talking Across Leading Edge Technologies), PROMETEUS (Promoting Multimedia access to Education of Training in European Society) ... [194,195,196,197] On the initiative of Ministry of Defense (The U.S. Department of Defense) and the Administration of Science and Technology of the White House (The White House Science and Technology Office) was created the initiative ADL (Advanced Distributed Learning) and whose greatest contribution to the field of standardization is reflected in developing the SCORM reference model (Sharable content Object Reference Model - Reference model of tradable content objects). SCORM is not standard in the legal sense since it is not accredited by an official institution and it represents officers approach used to verify the effectiveness

of the applied set of specifications and standards. It was developed in collaboration with entities such as standardization of AICC, IMS and IEEE in order to integrate their specifications into a cohesive, useful, comprehensive model and define the key relationships between their standards. The first version of the ADL's SCORM documentation was oriented to content of delivered courses through Web and the aim was to enable the following:
• The ability of the LMS (Learning Management System) to initiate content that was developed by other manufacturer tools, as well as exchange data with that content,
• The ability of LMS system from different manufacturers to initiate the same content feasible, and to exchange data with that content during its presentation,
• The ability to more LMS products / environments feasible approaches to common stock content and such Content to initiate
• The ability to transfer entire courses from one system to another LMS. SCORM recommendations define meta data for the educational content; model of organization and packaging of educational content - the structure of the course (content packaging) mechanisms for communication between the learning content and LMS system, which defines the data model managed by the LMS method of launching and delivery of content. Central to the structure of the educational content that is compliant with SCORM recommendations occupies exchangeable object content (SCO - Sharable Content Object).
Its understanding is based on a concept of the object of learning (learning object), which is independent, discrete part of the educational content which enable one and only one educational goal. Commuting content object is an object of study consisting of one or more basic units of learning content (asset), has the ability to locate the LMS API adapter, but cannot invite other objects. Based on the SCORM specification is determined a hierarchy of educational components. At the lowest level are the basic units of educational content (assets) which are in form of text, images, audio or any other type of data in a digital format.
Their combination can form an information center (information objects) that represents concepts, facts, principles, processes, procedures. Collections of objects form a lesson of learning, and make one more lesson course.

2.4.2. The criteria for successful distance learning

Distance learning can be understood as the simplest process of transferring knowledge and skills through the Web, using computer applications and environments in the learning process. These applications and processes include learning via the Web. Web pages are intended to help pupils / students to find the necessary information about the course, receive the required training materials (multimedia character) and have the opportunity to test and verify their own knowledge. Web pages designed appropriately should help thinking, discussion and active participation of pupils / students in the course. Elements to be included in a Web page dedicated to the course are:
• Information on the course and the teacher - course title, hours, trainers, information on printed materials, a review of the course, the rules.
• Communication groups - access to email lecturers, discussion group for communication between pupils / students, a form for reporting problems.

• The tasks and tests - distribution of tasks and tests for online completion and submission, review solutions, the most frequently asked questions.
• Material for classes - Lessons is available in the form of Web pages and files to download.
• Demonstrations, animations, video, and audio - include materials which cannot be presented in a classic text format.
• Reference materials - the list of materials in printed or electronic form that complements the lectures. To avoid problems with copyright law, these articles should be in the public property. As a supplement it can be provide links to other pages on the web that cover this topic, similar courses, which are available on the Internet, the university library, and other resources that can complete the course.
Teaching contents prepared this way have different characteristics than traditional sources of information: the content is current and dynamic content can be a primary source, the information is easy to manipulate, the pupil / students may participate in the on-line system.
While the Internet facilitates individual learning, research shows that teachers through the interaction in real time increases efficiency and improve distance learning course. Pupil / students need guidance, and that represents feedback from an instructor or the possibility of achieving discussions with colleagues. Without interactivity and connectivity with the rest of the world, distance education becomes impersonal and artificial, unnatural form of learning. Successful distance education programs begin with careful planning and a focused understanding of course requirements and needs of the pupil / student. Appropriate technology can only be selected once these elements are considered in detail. There is no secret way to make successful distance education. They do not happen spontaneously, they are produced by hard work and dedicated efforts of many individuals and organizations. In fact, successful distance education programs are based on the consistent and integrated efforts of pupils / students, faculty, support staff and administrators [Ana].
-Students - satisfying educational needs of the pupil / student is the cornerstone of any successful distance education programs and a test by which to measure all efforts in this area. Regardless of the educational requirements, the primary role of the pupil / student is to learn. It is a difficult task even in the best terms, it requires motivation, planning, and the ability to analyze and apply the instructional content. When lecturing is performed from distance, there are additional challenges because students are often separated from others who have the same previous knowledge and interest, have little or no opportunity to interact with teachers outside of class, and must rely on technical connections to overcome the gap between physically separated participants.
-Teachers - the success of any distance education depends largely on teachers. In a traditional classroom, the instructor's responsibility includes the planning of the content and understanding of the needs of pupils / students. Teachers who teach at a distance face particular challenges. For example, the teacher must: understand the characteristics and needs of distant students / students with little first-hand experience and limited, or no, contact "face to face" to adjust teaching style, taking

into account the needs and expectations of multiple, often diverse, audiences, and develop working understanding of technology, but remain focused on their role; function successfully as a skilled assistant and lecturer.

-Assistants - teachers often find it useful if there is an assistant who serves as a liaison between pupils / students and teachers. To be successful, an assistant must understand the pupils / students and expectations of the teachers. More importantly, the assistant must be willing to follow the directives established by the teacher. In cases where the material and technical conditions permit, the role of teaching assistants is increasing even when they have little knowledge of the subject. Their minimum responsibility is to set the equipment, collect homework, supervise examinations and serve as the "eyes and ears" of teachers.

-Support staff - ensures that the requirements that are necessary for the success of the program are resolved in a timely manner. Most successful distance education programs in the service of support staff include registration of pupils / students, copying and distribution of materials, ordering books, obtaining rights for copying, scheduling facilities, processing reports with scores, maintenance of technical equipment and so on. The support staff is essential bond that makes distance education sustainable.

Administrators - Administrators in most cases participate in the planning of distance education programs of an institution, and when the program becomes operational they ceding control to technical managers. However, successful distance education administrators must be more than people who contributing ideas. They help to be achieved consensus, make decisions and also serve as judges. They work closely together with the technical and support staff in order to ensure that technological resources are effectively used to enhance the academic mission of the teacher. More importantly, they maintain an academic focus of the institution, recognizing that satisfying educational needs of distant pupils / students is their ultimate goal.

2.4.3. The new role of teachers

The proposal of the European Union on a new process of education is clear. All changes and opportunities that the Information Society offers people depends largely on whether people know how to use them and the positive use in their daily lives. However, it also takes a complete change of structure and culture.

"What Europe needs to be able to stay in the race with the revolution in information and communication technologies and to be able to monitor the progress of technology in the near future, is the general repair of its educational and training systems." [41]

Characteristics of the information society require changes in educational models and use of new interactive and distant learning methodologies which in a comprehensive manner use information and communication technologies.

At the same time that teachers become active agents who use the full potential of information and communication technologies, new educational systems forces us to rethink the role of the teacher. And to further test the role of teachers in the information society should be considered first differences and similarities, as well as

the opposite and complementary aspects of traditional teaching and learning that is not performed face to face (distant educational systems). To do this, it is necessary to understand that the two teaching methodologies (face-to-face and online) are not contrary but are in fact complementary. As some experts say it is important to "have the core of critical judgment in order to these two situations could be adequately distinguished. This is so that the one would not work what needs to be done in another and that they are merged into appropriate dynamic synthesis be further developed and enriched. "[49] For the appropriate program calf-classes can be recognized two crucial aspects. They in many cases can be a key actor between the success and failure of new ways of teaching and learning in the information society. The first aspect is related to methodological aspects and styles of teaching, and the other on resistance to changes and fear of the unknown. Since we live in a time that is rich with information and resources for learning, it is important to develop capabilities for faster and better quality acquisition of knowledge. In order to achieve this, it is necessary to change the content of education familiarize teachers with efficient working methods and forming of pupils / students, develop and extend measurement systems and efficiency of teaching, adequately reward teachers extract and encourage those who achieve the best results. In order to achieve the best quality, it is necessary to use modern educational technology. Integrative function of teachers can be seen in its ability to connect to a single Action entirety school environment, curriculum, pupils' behavior and its way of working. "From the integrative function that is arising, more or less specific roles of teachers are such as planning, initiating, encouraging, organizing, directing, guiding, modeling, monitoring, analyzing, evaluating, correcting and updating the course and dynamics of the learning process." [57] On this basis may be inferred that the role of teachers are varied, numerous, interrelated and complex. Successful implementation of these conditions the role of teachers to be focused on new pedagogical principles of educational activities based on scientific postulates. "The personality and activities of teachers depends very much on entire life and work in school organization and performance of pedagogical - educational work, the quality of acquired facts and their functional connection with objective reality." [16]

"Teachers are required to possess a solid general culture, to know contents - subjects which delivers, to know psychology and pedagogy, the educational problems of young people learning, their personal characteristics; interests, knowledge and skills, to knows itself as a human and educator and to control himself. "[16] The teacher must have a stable character and other qualities, and those qualities to convey to the pupils / students. Referred requires investment of energy, stamina, good concentration, emotional stability and mental integrity of a person. "For a successful action, communication and interaction is significant flexibility, patience, tolerance, kindness, understanding of the problems, the enthusiasm, the ability to encourage students comments and compliments, training the pupils / students to solve their own problems and to objectively evaluate the results of their work" . [16] Within the teaching realized through distance learning radical changes are taking place. It's changing role and status of teachers, the role

of the pupils / student, teaching methods and didactic methods. In traditional education students have a passive role, listening to the teacher's presentation without the possibility for greater self activity. As mentioned earlier, in distance learning, students get active role, which allows them to work according to their abilities, interests, and their pace of work. Teacher in a traditional classroom care and relies on a number of obvious and inconspicuous signals received from its pupils / students during the presentation material. A quick view of them reveals who have been carefully taking notes, thinking about target problems or preparing comments and explanations. Similarly noticeable is pupil / student who is frustrated, confused or tired. The attentive teacher consciously and subconsciously receives and analyzes these visual signals and based on them determines and directs the future course of instruction according to the needs of pupils / students. On the contrary, the teacher in distance education has very few such visual signals. These signals are filtered by the technical devices such as a monitor. It is difficult to maintain a stimulating discussion between teacher and pupil / student, when spontaneity is limited by the technical requirements and distance.

On the other side the new function of teacher allows diversified and perhaps inspiring role. The teacher is a lecturer, designer, producer, media specialist, and provider. The new role has an impact on direct contact with the students, then the aspects of the teaching profession - preparing materials, developing lessons, monitoring students' improvement and collaboration with parents.

3. Innovations in teaching practice in the world and in our country

3.1. Experience and practice of developed countries

The concept of e-learning was mentioned in all important declarations of European Union and it is gaining importance. The 2004th year, the European Union announced eLearning action plan, a program that includes the objectives of the European Union in Teaching - Education Program and encourages open and distance learning, the application of information and communication techniques in teaching and cooperation of educational institutions. In its strategic policy, the European Union is an e-learning ranked among the basic objectives that will contribute to the important changes not only in education but also in the economic and cultural life in general. In this regard has been developed a multi-year program for the effective integration of information and communication technologies (ICT) in education systems. [23] The EU policy is aimed at ensuring staff who will show you which features provides e-learning for individuals and the community; providing an environment conducive to the development of quality content and e-learning and will provide quality educational outcomes. Numerous international organizations and associations have started with the practice of drafting standards, recommendations and guidelines in order to develop tools and programs for the development of courses, information and services that are renewable and exploitable (for example Information Technology for Learning, Education and Training ISO / IEC JTC001 [194], the IEEE Learning Technology Standards Committee-LTSC [195], the IMS Global Learning Consortium [196], Aviation Industry CBT Committee AICC [197], etc.). Many examples and experiences indicate consciousness of the need for new, enormous technical resources to properly take advantage in education and training of pupils / students. When it comes to e-learning, we can say that this is actually a project that is still being developed and tested on both a theoretical and practical level. The main idea of this project involves the use of Internet technology, multimedia systems, databases, and access to distant sources of knowledge. In order to develop an effective model of e-learning in the field of education, it is necessary first consider the real conditions, ways and possibilities of applying technology in education. In this regard, there are numerous evident problems with planning and programming content. These are the problems of selection and determination of educational materials, course design, and project evaluation. The evaluation assumes developed specific methods and techniques for monitoring, measuring, evaluation and improvement project as well as activity evaluation of pupils / students and their progress. E-learning program identifies four key areas:
1. Equipping schools with the necessary number of multimedia computers that are connected to local and global Internet network, with free access to electronic libraries, cultural centers, museums, using sophisticated software and multimedia products.

2. Training teachers for changeable conditions and application of latest information technology in planning and teaching.

3. Develop of high-quality multimedia services and contents. Information technology can be incorporated into the educational system, if there is controlled quality of multimedia products and its content.

4. Developing and connecting learning centers including formation of virtual institutions of learning and teaching (virtual forums, campuses), also connecting universities, schools, cultural and educational institutions.

The development of e-learning in the world today has reached one of the turning points. A large number internationally recognized higher education institutions in their program of study as a compulsory choice of modern education apply this category of learning as serious organized programs characterized by a large number of pupils / students. Some of the most important institutions that apply in their educational work distance learning in U.S. are University of Minnesota, University of Phoenix, and Columbia Network for Engineering Education. In Europe is significant development of distance learning initiatives that have been realized primarily through the European Distance Education Network (EDEN) and the European Association of Distance Teaching Universities Education (EADTU). Open University from UK has set some standards for this type of education by which model was organized institutions that apply distance learning in Spain, Germany, Holland and Portugal. European Distance Education Network (EDEN) [192] - European network for distance learning, established in 1991 year as an association which deals with e-learning and offering support and advice for a number of projects in this area. They advocate for the effective integration of information and communication technologies in education and training in Europe and abroad.

The program action is composed of:
- The collection of descriptive and statistical data, and comparative analysis of educational systems of different countries,
- Development of methods for evaluating the quality of education, including the development of appropriate criteria and indicators,
- The development and updating of databases and other sources of information on innovative experiments,
- Dissemination of experiences arising from the relevant activities supported at the community level and from different countries,
- Facilitate the recognition of diplomas, qualifications and periods of learning at all educational levels more countries.

European Association of Distance Teaching Universities Education (EADTU) [193] - is the European association of University for distance learning, which was founded in 1987 year in order to encourage cooperation between European higher education institutions that are active in distance education. The members are from 19 countries, offering programs in distance education for over 2,000,000 students.

Declared aims of the association are following:
- Inform participants about the ways and means of implementation eLearning in order to promote computer literacy and thereby contribute to strengthening of social cohesion and personal development,
- Exploit the potential of eLearning for propagating the European dimension in education,

- Provide mechanisms to support the development of European quality products and services
- Exploit the potential of eLearning in the context of innovation of teaching methods to improve the quality of eLearning and strengthening the autonomy of the student.

The Education, Audiovisual and Culture Executive Agency (EACEA) [190,191] are responsible for the management of the European Union related to education and culture. Within the program called Leonardo da Vinci and Socrates there are several actions which pay special attention to lifelong learning (Lifelong Learning Program 2007-2013). The European economy has now facing two major challenges. First, there is need to the citizens of Europe be better prepared to enter the labor market in order to reduce unemployment. Second, companies need a qualified workforce that can tackle the rapid scientific and technological changes in conditions of constantly growing competition. To cope with these challenges, the European Commission has established program Leonardo da Vinci as a laboratory of innovation in the field of lifelong learning. The first phase of program was taking place between 1995th up 1999th year with a total budget 620 million ECU. By adopting this program was rationalization of European action in the area of professional training through initiatives such as COMETT (Community Program in Education and Training for Technology) program for collaboration between the universities and companies in order to achieve training related to innovation and the development and application of new technologies; PETRA is the action program for professional training of young people and preparing them for life and work; FORCE whose mission is to support and supplement the action member states of the EU in the field of continuous professional development; LINGUA is the action program to improve the teaching and learning of foreign languages in the EU and EUROTECNET is the action program for the promotion of innovation in professional training incurred as a result of technological change.

The set goals:
- Improving the skills and competencies of people, especially young people, through initial training at all levels,
- Continuous improvement of the quality of professional training and lifelong acquisition of skills and abilities in order to develop flexibility, especially in conditions of technological and organizational changes
- Promoting and strengthening the contribution of training innovation process, with aim of improving competitiveness and entrepreneurship.

As in case of a program Leonardo da Vinci, Socrates is Europe's program for education which aims at promoting a European dimension and improving the quality of education by encouraging cooperation between the participating countries. Special attention is directed to the lifelong education, which should:
- enable easier adjustment of workers to permanent change and extend job opportunities,
- Provides individuals possibility to gain the required qualifications, social skills and satisfy personal needs,
- enable introduction of other cultures.

Socrates supports all forms of learning, both formal and informal, at all levels, from kindergarten to university.

Comenius action program is oriented towards early stages of education, from pre-school to high school level, and appeals to all members of the education community: pupils, teachers, other educators, parents' associations, non-governmental organizations and so on. The goal of the program is to improve the quality of education, strengthen the European dimension and promote language learning and mobility. Special emphasis is placed on the following issues: learning in a multicultural environment, support for people with disabilities and preventing school failure and educational segregation.

Erasmus has an action program with higher education. It encourages international collaboration of universities, supporting the concept of mobility and improving the transparency and full recognition of studies and qualifications acquired in EU countries. Pupil / student has opportunity to study this program at an educational institution, some of the participating countries for a period between 3 and 12 months, provided that both institutions implementing European credit transfer system (ECTS), which facilitates the recognition of studies of other university. Regarding teachers, this program enables exchange of teacher's common preparation curricula, common preparation of intensive summer courses and the establishment of thematic networks.

Grundtvig program is oriented towards improvement of European dimension of lifelong learning and through their actions allows adults to: improve their skills in order to assume full and active role in society, improve their employability by acquiring or upgrading their skills and to increase their prospect to access or re-enter into the process of formal education. These goals Grundtvig tried to accomplish through four types of activities:

- Projects of international cooperation in the areas of adult education (accreditation and evaluation of skills acquired through non-formal education, the development of new teaching methods and materials, mobility, development of new training modules ...)

- Partnership projects in the areas of adult education related to closer cooperation at the local level between pupils / students and teachers from different countries (conferences, exhibitions, exchange of ideas, experiences and methods ...)

- Scholarships for the training of education personnel who wants to keep training adult in some other country (may be included not only teachers, but also managers, administrative staff, consultants ...) and

- Grundtvig networks with the task to enhance connections between the various participants in adult education that takes place through thematic networks dealing with key issues and network projects that bring together institutions involved in the common project.

Jean Monnet Program stimulates explore on European integration in higher educational institutions around the world. The project is being conducted in five continents and reaches up to 25,000 pupils / students each year.

Erasmus Mundus (2009-2013) [189] - This is a cooperation and mobility program in the field of higher education. It aims to enhance quality in European higher education and to promote intercultural understanding through cooperation with countries outside the European Union. Tasks within the Erasmus Mundus program: promoting quality offerings in higher education with a European added value, attractive both within the European Union and beyond its borders, to encourage and enable highly rated school and university students from around the world gain a qualification or experience in the European Union, the development of more structured cooperation between European Union and institutions from the outside as

well as higher output from the European Union mobility and advance accessibility and improve the profile and visibility of higher education in the European Union.

These goals Erasmus Mundus trying to accomplish through four specific actions:

1. Postgraduate studies, which is a central component around which Erasmus Mundus was built. It is a high quality integrated postgraduate studies offered by a consortium of at least three universities in at least three different countries.

2. Scholarships which are designed in order to Erasmus Mundus postgraduate studies be more affordable in manners that are awarded to pupils / students from around the world.

3. Partnership with countries outside the European Union in the implementation of Erasmus Mundus postgraduate studies, which would encourage universities from European Union be opened to the world. This partnership increases output mobility of pupils / students who graduated in the European Union.

4. Increasing the attractiveness through support activities that enhance the image, visibility and accessibility of European higher education and key issues related to the internationalization of higher education, such as the mutual recognition of qualifications from countries outside the European Union. It is very important that all Serbian universities are in this program.

eContentplus [187] - for the first time during the period 2005-2008, this four-year program aimed to promote the use of modern technical solutions to improve access and use of digital material in a multilingual environment. By June of 2010 was opened invitation for the continuation of this program. eContentplus is facing three main areas:

In the field of geographic information stimulates the aggregation of existing national data sets in regional data sets that will have the task to support new information services and products.

In the field of educational facilities program supports the construction of appropriate information infrastructure and encourage the use of open standards-and to stimulate effective deployment of pan-European service learning.

Finally, in content areas of culture, science and academic information content eContentplus will support the development of interoperable collections and objects of cultural institutions (archives, libraries, museums ...), as well as solutions that will facilitate the presentation, discovery, and search of these resources.

Digital Libraries - electronic library, virtual library, hybrid library, library with no walls, the universal library - this is the number of new terms that have appeared in the last decade. At the initiative of the six heads of state and government of the European Union, the Commission in 2005th year adopted a plan to create a virtual European library under the auspices of the project "I 2010". Building a digital library would contribute to European records of culture and science to be widely available. The content of the digital library would be made of the information that was originally created in digital format as the process of digitization of content that exists in the form of documents or in another form. The three main areas of activity in establishing a European digital library are: interactive accessibility, a precondition for maximizing the benefits that citizens, researchers and companies can draw from information digitization of analogue collections for their wider use in the information society, preservation and storage that will ensure that future generations can access the digital materials and prevent valuable content to be lost . The most important international projects related to the development of digital collections and library are the following: The European Union - a project of The European Library (TEL - The European Library), UNESCO - Memory of the World project (The Memory of the

World), G7/CDNL - Bibliotheca Universalist project. Whether it is world digital library dream of modern man, or that it has become part of virtual reality in the near future, we will not be able to circumvent the issues related to building digital collections, if at all we want or we intend to be part of the new digital age and the modern information society. If we do not start the project of digitizing documents and creating digital collections it will be definitely run by someone else in our environment. Simply, the digital library has become imperative for the development of the modern library. Today, in the developed world there is no a traditional library that a large part their information, technical, financial and human resources is not directed towards the development of digital collections. To become a part of this future world of universal digital library, it is necessary to build a national level strategy of development of digital libraries. The national development strategy involves precise determination of the following elements: the objectives of digitization principles of digital collections, selection criteria, the model of access to digital collections, digital collections management, harmonization of standards at the international level, the protection of original documents, marketing and promotion of digitization, coordination and cooperation at the local, regional, national and international levels, as well as faster integration into international projects.

Library consortium of Serbia (KoBSON) is a new form of organization libraries of Serbia. The initiative for the establishment of the Consortium was launched in November 2,001th. On every continent there are organizations and universities that offer distance learning. Most of them require membership (password), and some of them are available to everyone.

California Virtual University (USA) [198] - has created a virtual university with the possibility of attending the course over the Internet. On the site can be found basic things related to courses, programs and degrees for Distant Learning in a virtual basis. Website provides the most important information from the California College or university, course-related, costs, objectives and course credits. University of California is very flexible in terms of inclusion of courses by some colleges in California. Virtual courses are very popular, especially in the fields of economy; education is designed to create a 24-hour, seven-day education to anyone, anytime and anywhere. Education is available at the workplace or at home, according to schedule of individual users.

Athabasca University (Canada) [199] - Canada's top university for distance education. Also known as a center of excellence for teaching, applicable research and learning. AU provides high quality graduate pupil / students who are wanted all over the country and the world. They offer courses that provide "on-line" and "continuing education" (lifelong learning). The courses provide a high quality of instruction that is provided to pupils / students across the state. Instructions, courses, discussions, take place in a virtual classroom in the Internet network. Athabasca University is nationally and internationally recognized as a leader of distance education.

The University of Sydney [200], Open Universities [201], Australian College [202] Deakin University [203], (Australia) - are just some of the colleges that offer distance learning programs (electronic forms of communication, such as room chat, email, video conferencing, interactive learning activities, online resources, such as Web links, e-journals). Australia is one of the first countries to develop distance learning, and today one of the leading in the world in this field. Given the fact to have a small population on a large area, and aims to offer equal opportunities for all users, Australia is developing distance learning and new technologies.

The Open University of Japan (Center of ICT and Distance Education) [204] - (formerly the University of the Air) was founded in 1983th, to provide higher education at a distance. It promotes lifelong learning, gives opportunities to acquire academic degrees and experience to pupils / students, by distance learning.

CARNet (Croatian Academic and Research Network) [205] - Develops advanced information and communication infrastructure for the academic and research community, including a quick and secure network, a variety of facilities and services. It promotes higher education, work and life of pupils / students, teachers and scientists using information and communication technology, learning about its capabilities and helping in its use. Specifically promotes the dissemination of knowledge and content available through the network. Cooperate with international organizations and academic and research networks. CARNet activities are primarily oriented to academic and research community. The role of the academic and research community in any society is the creation, implementation and use of new technologies.

That is why the academic and research community must first have access to the best and the most advanced information technology and infrastructure.

National University of Distance Education (The Universidad Nacional de Educación a Distancia (UNED), Spain) [206] - is the only public Spanish university for distance learning, founded in Madrid. It is the largest university in Spain, with more than 180,000 pupils / students. UNED was founded in 1972 following the idea of the UK and the Open University. Assigns same qualifications as other Spanish universities, using different methodologies, applies the latest teaching technology, and has a wide social impact of radio and television programs. UNED mission is to present itself as a center of excellence throughout the world. UNED currently has 60 study centers in Spain and 20 abroad, thanks to the cooperation of local institutions. These centers provide face-to-face sessions with teachers once a week. During the last ten year are working intensively on developing and improving teaching materials, teaching methods and forms of work in order to achieve better and more efficient teaching process.

The European Union 2004th launched the e-Learning program, which includes the objectives of the European Union in educational field and encourages open and distance learning, the application of information and communication techniques in teaching and cooperation of educational institutions. In its strategic policy, the European Union is an e-learning ranked among the basic objectives which will contribute important changes not only in education but also in the economic and cultural life in general.

Worldwide are increasing the number of technical schools in the education of students who use Internet technologies to improve traditional education. The trend to develop the implementation of multimedia in traditional teaching mechanical objects on tertiary level should rise as the computer provides great opportunities for visualization of complex mechanical systems. MIT (Massachusetts Institute of Technology [208]) offers over 1900 online courses in various fields - Architecture, Engineering, Medicine, Social Sciences, and Management. MIT Open Courseware (OCW) is a web-based course with almost all published content at the university, accessible worldwide. Students of the Department of Mechanical Engineering in the course Product design and development (Figure 3.1) are offer traditional lectures and seminars combined with Internet-based learning platform. Through the Internet are available courses of practical training, examination and communication forums. Results of on-line evaluation of this method have shown that pupils / students accept this way of learning and give themselves ideas for further improvement of

education. In small group seminars pupil / student is given the option to self-select the manner in which attend courses. It is important to mention that the didactic courses offered in well-designed educational platform are gladly accepted and highly valued by pupils / students.

Figure 3.1 MIT OpenCourseWare - Course Product design and development

3.1.1.   Experience of Romania (UPT) - The Study

In UK this study looked at seven level one computing students attempting a group project for the course *Introduction to Web Design*. We established a course community (blog, wiki and a resource sharing area) on Community@brigton, and students and the tutor shared IDs for MSN and Skype. The Community tools were available for all the 146 students who took part in the course. The communication tools were restricted to the study group (see figure 3.2.), (Andone et all, 2007).
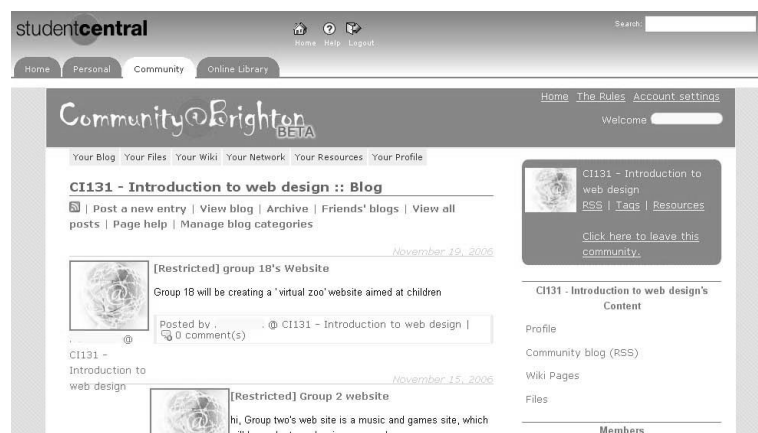
Figure 3.2. The CI131 Community Blog in community@brighton

The Community area was very active. The blog proved a popular place for students to ask questions (which the tutor or other colleagues answered), and to share thoughts and reflections over the course subject and their work in the project. Over 40% of students took part in the blog discussions and 6 other students' established independent blogs for the same subject, restricting access to this community alone. In Romania the study involved 36 students from the distance education specialization Multimedia Technologies. We established a course blog, wiki and a resource sharing area (figure 3.3.) and students and the tutor shared IDs for IM and Skype. The Community tools were available for all the 36 students who took part in the course. The blog and the wiki was very active used by about 90% of the students and 21 students contacted the tutor regularly (2-3 times a week) by using IM or Skype.
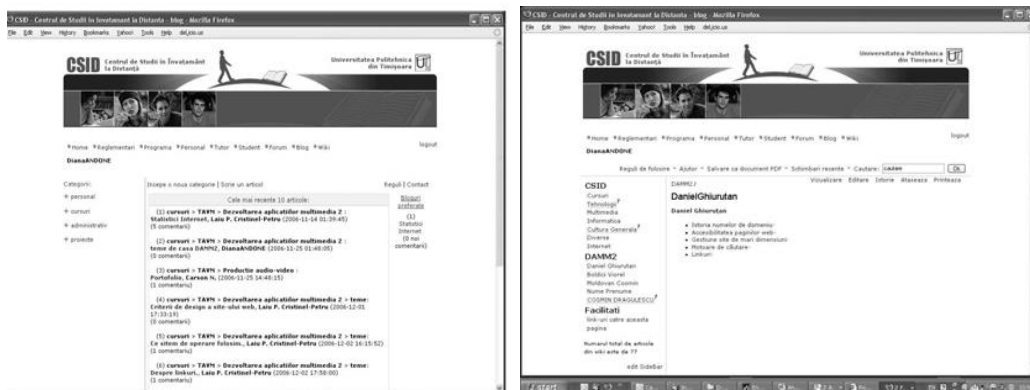
Figure 3.3 The Blog and wiki in CSID-UPT

3.2. National experiences, concepts and trends of distance learning

IT education system in Serbia is lagging behind in alignment with the needs of employers. Formally educated people are not flexible enough. This situation does not lead to an increase in the competitiveness of our country's young employees. Employers are not satisfied with the knowledge and skills that workers acquire through formal schooling. Many of them are left to themselves, and their capacity for self-education. Local communities and their respective faculties must be allies of their graduates pupils / students and help them find their way to employment and finding new information and knowledge that they need in for their profession. The concept of professional continuous education is the approach that should serve as a prevention of a wrong choice of schools and professions. On the other hand, the traditionalist approach to teaching as a way of learning traditional approach at this level has weaknesses and deficiencies, especially because of the insufficient amount of time young people. For this reason, searching for a solution to online learning where would students themselves elect an area they want to learn, select out areas of interest and new skills and immediately apply them at work, or in some other form of engagement. From the experiences of countries in the region many of students claim to learn more online courses than in traditional workshops.
The arguments for that are:
- Expressed visualization - clearly written texts, many diagrams, use of flash animation and short films.

- Active learning - the student must be focused on what he has learned, because he is not allowed to progress until he exactly answers the question. All participants must be equally active.
- Individualistic approach to learning - Is It Necessary to adjust teaching a wide range of students of different learning styles, initial knowledge and their abilities, as well as self-paced work.

In short, in online education can be selected: what you want to learn where and when you want to learn. The biggest problem is most common in the absence of institutional vision and definition of guidelines for the use of new technologies in the classroom. Also evident is the lack of adequate technical and professional support to teachers. E-learning is a slightly different form of education, which often gives the student more freedom than traditional way of education. Unlike traditional workshops "face to face", where most of students are passive and receives information from the teachers, e-learning requires interactivity of participants throughout the course. In this region, distance education did not develop in the way and intensity as those in other areas. Western countries, for example in the framework of their education systems have developed various types and forms of education, including distance education, in accordance with its economy, culture, geographical conditions and others. In highly populated countries such as Australia, Great Britain, Brazil, the tradition of distance education is a very popular, safe and long mainly because of geographical factors. In Southeastern Europe the development of such programs are not encouraged because of influence of the existing ideology. There were no alternative forms of education, nor encouraged alternative forms of anything. Distance learning and open learning are exactly as, non-standard and informal forms of education. It is an approach to education, where the emphasis is not on the form but the content and where it is important to increase the coverage while not neglect quality. In our country such educational forms are often understood as an additional form of learning and not as an additional value of the existing education system. An important question is whether there is an interest, motivation and willingness to learn something new and find out in this way, with the intermediation of information and communication technologies. According to the requirements of Europe, in the spirit of Bologna concept, action programs of education reform in our country should include: [30] the release of unnecessary and obsolete programs and the setting up of new contents; better composing teaching materials; nurturing interdisciplinary in teaching material, so-called. small objects with other disciplines, the introduction of new forms of teaching (e-learning, practice-oriented teaching, teamwork, group projects, etc.); modularization teaching, improving teaching materials in the direction of practice requirements, with new ways of promoting the development of science and research practices; new forms of testing student; new methods when selecting student guidance and counseling-student; improvements in monitoring student progress during the work (mentors, tutors, etc..), quality assurance through accreditation and evaluation methods, organizing frequent visits of foreign delegations, especially the so-called. University reference, in order to face the competition and the need to speed the release of some illusion, looking at the necessary investments in the modernization of the education and research processes, improving education based on information technology and new media, establishing basic norms and standards for equipping schools with multimedia classrooms. When discussing about the transition in education, we are on a path between traditional schools and what kind of school need students, teachers, local communities and society as a whole, the school that must quickly adapt to the dramatic social changes, to respond to these

changes and be adaptable. So, in our country, education is still associated with traditional teaching and learning model in distance does not have enough use and is treated only as an additional service to help students. Unfortunately, the use of these solutions in conditions in our country is limited by a number of factors starting with: high package price, necessity a high level of computer education, the teachers and pupils / students to speak English, requirements for a good information and communication infrastructure. Draft of the new strategy for the modernization of professional education in Serbia was enacted in February 2005th in cooperation with the Ministry of Education and 25 other competent institutions with the aim of "making education more attractive and accessible to respond to the needs of labor market, as the foundation for lifelong learning and continuous improvement, to be flexible when it comes to assessing, evaluating and connecting the formal and informal professional education and training system, to be effective, and to all participants provide further education that is based on the cooperation of all relevant stakeholders - the government, through the social partners to parents, to be rationally and use optimally available resources and to be functional - simply phrased in terms of the organizational structure and responsibilities for implementation. "In the selection tools, e-learning software solutions, our country should take care of following factors: the price of tools, localized versions in Serbian language, simple set of educational materials on the Internet, a simple interface that will allow easy system use by the participants, a software solution to be "open source" flexible solution, verified software with quality list, for example the reference organizations and universities. The goal of achieving National Education Strategy in Serbia since 2005 to 2010th year was the rapid integration education in modern European educational area. Below are shown some of our faculties which in its programs offer the possibility of distance education. Web Laboratory Mechanical Faculty in Kragujevac - To ensure effective use and development of laboratory support for teaching and research are organized web pages that need to be able to document laboratory capacity of the Faculty in Kragujevac (Figure 3.4).

Figure 3.4 Web Lab, University of Kragujevac

In certain situations it is provided exchange of experimental data or access to laboratory resources via the Internet. Most often we are confronted with the situation that the cost of laboratory models is too high to be provided 8 or 20 workplaces with the same laboratory model. Hence, the laboratory conducts demonstration lessons after which the computer classrooms pupil / student book their time exploitation of laboratory models on the Internet and actively spend time in the classroom in analyzing, preparing, discussion and documentation of results and implementing experiment. Also, it is possible monitoring implementation of experiment and by other students as well as communication with them. If access to the laboratory exercises provided via the Internet, students and interested researchers can access laboratory exercises from anywhere at any time. The advantage is documented portal that is constantly being improved (descriptions of the experimental system, the objectives and requirements of possible exercises, tutorials, illustrative examples of the results, the bench mark tests, student and other works, etc..). Objective is networking laboratory resources and enabling their use by authorized user group for research, academic and professional training and permanent education. To laboratory resources that are not enabled Internet accesses; it is important documenting, sharing results and relevant teaching and other materials, as well as the idea about the construction and improvement of overall laboratory resources.

The Faculty of Mechanical Engineering in Kragujevac use e-learning in form of a lesson where students can access it with a certain password (see Figure 3.5). The University has several lessons of technical drawing with computer graphics in the form of Power Point presentations and it is available through the portal for e-learning. These lessons can also visit other college students, because they are not protected by a special code.
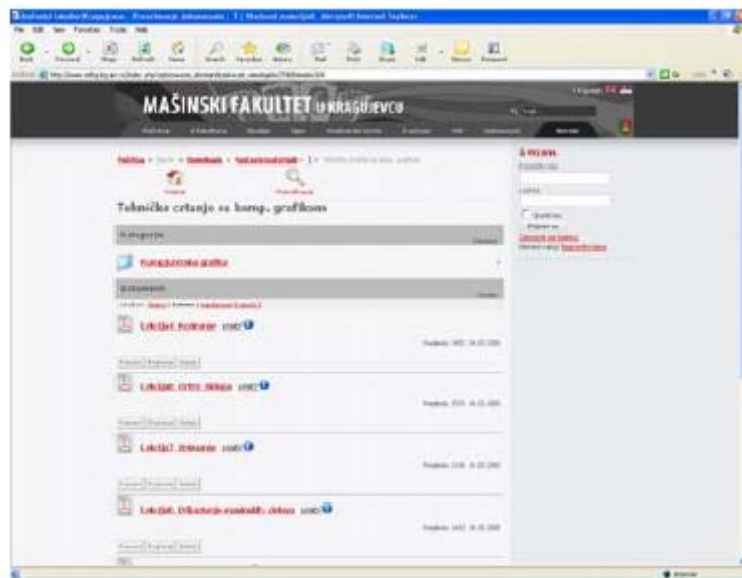
Figure 3.5 Appearance of e-portal Faculty of Mechanical Engineering

Faculty of Mechanical Engineering in Belgrade contributes to e-learning in Serbia and all the objects that are accessed are password protected, and there are few subjects that have been created in each Cathedra (Figure 3.6).
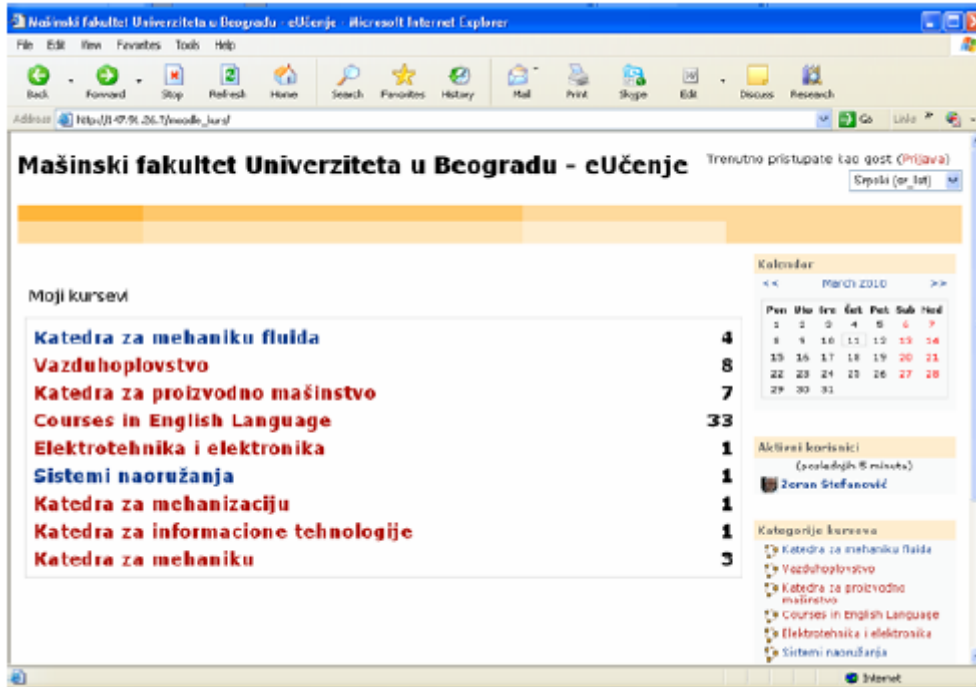
Figure 3.6 Faculty of Mechanical Engineering in Belgrade - eLearning

Within the realization of WUS MSDP project "Master in Remote Control" at Technical Faculty in Cacak (University of Kragujevac [225]) 20.10.2009 vacancy has been advertised for enrollment first generation students to the new program of study: Postgraduate studies of Electrical & Computer Engineering - Master for remote control, in the E-Lab (see Figure 3.7). E-Lab is a hypermedia laboratory with environment specifically adjusted for different types of advanced electronic communications. The laboratory is equipped with most modern video conferencing system, exclusive computer and communications equipment and possesses an outstanding ergonomic design. E-Lab was established within the EU TEMPUS JEP project "M.Sc. Curriculum in E-Learning", with significant support from the Faculty of Engineering. One of the primary purposes of this lab is to provide logistical and technological environment for teaching online and via a videoconferencing system. In this sense, E-lab conduct system for e-learning, based on Moodle environment. Videoconferencing in the E-lab will be used to and other activities of the Faculty that will be performed at a distance: lectures, presentations, experiments and meetings with partner universities in the country and abroad and to work on joint projects. E-lab has a capacity for business solutions, such as business meetings, presentations, corporate training, etc.

Figure 3.7 E-Lab Technical Faculty in Čačak

FIT E-Learning System - Faculty of Information Technology in Belgrade [173] is an independent academic institution that offers education directed towards a career in five basic programs and two programs of academic study. FIT introduces modern technical concepts and provides students with a quality practice in areas such as information technology, operations management, marketing, and graphic design. Faculty of Information Technology was the first in the country to receive permit from the Ministry of Education which includes implementation of distance learning - through the Internet, thanks to the latest technologies which applies. In this short time, especially in collaboration with lecturers from the "New York Institute of Technology's" in the IT program, they have managed to achieve a unique program of advanced academic and professional study (Figure 3.8). Currently the FIT program in distance learning is studying more than 500 students from all over the world: Greece, Austria, Spain, Germany, the United States, Mexico, and the United Arab Emirates. Pursuant to the Law on Higher Education diploma from the Internet is equal to the diploma from traditional teaching, both in terms of acquired knowledge and in the métiers. Students are available 24 hours multimedia lectures and exercises, literature in digital format and teaching materials for exam preparation, which allows successful studies to all who work and are unable to physically attend classes on a daily basis. Our teachers are available to students by means of video conference so the absence of physical presence does not exclude the live communication with teachers.

Figure 3.8 Home Page eLearning system

Vocational colleges of Information Technology ITS [174] - for students who prefer studying from home, whether they are physically distant from Belgrade, or are unable to attend school regularly because of work and other commitments, ITS implemented e-learning as a student package of assistance for study or exam preparation (Figure 3.9).

Figure 3.9 Website Vocational Colleges of ITS Information Technology

Technical Faculty "Mihajlo Pupin" Zrenjanin - Develops dLearn system that provides distance education. Pupils / students and teachers is enabled quick and easy access to the content system, which increases the efficiency and quality of the educational process. Teachers are able to successfully perform the activities necessary for the implementation of distance education: preparing the course content using the Internet, course design, creation and installation of educational content, monitoring and consultation with pupils / students, assessment of pupils / students. Pupils / students are able to: access to courses, access to educational facilities, access to various resources on the Internet (digital libraries, online journals, etc.)., Communicating with their teachers and other pupils / students (various synchronous and asynchronous forms of communication), testing, and monitoring progress in acquisition of knowledge, as well as exams(Figure 3.10).

Figure 3.10 System for distance learning TF "Mihajlo Pupin" Zrenjanin

Centre for development and application of science, technology and computer science, Novi Sad (Figure 3.11).

Figure 3.11

Centre is developing a system for the management and education of school classes and teaching through e-learning in emergency situations. Often emergency situation (A1H1 influenza pandemic, earthquake, freezing, blizzard, fuel shortages, damages, district heating, flood, interruption of transportation, accidents, etc.) lead to the interruption educational process in schools. The loss of teaching can be reduced or mitigated by using appropriate organizational and technical solutions. Timely preparation of school emergency teaching can be performed using distance learning. Therefore, we give priority to the professional development of educational institutions through a program that is accredited under the title:
"Managing school class and teaching through e-learning in emergency situations."
In the new catalog of accredited program of Ministry of Education for the school year 20011/2012 there is a inscription of this program and is located on 370 catalog page of accredited programs (No. 694/2011), mandatory seminar.
It applies a modular program with the following topics:
Topic 1: Use of system for distance learning. Introducing students to the basic elements of one of the free system for distant learning (ATutor / Moodle), depending on their preferences and needs. Introducing participants to the possible types of content for mentioned systems which are supported by system of distant learning. Creating a course, adding users and content, selection and monitoring activities. Each student is placed in the role of the author, and made materials will be presented to other colleagues. Administration and communication systems for distance learning. Organization of materials, a division of students into groups and specificity of group work. Practical work - workshop.
Theme 2: Development of electronic tests: Mastering programs for producing electronic tests. The integration of multimedia content to tests. Test planning, test creation, rules for making electronic test, integration of multimedia, time intervals, uniting the whole lesson content and applications. Software for electronic quizzes and tests for the purpose of teaching the system for distance learning. Practical work - workshop.
Topic 3: Creating content for use on systems for distance learning by SCORM standard: Creation of materials that covers a teaching unit and satisfies SCORM standard. Basics SCORM standard. Introduction to programming for the creation of electronic teaching materials in accordance with the SCORM standard. Processes are typical representatives of Authorware courseware and software. Tools for offline preparation materials for online lessons. Uploading made lessons of distance learning system. Development of learning materials directly to the system for distance learning respecting SCORM standard. Practical work - workshop.

The program of activities is adjusted to previous level of skills that teachers have mastered in their studies and professional development during their teaching practice.

Target audience:

The target groups of this program are teachers / class teachers, teachers / professors of subject teacher - elementary school teachers teaching the subject - high school teacher's subject teacher - secondary vocational schools, teachers / professors in schools for students with disabilities, principals / assistant Director.

Institutions supporting the project of the education program are:

- Centre for Development and Application of Science, Technology and Informatics (CNTI) and
- Union of informatics in Vojvodina.

Program is being implemented in the duration of 8 hours per subject, a total of 24 hours in three days.

Number of participants: 25

Teacher competences are capacity of an individual who is recognized in the performance of complex activities in the educational work. Competencies are a set of necessary knowledge, skills, attitudes and other valuable of teachers. Central role in promoting education have teachers, because they have a direct impact on student learning and development of their personalities.

Teacher competences are defined in terms of objectives and learning outcomes and should ensure professional standards about what kind of teaching is considered successful.

They relate to the competence of:

-Teaching area, subject matter and methods of teaching;
-Teaching and learning;
-Support to development of students;
-Communication and collaboration.

System Law on Education stipulates measures for improving the quality of teaching; the goals are set and the overall outcomes in line with the vision of education as the basis of "knowledge society". In the objectives and outcomes of education for students emphasis was placed on competences and the development of specific knowledge and skills for life in a modern society.

Therefore, the role of teachers is multifaceted, as they should:

- Develop key competencies among students which educating them to live and workand so they provide a basis for further study;
- Provide additional support to students from vulnerable social groups and talented students and students with disabilities in order for them to meet educational needs and educational potential in accordance with their capabilities;
- In order to contribute to efficiency and equal rights and access to education for all students, teacher should have a competences relating to the prevention of violence in schools, motivating students for learning, tolerance, combating discrimination and more.

This project presents guidance to employees and institutions and should be the mainstay for:

- Self-assessment and personal orientation of teachers in planning their own professional development;
- Create a plan for training at educational institutions, and

- Improving the practice of professional development for teachers of initial teacher education, introduction to work, licensing, vocational training, occupational promotion, monitoring and evaluation of teachers, as well as defining national priorities.

The teacher should:
- knows system of education, the principles and objectives, outcomes and standards of education;
- Knows and applies legislation in education, policy documents and relevant international documents;
- Understand the social context of education and schools and to actively contribute the multicultural and inclusive approach to education;
- To contribute sustainable development and encourage healthy lifestyles;
- To express themselves verbally and in writing in accordance with the rules of the Serbian language and the language in which classes are held, then to work on enriching their linguistic culture and language skills in students;
- Applies Information and Communication Technologies;
- Harmonize its practices with innovations in education;
- In his professional activity analyzer, estimates make changes and improvements, using information that receives by self-evaluation and external evaluation;
- Respect the universal human and national values and encourages students to adopt them, supporting mutual understanding and respect, tolerance, respecting differences, collaboration and socializing;
-To act with personal example on the formation of values and the development of positive characteristics of students;
-Understand the importance of lifelong learning, continuous professional development, innovate and improve its work; know at least one foreign language.

Competence in teaching field, subject and teacher training
Knowledge:
-The teacher should be familiar with a discipline which is the subject who teach and its links with other scientific disciplines;
- He knows the subject area and appropriate curriculum subjects, also to know its correlation with other areas and subjects;
- He knows the general principles, objectives and outcomes of education, as well as general and specific standards for student achievement and their interconnections;
- Understand social relevance of subject content;
- has a didactic-methodological knowledge required for the subject who teaches;
- knows the technologies which follow and the scientific discipline the subject who teaches;
- Knowledge of foreign languages in the function of instructional subjects.
- Preparedness
- The program of work prepared to acknowledges: the standard of achievement, syllabus and individual student differences, safeguarding the content and timing of compliance;
- Planning and programming work, making sure that the content is available to students (receptive, understandable, interesting);
- Planning the use of different methods, techniques and forms of work and teaching resources available for the efficiency and effectiveness of the teaching process;
- Plan and programming content of teaching and taking care of correlation, both horizontal as well as vertical;

- Planning information on new trends and applying appropriate and affordable technologies in education;
- Verification of achievement of planned prescribed educational standards and learning objectives teaching subject.
- Implementation
-Generates functional, educational and behavioral objectives in accordance with the general principles, objectives and outcomes of education, by curriculum objects that teaches, adapting them to the individual characteristics and abilities of students;
- Systematically introduces students to the scientific discipline;
- Connects lesson content to prior knowledge and experiences of students and their current and future needs, with examples from everyday life with facilities in other areas, with current developments / scientific papers;
-Connect and organize teaching contents of one or more subjects in thematic units;
-Applies various methodological approaches consistent with the objectives, outcomes and standards of achievement, content of teaching subject and age characteristics of individual abilities and needs of students;
-Applies appropriate and available technology in education.
-Evaluation
-Continuously monitor and evaluate the achieved horizontal and vertical integration will;
-Continuously monitors and evaluates student achievement using a variety of valuation methods in accordance with the specific subjects they teach;
-Monitor and evaluate students' interest in the subject they teach;
-Plan and take measures of support to the students, based on the analysis of the achievement educational standards of achievement.
-Improvement
Continuously improve professionally in the field of scientific discipline which belongs subject, teaching methods and educational technology;
-Improves its quality by applying new knowledge in the field in which he specialized;
-Planning training based on the results of self-evaluation and external evaluation of the work and needs of the school where he works.

Competencies for teaching and learning
Knowledge:
- Possess knowledge about cognitive development of students (cognitive levels and the zone of proximal development);
- Possess knowledge of about the nature learning different learning styles and learning strategies;
-have knowledge in formation of scientific concepts.
-Planning
-plans activities starting from the knowledge and experiences that students have, individual characteristics and needs of students, the objectives, outcomes, content and characteristics the context in which he works;
-Planning activities that develop science concepts among students;
-Planning enhancing critical, analytical and divergent thinking;
-Plan different ways of monitoring and evaluating the performance and progress of students.
Implementation teacher's activities:
-Applies different forms of work and activities in accordance with the experience and knowledge that students have, individual characteristics and needs of students, goals, outcomes, content and characteristics of the context in which they operate;

-Encourages and supports different learning styles and helps students develop learning strategies;
-Continually promote the development and application of different thinking skills (problem identification, problem solving, decision making) and forms of thinking (critical, analytical and divergent);
-Supports students to feel free to express their ideas, ask questions, discuss and comment in connection with the subject of learning;
-Gives clear instructions to all students and pointers to knowledge transfer;
-Monitors and evaluates student achievement, applying, objective, public, continuous and supportive evaluation, giving a full and comprehensive feedback to students about their work.
Valuation / evaluation:
-Monitors and evaluates various aspects of learning and progress, using a variety of evaluation techniques;
-Monitor and evaluate effectiveness of their methods based on student achievement;
-Monitors and evaluates student performance according to individual students' abilities, using established evaluation criteria;
-Monitor and evaluate the implementation of tools for monitoring and analyzing the work related to students' progress;
-Continuously monitors and evaluates student achievement using the evaluation procedures used in the function of further learning;
-Assesses the needs for additional support to students in learning.
Improvement of teachers:
-Continuously improvement of their own pedagogical practices based on the analysis of student achievement;
-Enhances their work, using the knowledge acquired in the field of cognitive training, educational psychology, modern didactics and Methodic.

Competencies for supporting the development of students
Knowledge:
He knows and understands physical, emotional, social, and cultural differences between students;
-Knows and understands the psychological, emotional and social development of students;
-Possess knowledge on how to support students from vulnerable social groups;
-Knows different types of motivation and how to motivate students;
-Can recognize, mobilize and encourage the development of the capacities of all students while respecting individuality.
Planning:
-Planning various activities to engage all students, respecting their individual differences in social and emotional development;
-Plans and coordinates its work with the mental and physical and developmental characteristics of students, accepting students as person in developing;
-Planning methods and procedures to encourage self-confidence and self-esteem of students:
-Planning interaction of all participants in the educational work, based on respect for diversity and appreciation of exigency;
-Planning various activities that encourage creativity and initiative of students.
Implementation teacher's activities:

-Includes students in various activities, respecting their individual differences and principles of psychological development;
-Applies constructive actions in solving development problems, as well as in situations of crisis and conflict;
-Provides opportunities and environment for activities, interests and requisite of the students respecting their attitudes and opinions;
-Encourages self-confidence, self-esteem and raise the level of aspirations of all students;
-Use different methods to motivate students.
Valuation\ evaluation:
-Uses various strategies of monitoring the development of various aspects of students (collaboration with other students, conflict resolution, response to failure);
-Evaluates their own work by analyzing and monitoring motivation, job satisfaction, and student activities in class, their independence and perseverance in work.
Advanced training:
-Planning professional development based on analysis of the relationship in the classroom, students' motivation for learning and performance of students;
-Expand their knowledge in the field of psycho-physical, and social development of children and motivation;
-Actively works to improve their relations with students;
- Develop pedagogical skills to manage school class.

Competence in communication and collaboration
Knowledge:
-Understand the importance of cooperation with parents / guardians and other partners in educational work;
-It has information about available resources that can support educational activities (school, family, in the local and wider community);
-Knows forms and contents of cooperation with different partners;
-It has knowledge of techniques for successful communication.
Planning:
-Plans systematic cooperation with parents / guardians and other partners in educational work, based on the analysis of potential network partners and available resources;
- Plans motivating various forms of cooperation;
-Invents situations and activities that provide an opportunity for application of communication skills.
Partners in pedagogical work are: students, parents / guardians, colleagues, local and broader community that is important for educational work.
Implementation teacher's activities:
-Cooperates with partners, promote the exchange of opinions and builds an atmosphere of mutual trust in joint work in the interests of students;
-Actively and constructively participate in school life;
-Inform and consult parents / guardians and encourages them to be actively involved in the school work;
-Considers and respect partner initiatives related to the improvement of the school;
-Through cooperation stimulates the development of social skills;
-Actively participate in work teams.
Valuation / evaluation:
-Analyzes and evaluates own capacity for cooperation;
-Evaluates cooperation with partners based on analysis the achieved results;

-Continuously report about partners achieved results of cooperation.
Advanced training:
-Planning training based on analysis of successful cooperation with all partners;
-Advancing in the field of cooperation and communication skills;
-Educate them for teamwork;
-Actively working to improve its relationship with all stakeholders in the educational work.

It should be emphasized that in Serbia there is a desire and will for introduction of distance learning in schools. The above college can be an example for other colleges and schools for the introduction of distance learning. The application of science and technology in the field of information technology with the development of telecommunications information systems, will have its full justification only if are studied principles, guidelines and methods for their implementation in the educational process of Serbia. Serbia needs to accept and implement in its educational system a new way of education, which is the distance learning using Internet technology. Education must keep up with global innovation trends by educating new professionals who are trained to work independently, to select and find information, their data processing and their use. Serbia as a part of Europe and part of the world must not remain isolated. What started in the world in the field of education and the development and promotion of education, should not be stopped, but to be accepted and to fully contribute reform of our educational system. Colleges and the Center for Development and Application of Science, Technology and Informatics, Novi Sad should be the main base of the development of the e-learning.

3.3. MODELS AND MODELING

3.3.1.   Concept

The term model is derived from Latin word "modulus" meaning measure or form. Concept models is based on an analogy or identity between two objects that can be expected to determine similarity in terms of taking any possibly, and that there is a relation between them and original models (Lerner, 1975). General concept of models by modifying the scope and content and specifies the subject of theoretical and (or) the practical field in which it is used. In terms of methodology model represents description of a real or imaginary system that is built to explain and predict the behavior of the system or its elements in different conditions.
"Every model is a theoretical, conceptual case study which helps in exploring base subject." The validity of models is assessed according to the criteria of its applicability, and in this sense the model is applicable if they posses common features with the modeled object, if it is applicable to a wider area, and if the predictions are valid for the original model. Convenient model is the one that most consistently act like an original (real system) in the same circumstances. "The models are: synthetic abstraction of reality and can be simple (physical model airplane in a wind tunnel), and very complex mathematical models (optimization and simulation models of strategic defense system, planning of complex structures, systems and processes)." (Sotirović - Adamović, 2002). The cognitive model value is based on the fact that it is rarely necessary to know everything about a phenomenon, but only those variables that are relevant for a given level of abstraction in the analysis of given phenomenon. About they may be judged indirectly by creating certain assumptions (hypotheses) that are then reviewed,

specified and perfected. Structure representation of the process obtained from such a procedure is the structural model of learning. In this regard, we can say that the method disclosed opinions formulated in a certain way, represents structural model process of proving that is built on basis of his intermediate studies.

Therefore has been developed large number of model types that can be classified in several ways.

Possible classification model (Sotirović - Adamović, 2002) [131] by those basic characteristics, depending on:

- Functions: descriptive, predictive, and normative
- Structure: iconic, analog, symbolic
- Level of coincidence: deterministic, risk, Conflict, Precarious
- Time: static, dynamic,
- Generality: general, special
- Degree of quantification: qualitative (mental, verbal) Quantitative (Statistical, Optimization, Heuristic, simulation).

3.3.2.   The division of models

In the division of models we started from division of system which means that if there is a division system, then there is a division and models that pretends to represents the system or its parts. Considering the fact that it is impossible to do the correct classification of models in the theoretical analysis, it was necessary to decide which models to consider and how to divide them. First of all, we have decided to those models that are related to learning as a entirety or in teaching as a pedagogical problem. These models are generally gravitated toward a cybernetic-IT category, that is, the information, the knowledge gained (redundancy), connection (communication) and the algorithm. In this way, we get:

- Informational models
- Redundant models
- Communication models and
- Algorithmic models.

Informational model - in psychology and pedagogy represents an imitation of borrowed transmission system of communication and information. The most common model assumes the existence of three basic parts: the transmitter that sends information, the receiver who takes over, and links that realizes transfer.

Redundant model - with a pedagogical point of view, redundancy is the subject's stock of information and acquired knowledge. Based on information acquired stock subject easily adopts new content.

Therefore comes to subject preparedness to be successfully adjusted to the environment and changes, through information connection with reality.

Communication model - modeling educational content in this model represents programming relations (links) between the transmitter and the receiver. In this way, it is possible that the two main participants in learning and teaching (student and teacher) present a unique communication system, in which one takes managerial role and the other role of an object that is managed while the learning system is treated as a unit with two subsystems, thus subsystems to interact with one another; management subsystem (teacher) regulates their behavior towards students' activities.

Algorithmic model - in this model modeling educational content is strictly determined by the rule that prescribe how and under what conditions should be handled a certain class assignments, and strictly carry out the order of operations

and defined conditions, in order to safely achieve set goal. "The rules defines conditions and sequence of operations that input parameters (tasks or commands) are converted to output values."

The characteristics of algorithmic models: are strict management, determination (precision) and mass participation.

Algorithmic models of learning and teaching Knežević divides into:

- Inelastic;
- Inclusion algorithm;
- Elastic - partially accept psychological and pedagogical factors and
- Heuristics - significantly respect psychological and pedagogical factors and lose their characteristics rigorous determination, mass participation and rationality (the shortest path to a solution) but they enable finding all possible solutions.

The most serious criticism which can be related to introducing algorithm, although in the teaching process it achieved successful integration of content, that teaching is not just a cognitive process of developing skills but also the process of developing students' creative thinking by understanding and solving tasks, as well as incitement activities of search and discovering new information, which is the essence of heuristic learning model that teaching has to conduct.

"The models characterized by flexibly, and who are not losing character of management even though is changing, the models become somehow expression of cooperative relations between the subjects of teaching. Therein lies the future of heuristic models of learning that will through, the problem of individualization encourage connection of many theoretical ideas of pedagogy, psychology, cybernetics and didactics "(Krkljuš, 2003). [45]

3.3.3. Cybernetics and teaching

The term cybernetics implies the science of management, which can be applied to any process or a system, if it is manageable.

Sudden appearance of cybernetics in all areas of science, technology and practical life does not circumvent the sphere of education. Cybernetics engagement in solving the problem of teaching, especially of its main branches: systems theory, theory of information and communication theory and algorithms, opened a new page in the history of pedagogy and teaching practice.

Dr. Gerhard Meyer, in his book "Cybernetics and the classroom," says:

1 Cybernetic considerations of teaching lead to better understanding of the complex process of teaching, and we can explain many phenomena which we have so far just described;

2 Using cybernetic considerations more quickly we understand practical rules in teaching because they are observed and interpreted from a variety of perspectives;

3 Cybernetic considerations in educational researches that are creating new problems that can be accepted by scientific workers and teachers in practice;

4 Cybernetic considerations lead to the rationalization of the teaching process.

Therefore the application of cybernetics in teaching has a number of good sides, and in order to teaching process is manageable is necessary to provide the following elements of management:

- System which manages (teacher);
- System which is managed (student);
- Precisely determined goal to strive;
- Program management;
- Feedback, and

- External factors influencing the system.

All of these management elements are known in classic way of teaching, with the cybernetic approach to regulating the relations between elements by strictly determined rule which represents algorithm.

In order to understand algorithms we need to know name, concept, essence and their classification.

3.3.4.   Cybernetic models

So far it has been developed several basic models which are used in teaching and they represent modern didactic and cybernetic models of teaching.

Modern didactic-cybernetic models of teaching:

1 Algorithmic model - with the following features:

  - Mass participation, determination (determination) and strict manageability;

2 Semi algorithmic models - features:

  - owns characteristic of mass participation, but not complete determination;

3 Semi heuristic models - the attributes that make it recognizable:

  - The process of task solving is less specified (determined), as well as result achievement;

4 - Heuristic model - is determined to provide not only accurate, but also all possible solutions;

5 - Heuristic Algorithms - contain complex system of operations disaggregated into elements, in order to find all possible ways of task solving.

Defining the concept of heuristic model has to start from previous considerations of the term heuristics - the research, the development processes of creative thinking and discovering new original solutions to problems. Therefore heuristic model enables research, engaging and developing processes of creative thinking and the development of new and original solutions to problems.

4. 4. MODEL OF ALGORITHM

3.4.1. The concept of algorithms

The name of algorithm is derived from Arabian mathematician Al Khwarizmi. [105]

The algorithm is an application of systems operations under strictly defined rule that prescribe how and under what conditions should be handled a certain class assignments.

The algorithm is correct and understandable general instructions on carrying out a particular (in each case) number of elementary operations (from some systems of such operations) to solve any task that belongs to a class (or type). From this definition, Landa [77] emphasizes the essential features of algorithm:

- Strict determination of the course of the given task that does not allow any arbitrariness, which means that the algorithm may be repeated by person or machine, always with the same results;

- mass participation, because the algorithm, assuming the appropriate activity data for each and every task of a certain type, and

- Result achievement, because there is a certain guarantee of success if they adhere to the exact algorithm.

3.4.2. The essence of algorithm

The fact that most of the mental and physical activities of man, and most of the tasks that students solves in teaching have algorithmic character offers teacher and methodic many new aspects of the methodology.

The algorithms can be used as a support to teacher and guide him in the preparation of the teaching process. They are helping student if he wants to permeate independently into an certain area, also if he wishes to expand it, better understood and more intensively study it. Development and discovery of algorithms are not implemented enough in teaching technical education, although in this way, the organization of the teaching process could be much more appropriate. Using algorithm can be faster and more effectively achieved knowledge, skills and abilities. The algorithms can serve as a guideline to work and can alert to the methods of thought, as well as provide solutions to signal a pedagogical goal.

One of the greatest challenges of modern society is the reform of teaching, and consequently methodological innovation of its programming. Inclusion algorithm in teaching Technical education as a methodological innovation aims to increase the effectiveness of teaching in which students acquire knowledge, skills and habits in the processing of materials starting from the idea (purpose, appearance) schemes, i.e. way of presenting ideas, technical drawing (technical communication according to the rules of international standard ISO), the choice of materials and processing operation. The attitude towards the goal and objectives of technical education is changing; technical creativity becomes objective, practical exercises and student's means of achieving the objectives and tasks of teaching.

Method for the algorithmically realization of teaching tasks is characterized by detailed dissection of elementary operations. Applying algorithm in teaching means determination of precise rules system and instructions which should be used for determination of teachers and students activities to make faster and secure achievement of goals. In order to teachers and students independently develop algorithms they must be familiar with their structure and method of making. Therefore, developing algorithms mean:
- Decompose the matter to the operators;
- Define logical conditions, and
- Adequate logical scheme.

3.5. HEURISTIC MODEL

3.5.1. Concept (Figure 3.12) [9]

Rapidly accumulation of global knowledge and impossible acceptance to quickly, efficiently and effectively adopt this knowledge as well as no ability to apply them in practice encouraged the development of a scientific area called "heuristics". This term was first introduced by Lenat in 1982, ", "as a discipline that studies area of heuristics organized with specialization relation, who attempts to discover the nature of heuristics, their interdependence, and the ability to automatically generate new heuristics. "Heuristics may include some general knowledge, but the most effective ones are those that use the domain of knowledge about problem that should be resolved" (34). The heuristic approach of problem solving involves algorithmic unsolvable problems, problems that are algorithmically solvable but have multiple ways of solving.

Heuristics is based on the thinking processes (analysis, synthesis, generalization, etc.) and examines how the special operations are structuring in the complex type of strategy and tactics for directing and management of given information, in finding all possible solutions.

Heuristic method - represents solving problems method which discovers new ways and means of solving them, and develops the students' creative ability.

Heuristic explores and tends to simultaneously detect logical forms for to describe presentation of activity structure in the form of programs or operational models.

Defining the concept of heuristic model must begin with previously mentioned meanings of the term heuristics – it is a research, development process of creative thinking and the development of new original solutions to problems.

Therefore, heuristic model enables exploration, engaging and developing process of creative thinking and the development of new and original solutions to problems.

Heuristic model is a quantitative model that provides the opportunity of developing creative thinking, as well as researching and discovering new original solutions.

When it comes to heuristic model of teaching their basic characteristic is that teacher guides the students intellectually from the beginning to the end of teaching process until they understand specific content. Understanding the students is the best indicator of whether the teacher is able to achieve the main goal of heuristics, which represents acquiring work material with understanding that results in operability, applicability and functionality (Sotirović, 2000).

3.5.2. Conceptual definition of teaching through solving heuristically conceptualized problems and distance learning

The word "problem" is from Greek and it means "task, riddle, the issue the question that is difficult to solve." The provisions of this etymological notice have two essential features: the disagreements and difficulties as inseparable characteristics of the problem. In the previous analysis of our problem: model of distance learning innovated with heuristic teaching, we have identified a system of effective education, rational process, logical and abstract thinking.

In heuristic problem the one who solves it is active conscious being which by creative, mental effort tries to find a way towards the goal by applying knowledge, and without satisfying with one, but searching for new solutions. This assumption to both worse and better students enables to achieve their maximum. Therefore, heuristic problem solving is a creative process of progressive changing personalities.

The essential characteristics of education through innovated model of distance learning and solving heuristically conceptualized problems are:

- In a psychological sense, heuristic problem solving is the highest form of human education. In such a situation dominates learning difficulties or inanity in train of thought that should be filled with new data and solve the problem.

- In the phenomenological sense, the heuristic problem solving _ has a didactical and pedagogical dimension (acquisition of knowledge, understanding natural phenomena and laws which are being study, etc..) it also has a psychological dimension (motivational aspect, the personality of the subject, the acceptance of heuristic problem, personal attitudes about the problem and goal, processing and direct opinion on solving the problem), and epistemological dimension, which includes mental operations (analysis and synthesis, induction and deduction, abstraction and generalization).

- Didactic qualities of heuristic problem solving are: increasing educational performance (general level, improving the durability and applicability of knowledge,

adoption of factual information, etc.); developing a process of thinking (creative and flexible thinking, sensitivity to problems, critical thinking, etc..); and the educational effects (independence, perseverance, persistence, etc..).
- Essential components of a heuristic teaching models and distance learning (setting and problem solving) can be done by:
- Teacher (most unproductive process where students are passive observers);
- Teacher and student (this procedure is envisages the using in problem-solving methods: heuristically conceptualized problem presentation, heuristically conversation, research, computer work, etc.) and the
- Student (in this process the student has the highest level of independence and in here are manifested his creative abilities, because he defines and design a heuristically problem, hypothesis, develops research plan, solves the problem and checking obtained result).
All three processes are applicable in heuristic teaching, and the optimal goal of modern teaching is achieved by the third process, which is the independent work of students, because it is coming up to its maximum of intellectual activity. For phases of education by heuristic problem solving _ and with applying distance learning model modern didactics considers it is appropriate to restructure teaching class. In everyday teaching practice often the first part of class is dedicated questioning students, their answers related to homework, while the second part of class, when students are passive, the attention is given to teachers' exposure to new material. So we have standard structure of teaching class: students' preparation, processing new teaching material, repetition, and practice and testing. In heuristic teaching preparing students for teaching is realized in problem situation, the processing of new teaching material is related to heuristic problem solving, and repetition, training and testing, intertwine in all of the class phases also do not have to rotate in a specific order.
The structure of the educational process of teaching heuristic corresponds to the logic of scientific research, including:
- The creation of heuristic problem situations;
- The formulation of heuristically conceptualized problem (hypothesis, the choice of methods and forms of work to research problems);
- Problem solving and analysis of the results in order to confirm or reject a hypothesis.

Heuristic problem situation

At the beginning of the class conceived by heuristic strategy, the teacher presents work assignments in the problematic form in order to create a problem situation as the initial step of thinking process. As soon as student begins to think about the problem before it is set, it means that he felt the need problem to identify and solve some problem.
Problem situation is created by problem setting questions and tasks of heuristic nature, setting thesis that should be proved, specifying an alternative which should be chosen. Choosing the right path toward solving the problem should include the student's previously acquired knowledge, which makes it easier to solve puzzling situations if they are properly involved in the situation. Problem situation is determined by: the specificity of teaching materials that contain some problem mental abilities students (problem to correspond with their age), the functionality of didactic instruments and more.

This means that the teacher has the task to ensure in the classroom favorable psychological environment in which students will be able to build a new operation that have yet to learn.

Formulating heuristically conceptualized problem

Problems can usually be formulated in the form of problem issues, alternatives, theses or claims. They may result from teaching content, student's life experience or social issues in general. It would be advisable, whenever is possible, to leave initiative to students, in formulating their own problems, and planning their solution, because the results would be better that way.

The choice of form, teaching methods and teaching aids almost always depends on the specific teaching units (heuristically conceptualized problem) and the planned course of the research process.

Solution of heuristically conceptualized problem

Thinking process begins with understanding the problem situation. Therefore it is important problem to be correctly formulated, as well to decompose into sub problems and developed in right way. Understanding the problem makes easier it's solving. It is very important that the student has an active approach to the problem. His intellectual and cognitive effort is necessary as well as knowing rules of research methodology, and formulation of hypotheses and proving them. Teacher's role in solving heuristically conceptualized problem is very active, but also indirect. The modern teacher incentive issues help students to determine the rational hypothesis and eliminate wrong. Teacher, therefore, direct cognitive process in right direction. He guides better students after solving one task to focus on finding the remaining solutions, and weaker students to find at least one solution. The right creative thinking cannot be developed without painstaking heuristic search for best ways of finding solution (with use of computers and the Internet), and they are not immediately visible or clear. Learning of students in this way has the educational value, which is reflected in forming of conscious, safe and independent personalities and above all capable of self-education by using distance learning.

Analysis of researching results

After formulating the problem, hypothesize and problem solving, final phase is analysis of researching results. Results can be analyzed by the students themselves, in order to achieve optimal success, or their teacher. The research results can be presented globally, partially and detail. The process of analyzing the results conducts selection, process, argumentation, application and distributing them.
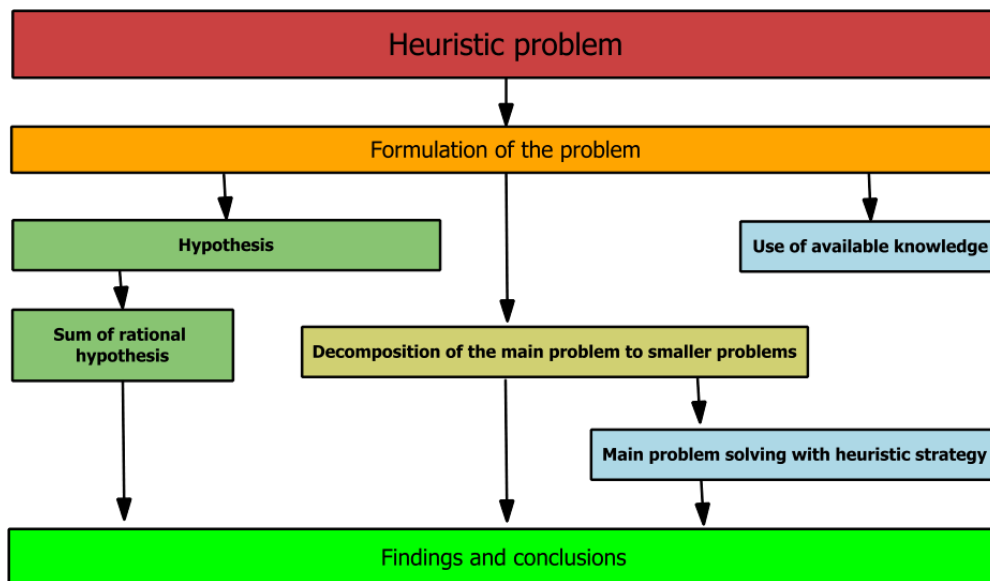
Figure 3.12. Schematic presentation of heuristic problem solving strategy[9]

3.5.3. Heuristic modeling

"Modeling" is a thoughtful theoreticlly activity of developing logical math systems, in the form of theoretical models of some objective systems, but also represents construction of appropriate and practically - analogue systems. Respectively modeling represents construction of realistic models of different types (scale models, charts, machines)".[131]

During the organization of educational processoccurs a need for certain phenomena, concepts, processes, functioning machinery, objects and similar to be represented by their analogue models - copies, e.g. "model". This is necessary for students so thay can identifiy essential characteristics of objects, understand the legality of certain phenomena in nature, society, production, machine operation, etc. and this process is referred to as "modeling".

Therefore modeling is cognitive dialectic process of creating knowledge from practice to theory and inversaly. This is why there is:
- Theoretical modeling of real phenomena (explanation of reality), and
- Practical modeling theory (theory explanation).

"With noticing that certain phenomenon occurs, we already start creating a model or a picture of a phenomenon. Our desire in that case is (or our goal) to predict how these phenomena occurs in certain conditions (projected or random), and because of that we perform modeling (formation models, algorithms and similar mechanisms).

Therefore, modeling is the study of models, where we assume that if all phenomena are similar in certain respects, it will be in another trait, and system research will be perfomed by modeling method. Thus, by the model we mean the system of ordered structures and relations analogous to research subject, or a special kind of model abstraction, i.e. a link between the abstract and theoretical thinking and objective reality. The model is analogous to the essential dimensions of the modeling. " [131]

The modeling has three functions:

Practically applied: solving practical problems (functioning of a particular object);

Demonstrative: this is used for pedagogical purposes (assistance in training), and

The research: it is used to explore and detection of new knowledge and studying of an object.

Implementation stages of modeling:

1. Task establishment - determining object of study; studying aspects of the properties and relations in such object; updating various knowledge about the object that is the subject of interest as well as his model; observation and experimenting in the study, checking and gaining knowledge about such object.

2. Selection - creating a model representative of the original, with the highest level of similarity with original, and this allows a better finding new knowledge of heuristic meaning

3. Exploring the model - the new knowledge about the model, testing its structure, relationships and functioning of its individual parts.

4 Knowledge transfer - making a correlation between those knowledge we obtained in the third stage; their ratification or rejection.

Heuristic modeling implies _ creation of a model that has heuristic meaning and represents several originals in one and the same model. That model enables finding new knowledge and develops creativity of students by requiring independence while respecting the level of knowledge of each student individually (Example: An engine-generator DC or AC).

Heuristic model determines very few actions in course of solving problems so that leaves student a possibility of finding one or all of potential solutions depending on prior knowledge, degree of independence and his creative abilities.

Such approach solving the problem enables each student to achieve their maximum, students faint, and also the average and above average, i.e. talented students.

Formulating problem by heuristic strategy means that student has been placed in a position of applying previous experience in new situations revealing that prewious knowledge leads to new situation and discovering new ways of creative problem solving.

Such problem solvingt has following features:

- Forming new, rare, unusual and original ideas applicable in practice during problems solving;

- Evaluation of ideas;

- Developing a Plan according to which problems will be solved;

- Problem Solving according to newly developed plans and ideas;

- An attempt to perceive problems in an original, new and different way by using new ways of resolving, and

- Discovering new facts and testing various assumptions (hypotheses).

The global structure of heuristic modeling educational content:

- impart basic information on the problem;

- Instructions for discovering new information;

- Discovering new information by solving problems;

- Additional explanations for finding new, that are, all the possible ways of solving problems.

Elements of heuristic models are not so strictly related to upper order, but their order depends on nature of the problem and the system of sub-goals.

The first element (communication to the basic data on the problem) can also be complete text on an issue based on which students are encouraged to repeatedly overview prior and formulate new ideas. The structure of such content is provided

for solving the problem-oriented heuristically, which allows the student free choice of problem solving.   Based on possible alternatives can be predicted additional explanations, necessary for students' further work.

Solving stages of heuristic modeling are:

1. Decomposing problem into small problems with a specific organization of objectives and subobjectives of behavior.

2. Accurate prediction program of information and managing process learning subjects in course of solving problem situations primarily is characterized by:

(precise presentation of management goal, creating guidelines that need to be in order to achieve a specific goal, the system that controls periodically receives data from a system which is managed, as well as customizing the system that controls the character and capabilities of the system which is operated).

3. Studying the process of solving problems and attempt of modeling thinking process in terms of itemization opinions of respondents on the smaller operations in course of solving problem in order to solve them as effectively and in a way that is more creative.

Input set ⟶ **PROBLEM Parameters - Features** ⟶ Output set

Variables   Multivariant solutions
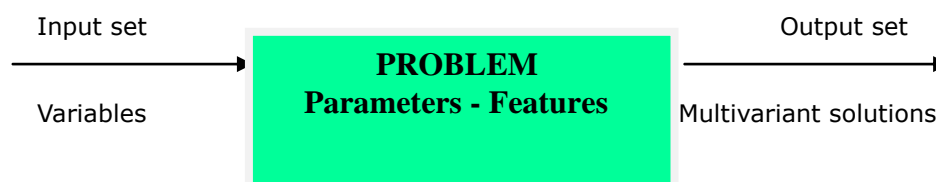
Figure 3.13 Schematic view of presenting of heuristic problems

Individuality of students in learning heuristic modeling is accepted when is:

- Ensured wide range of different learning models with the possibility to be choosen model most appropriate to each student.

-Possible individualization of the extent and complexity of the teaching content as well as pace and way of its adoption.

- Possible using "skipping tehnique" by which capable students can omit those parts of the curriculum that they are familiar with, and without which the faint students would not understand the following informations. For weakest students teacher provides additional content.

- Possible individualization with considering different abilities of students in solving problems and recognizing the diversity of types of thinking.

- Possible individualization with regard to psycho-physical personality characteristics (motivation, character, temper, interests, habits etc.) and

- Possible individualization of teaching in terms of respecting student's knowledge, skills and habits.

3.5.3. Heuristics and computer in teaching Technical education

Heuristics as modus, method or rule of problem solving with the assistance of computers in education Technical education is an innovation both for students and for teachers. For the first time education is based on quantity and quality of acquired knowledge of each of the individuals in detection and implementation of new solutions, which enables each student to achieve their best.

Heuristics give to to better student's opportunity to find possible solutions, while faint students encouraged locating at least one of all possible solutions to the

problem. This approach encourages all students to work and does not favor a faint student as in the case of traditional learning, but equally provides an opportunity for even the most talented students to demonstrate their maximum.

Application of computers in teaching Technical education can be observed in the use of computers in the learning process:
1. Learning strategies by using computers;
2. Development of a computer program;
3. Adapting teaching computer and
4. Theoretical problems of learning, with the help of a computer.

The above problems are closely related to the heuristic modeling teaching and learning content of Technical education.
1. A computer learning strategy in terms of a modern teaching aid in the implementation of heuristic teaching strategies and allows students and teachers to establish a new-modern way to approach the problem.
Linking individual computers, and other local networks into a single network known as the "Internet" - a "network of networks" whose resources are organized service system that allows data transfer by using a single protocol (TCP / IP), which is the standard for communication within the facility and provides a heuristic approach to global knowledge at any moment, which also gives students and teachers a quick and efficient way conceive the problem that should be solved.
Distinguish between several forms of computer-assisted learning:
- Teaching - The computer plays the role of tutors in teaching students;
- Dialogue - it represents specific problem solving between students and computers in the form of conversation;
- Seeking information - motivating students to independently solve the problem initiated;
- Solving problems - the use of computers in solving quantitative problems;
- Simulation as a learning strategy - refers to learning through the presentation of real or unreal situations and models;
- The game as a learning strategy - is a kind of simulation of the competition or conflict where victory comes to thinking.
2. Creating computer program - from the aspect of heuristic modeling teaching and learning process. First are determined tasks for planned program, with more concrete and operational terms, and then develops the criteria for measuring the effectiveness of programs with detailed analysis of scheduled content for searching strategy of learning material and considering respective characteristics of students in order to achieve its optimization.
3. Adaptability of teaching to computer - means a selective choice of teaching content that may be heuristic model and which provide optimal results. Also includes adaptability to developmental level of computer capabilities and characteristics of students.
4 Theoretical problems of computerassisted learning - during programming material in the computer-aided learning should be developed algorithmic, semi-heuristic and heuristic processes, where algorithmically processes help accelerate the adoption of new information, while semi-heuristic and heuristic processes are the components of the creative process in which dominates research activities of students.

Accordingly, the problems of computer assisted learning are:

Compiling programs that help acquiring new information and also with the help of this information, evoking the forming and developing creative thinking skills of students;

Heuristic exploratory activities for students represent detection algorithms of possible solutions to problems and placing them in an appropriate program, while the student is in the heuristic situation until he discovers a resolution of this problem.

Computer-assisted teaching optimizes the individualization of teaching as the learning process, by modeling it according to real possibilities of different categories of students, by implementing following didactic and psychological demands: complete individualisation of teaching, creative relations of students towards learning and teaching, and its training for self-study and self-education.

The computer allows use of educational software (ORS), which was developed at the Technical Faculty "Mihajlo Pupin" in Zrenjanin and used for individualization of teaching and learning models by using programmed learning, intelligent tutoring systems, models and simulations and artificial intelligence.

Computer also allows Distant Learning (a form of learning where students are physically separated from the source of information, teacher or school).

Computer as a means used to improve teaching of modern computer technology can improve teaching and learning in the following way:

-   individualization of_lecture format;
-   introduction of expert teachers - tutors;
-   using video clip support for creating macro context for students, "Anchoring Instruction",
-   knowledge completing with another material (objects);
-   reducing cognitive memory to working memory, and
-   motivating students to stay focused on the material.

3.5.4. Heuristic strategies and searching

Heuristic strategy is a course of action focused on finding all the possible solutions in order to achieve the set goals. Heuristic strategy in teaching technical education represent new approach in teachingas well as in education and training of teachers and students in accordance with the new concept of teaching that requires teachers to explore and create possibilities of continuous improving and implementating new models in order to students reach their individual abilities to achieve their maximum. Heuristic search implies a search for the necessary data or information needed to solve a particular problem.

"Search strategies determine the conditions that will be reached in the process of searching for resolving in the conditions scope." Source: Dr. Peter Hotomski "Implementation and application of artificial intelligence".[62]

When searching, it is necessary to introduce control search strategy for narrowing of search space and orientating the search in the direction of promising solutions. Selection of control strategies greatly depends on knowledge about the domain of resolving problem, and there are two extreme possibilities:

- The absence of any knowledge of the problem area and
- Complete knowledge of the problem area.

Usually, solving problems in the teaching technical education is located between these extremes, and therefore investigation the properties of problem domain leads to a certain but incomplete knowledge on the basis that enable to build smaller and more efficient control strategies heuristic search.

The available are following heuristic search strategies:
- searching in breadth, into the depth, and the combined strategy.

3.5.5. Heuristic teaching

"The main characteristic of heuristic teaching is that a teacher guides the student mentally from the beginning to the end the educational process, until understanding of specific content (ie, to heuristics). By understanding we mean gaining clear insight into the structure of the content, ie. Identifying functional relationships between structural elements of curriculum (e.g. between the electron structure of the atom layer, and chemical properties of elements). Understanding students is the best indicator of whether the teacher is able to achieve the basic objective of heuristics. This objective is not unique to heuristic teaching but also for other teaching systems. Learned teaching material has operational characteristic, also applicability and functionality. In order to students lead to understandingteacher must establish logical structure of curriculum, since it determines the order in processing the learning content. This is a serious task that requires good preparation of teachers to perform each stage of the teaching process considering its microstructure. In the heuristic teaching is possible bidirectional communication between teachers and students. Teacher speaks to students to teach them, but they can contact teacher if they have any questions, or if they miss some information for better understanding the material. However, they do not have opportunity for direct communication with educational content, since they adopted it with the help of teachers[130]. Graphical view of relations between factors in heuristics teaching (Figure 3.14):

S - student
T - teacher
→ - comunication
LC – learning content

Figure 3.14.

Heuristic teaching combined with algorithmic problems in teaching and guidance, through heuristic problems and tasks designed to achieve safe results, represents one of the alternatives that we have decided to use in modeling educational content of Technical Education, which does not mean it should be exclusively applied.

3.5.6. Heuristically approach in evaluating

Reform of education (curriculum reform) can not give expected results if do not changed an evaluation system and consequently evaluation.
In the current (traditional) educational system of elementary education evaluation memorized knowledge of the students is expressed ranging from 1 to 5 regardless of specific groups of students to which it applies, the time or the experience of professors or teachers. This method of evaluation do not precise tells anything about the level of knowledge expected from students, as well as specific solutions for the realization of individual tasks.

Such evaluation in schools has quantitative character and is full of formalism.

The qualitative evaluation conciders the student's activites as participants in their own formation with constant gaining information about the level of personal possibilities and paths that should be followed in learning. In this way, the student will make conscious efforts in order to acquire new knowledge and skills and operational knowledge acquired with the aim to his educational process, which he is involved in, become effective.

Table 3.1 represents certain types of evaluation appropriate goals, and offered questions are crucial because they set the baseline of any projections: objective and time.

What is the purpose of evaluation?		
Before the start of learning	Throughout the process of learning	At the end of learning
Guidance for future activities	Regulation of the teaching - learning	Determining the level of knowledge - skills
Evaluation of students	Evaluation of teachers and students	Evaluation of one student
The prognostic evaluation	Diagnostic evaluation	Inventory evaluation
The initial evaluation	Permanent evaluation	Final Evaluation

Table 3.1 Schematic view of presenting a heuristic problem

Is well known that in technical education each student has their own personal rhythm of progression and according to that it should be applied appropriate evaluation, which takes into account the activities of students as participants in its own formation, giving him a permanent information on the level of personal capabilities, as well as the paths that should be followed in further learning.

International Association for the Evaluation of achievement in education and OECD has developed the concepts and procedures for evaluating strategy. The highest efficiency in education is the introduction of external assessment system for monitoring the performance of students, educational institutions and the functioning of the education system as a whole. External oversight and monitoring of education are parallel with the responsibility that teachers have regarding the evaluation of students who take the exams externally organized as part of the selection process for entering into the next, higher stage of education. Today there are diffrenent types of evaluation. It is not about evaluation process, but about getting the results of what happens inside the "black box". International Education Indicators Project - INES launched several years ago, in all European countries significantly affect on new policies and strategies of evaluation. Specific evaluation authorities and / or schemes are introduces in almost all European countries with the aim to help establish the diagnosis and to improve the education system in general. The governments of these countries and the society in general want to know the results of student learning, either through detailed analysis, evaluation and assessment performed by teachers, or by monitoring and / or national examinations at certain ages. Thus it has been given a valuable insight at the results achieved by individual

schools, with the aim of providing support to those who need it, but also to customers who pay the certain services (parents) and receive quality information, which makes the process of competition between educational institutions.

Heuristic evaluation is a method for quick, cheap and easy evaluation and represents the most popular method of testing utility. Heuristic evaluation is performed by systematic inspections at the level of the education system, or teachers when it comes to the overall assessment of students' knowledge and its application in practice.

The goal of heuristic evaluation is to find problems in handling classes, so they can be monitored as part of an interactive (repeating) process in this class.

Heuristic evaluation requires a small number of evaluators who examine the lessons, in our case, a technical education system and make judgments about its congruence with the known principles of utility.

Heuristic approach to assessment and evaluation of student means including his general knowledge but also most effective knowledge that he is using to address the problem or task. In this way we get true picture of the overall, qualitative and quantitative knowledge and ability of students to apply them in practice.

This approach to assessment and evaluation delivers inovations, one of which should particularly emphasize the appreciation of students, their general and specific abilities, as well as developing the characteristics and conditions of acquired education.

In order to heuristic evaluation be successful, it is necessary problems, tasks and questions to be set up (conceived) by heuristic strategy (see schematic representation of heuristic problem solving strategy).

4. METHODOLOGICAL FRAMEWORK OF THE RESEARCH

Methodology of research in accordance with the theoretical part of the research includes:
- – The research problem
- – The subject of research
- – The goal and research tasks
- – Research Hypotheses
- – Methods, techniques, tools and sample of research
- – Scientific and social justification of the research.

Following an experiment is to analyze the survey results and discussion, and what has remained to explore.

4.1. The research problem

The question is how to increase the efficiency and effectiveness of education in terms of regular and emergency situations, in the era of expansion of new information and discoveries?

Regular situation means working with computers in normal weather and other conditions, while emergency situation means working with computers and Internet, that is conducting and managing classes in terms of epidemics, pandemics, the small number of students in rural areas, problems with transport of students, i.e. distance learning in terms of interruption of classes.

It is understandable that today, in the world of major social change, to education and scientific research is devoted special attention. From year to year, are changing facilities and work methods, rapidly becomes obsolete existing technique and technology, and they are replaces with a new, more productive. These changes must be reflected on the educational programs at all levels of education. The whole world is changing, and education is a key factor in these changes.

The need for modernize and improvement of educational system, suggests a number of obvious weaknesses of traditional education: lack of adaptation of teaching and learning, to individual abilities of students, lack of students' motivation for learning, lack of productivity and efficiency of traditional teaching; insufficient practical applicability of the acquired knowledge and skills; inability to efficiently monitor the course of knowledge assimilation.

Due to rapid development of information technology that is finding its way into almost every field of human activity, education goes beyond traditional teaching and becomes independent from time and space, which motivated us to choose this PhD thesis.

Increasing and improving the efficiency of the education and learning process can be realized by developing new educational models (in our case innovated model, i.e. model of distance learning and innovating teaching model: algorithmic and heuristic and its application in the teaching of technical and computer education) using the new technology. Many foreign educational institutions have attempted to solve this problem by developing models of distance learning, which is the subject of our research, but with an emphasis on the organization and management of teaching in terms of emergency situations (work, conducting and management of teaching in

terms of epidemics, pandemics, the small number of students and professional teachers in rural areas, problems with transportation of pupils or students, education and training with work).

Distance learning means that in the educational process, the user and instructor are physically separated, and technology (radio, video, printed materials, computer data) are used to overcome this distance. This thesis will imply that the physical separation of teachers and students exceeds the use of information technology.

Distance learning offers a second chance for education at the all levels, overcoming the problem of lack of time, distance or physical disability and allow the expansion of user knowledge without leaving the place of employment, residence or temporary residence.

Distance learning is also a challenge and a tool for improving and enhancing the educational process in our country and one of the foundations for new and better ways of managing knowledge in regular and emergency situations.

Intensive introduction of information technology in education has become a priority for modern educational institutions around the world, including ours.

The research covered by this project is empirical and theoretical character. It should provide answers about the possibilities of implementing the updated model of distance learning in the efficiency of teaching technical and IT education in educational institutions in terms of regular and special events. The research problem is complex and is reflected in a series of related phenomena and processes taking place in society, science and education, and their mutual influences.

In this context, the following points are important:

- First, the concept of distance learning includes various modes of application, including some that are today part of the past. This research will be oriented towards the construction form of distance learning, which in practice is defined as an electronic learning (e-learning);

- It is intended to fulfill perceived gaps in preparing students and teachers when it comes to organization (heuristic teaching) and course management in terms of specific situations (work, conducting and management of teaching in terms of epidemics, pandemics, the small number of students and professional teachers in rural areas, problems with transportation of pupils or students, education and training with work) learning. This gap is due to inadequate adjustment of teaching and teachers to huge technological changes that occurred in recent years in the "Technical and IT education", in regular and emergency situations.

- It has been selected the teaching programs of technical and IT education in order to get closer, explain and present the innovated (combined-mixed) model of traditional and electronic learning (e-learning) in regular and emergency situations.

- The institutions included in this research are the educational institutions at primary school level students (elementary school) and teachers (at the Technical Faculty "Mihajlo Pupin" Zrenjanin "Center for Development and Application of Science, Technology and Informatics (CNTI) from Novi Sad).

The application of computers in education began in the seventies with the first development of software for learning the method of programmed instruction, which evolved through educational software, intelligent tutoring systems, simulation software, multimedia systems, to distance learning via the Internet.

Today there are more than a thousand institutions for distance learning and open learning, with different types and sizes, located in more than one hundred countries. Reasons why, in our country, education through e-learning is not yet applied to a large extent are: insufficient IT training of teachers, lack of adequate software, lack

of equipment, unavailability to a specialized literature; distrust of teachers towards new forms of presentation material and other factors.

Based on these findings, the research problem can be seen from a wider and narrower terms.

<u>Wider problem</u>, in which the research is performed, concerns the question of whether can be constructed a model of distance learning in the form of e-learning in teaching technical and IT education, so that significantly affects the efficiency of the teaching process, when it comes to organization (heuristic teaching) and managing teaching (learning) in terms of emergency situations (work, conducting and managing teaching in terms of epidemics, pandemics, the small number of students and professional teachers in rural areas and, problems with transport of students, education and improvement of the work).

<u>Narrower problem</u> of research should show whether Innovated model of distance learning in the form of e-learning in teaching technical and IT education contributes to:
- Improving acquired skills of students in solving real problems;
- Higher degree of development of intellectual skills and abilities of students;
- Increasing the motivation of students in the learning process;
- Increasing the motivation of teachers in the preparation and development of educational materials necessary for the implementation of the updated model, in terms of emergency situations.

4.2. The subject of research

The subject of this research is the education of students (V, VI, VII and VIII grade) by applying the innovated model of distance learning, heuristic models of teaching 'Technical and IT education ", and the impact of this model on the innovated training personnel for the regular and emergency situations on example of processing subject matter in teaching discipline "technical and technological character" ("Technical and IT education" in primary school) and the impact of heuristic models of teaching on learning outcomes (knowledge and skills of students) in the implementation of these educational disciplines by distance learning.

Based on the formulated research problem, the subject of this research is:

"Blended learning model with" Virtual Classroom Manager "as a factor in efficiency of the education system in ordinary and emergency situations"

Terminological analysis of the research shows that it is a part of several categories:
- Technical and Information Education
- Model of mixed (combined) learning - Innovative model
- Distance learning (e-learning, Internet services)
- The effectiveness of teaching and therefore the educational system in general,
- Ordinary, and
- Emergency situations.

<u>Technical and IT education</u> - means to acquire knowledge in the field of new, effective and efficient manner.

Each <u>model</u> is theoretical, i.e. conceptual, a practical and realistic for subject of research, and an analog system, by which is being investigated some basic subject

or a system (in our case, heuristic teaching model, implemented in the model of distance learning-innovated model).

<u>Distance Learning</u> - Distance Learning means that in the educational process, the student and the teacher are physically separated, and technologies (radio, video, printed materials, computer data) are used to overcome this distance. The rapid development of information and communication technology has led to the emergence of modern forms of distance learning, from which, in our case, one of the most interesting electronic learning (e-learning).

<u>Virtual/Internet classroom</u> with appropriate equipment provide opportunities for improving education - teaching work through distance learning. Learning in computer network, over the Internet is the basic idea of this system. Internet has been used for achieving the requirements for users to interact with content, lecturers (authors) and other participants in the updated model of distance learning. This software solution should satisfy the expected needs of teaching "technical and IT education" in the educational system in terms of the ordinary and emergency situations.

<u>The efficiency of the teaching process</u> is measured by the expenditure of time and energy to prepare teachers and students for mastering appropriate teaching content. Effective teaching is that it allows the acquisition of knowledge, skills and abilities in problem solving, also gaining maximum reliable and permanent knowledge. Such efficiency should be achieved by working in a virtual Internet classroom in terms of ordinary and emergencies.

The operational definition of the research object

Teaching Technical and IT education:

Students will acquire basic skills in technical and IT education in time and scope, trough limited practice, as provided by this innovated model; For carrying out this study, students are required to have some experience and knowledge in the field of informatics and computing, as well as the environment that provides the best conditions for research. For this reason, the selected educational institutions (elementary school"Djura Jaksic" in Zrenjanin, for the realization of the experiment and the Centre for Development and application of science, technology, computer science CNTI Novi Sad and Faculty "Mihajlo Pupin" in Zrenjanin for training teaching staff / professors) which have well-equipped computer classrooms and access to the Internet and have signed a protocol on cooperation with the University "Polytechnic" University of Timisoara - Romania. Teaching material in distance learning module contains electronic lessons, base concepts, assignments, simulations, testing knowledge (initial and final test), and surveys of teachers. The efficiency of technical and IT education will be determined on the basis of the results which would be obtained by the survey, as well as opportunities to improve learning, analyzed advantages and disadvantages of distance learning in combination with a heuristic model of teaching in terms of ordinary and emergency situations.

Components of the research:

1. Student as a subject in the educational process:

- The level of students' activities in the system of modeled heuristic teaching (preparation, planning, implementation and evaluation of heuristic modeled tasks) through the application of distance learning;

- Self acquiring knowledge and awakening of the creative potential of students;

 - The creation of their own beliefs and attitudes.

2. Developing internal motivation of students:

- The building a positive attitude towards education;

- Developing curiosity in investigations, using the updated model of distance learning;
- The development of intellectual abilities of students;
- Rich interactive relationship between students - teachers and
- A sense of satisfaction with the results achieved.
3. Understanding the essence of content and increasing teaching effectiveness:
- Different learning techniques, distance learning and independent study;
- Critical and creative knowledge acquisition;
- The ability to perform experiments and others.
4. The role of the teacher, in the heuristically-modeled teaching and learning at a distance:
- Teacher as a strategist, developer, organizer, researcher, coordinator, mentor and diagnostician;
- Skills, professionalism, knowledge and preparedness for such work;
- Motivation (material and intellectual) and others.
5 Timing of research;
- During the 2010/2011 and 2011 / 2012 school year.
6 Spatial definition of research:
- Elementary schools in the municipality Zrenjanin
- CNTI Novi Sad.
Objectives and tasks of research
The overall objective of PhD dissertation is based on the theoretical research and application of the updated model of e-learning in education in terms of ordinary and emergency situations, to indicate statistically significant opportunity to improve efficiency of teaching in general.
Secondary objectives of the research:
- To determine whether and to what extent Innovative Model "distance learning combined with a heuristic model of teaching", is applied to the realization of teaching content subjects "Technical and IT education" contributing to the improvement of professional skills for students in solving real problems;
- To investigate and establish the extent to which distance learning and heuristic model of education affects the development of intellectual skills and abilities of students in the teaching process, i.e. to provide for the same time, greater durability, and direct students' knowledge with respect to the classical approach to learning;
- To investigate and establish the extent to which distance learning and heuristic model of teaching increases students' motivation in the learning process with respect to the classical approach to learning;
- To examine whether and to what extent teachers are ready for the preparation of educational materials necessary for the implementation of e-learning model in terms of the ordinary and emergencies.
The main scientific objective of the research is objectively, in detail, comprehensively and fully description of all dimensions of distance learning in combination with a heuristic model of teaching, and the importance of teaching content and technical IT education in the education of students.
Special scientific goal is the scientific explanation and understanding the essence and characteristics of the updated model of distance learning and teaching as a heuristic statistically significant factor in improving the efficiency of the teaching process in terms of the ordinary and emergencies.
Associate research objective of this study is the classification, systematization and analysis of the form and manner of implementation of the distance learning system

and a proposal for the updated model of e-learning and heuristic teaching and its verification - confirmation as the new model of teaching in terms of ordinary and emergencies.

Scientific explanation will be based on previously discovered circumstances, causes and motives.

Scientific prediction will include prediction role and importance of the updated model of distance learning in the educational system to improve the efficiency of innovated teaching technical and IT education, with the heuristic model, in the terms of regular and emergency situations.

Based on the immediate implementation of the acquired knowledge is directly realized the social purpose of the research, through the trends in the field of distance learning, with the goal of achieving a higher quality in the educational process of technical and IT education.

In addition, the research tasks are directed to:

- Defining the role of elementary education system with education of students and preparing them for further schooling;
- Analysis of local experiences and the experiences of developed EU countries in elementary education of students,
- Monitoring the state of development and trends because of the training of personnel in solving practical problems,
- Determining the current situation and the situation in teaching "Technical and IT education" in general,
- Determining the degree of familiarity of professors and students with distance learning,
- The study of the existing models of distance learning and teaching models in terms of regular and emergency situations, the method of realization, the advantages and disadvantages that accompany them,
- Development and implementation of the updated model of distance learning in the form of e-learning teaching Technical and IT education,
- Determining the extent to which distance learning teaching technical and IT education contributes the improvement of the acquired knowledge for students in solving real problems in this area,
- Determining the extent to which innovated model of distance learning in teaching technical and IT education contributes to the development of intellectual abilities and skills of students, i.e. for the same time provides greater durability and direct students' knowledge with respect to the classical approach to learning,
- Determining the extent to which innovated model of distance learning in teaching technical and IT education increases students' motivation in the learning process with respect to the classical approach to learning,
- Determining the extent to which teachers are ready for the preparation of educational materials necessary for the implementation of the updated model of distance learning in terms of emergency situations,
- Evaluation of the updated model of distance learning in terms of emergency situations according to pre-defined parameters,
- Theoretical generalization of the results and experiences.

4.3.   Research hypotheses

Based on theoretical approaches to the problem, the objectives and research tasks, formulated the general hypothesis and sub-hypotheses which was the basis for the research.

The general hypothesis:

Innovated model of distance learning in teaching technical and IT education has a statistically significant impact on the effectiveness of teaching in education in terms of ordinary and emergencies.

Sub - hypotheses

The main hypothesis will be checked by specific sub-hypotheses:

- The updated model of distance learning in teaching technical and IT education, contribute to the improvement of professional skills of students in solving real problems;

- Innovated model of distance learning in teaching technical and IT education provides a higher level of development of intellectual abilities and skills of students, i.e. the same time provides greater durability and immediate students' knowledge with respect to the classical approach to learning;

- Technical education and IT education, based on the updated model of distance learning increases students' motivation in the learning process with respect to the classical approach to learning.

Methods, techniques, tools and sample of research

Type of Research - Research is operational, developmental and oriented towards changes and improvement of immediate educational practices in educational institutions in Vojvodina, in terms of regular and emergency situations. The research is also transversal. Implementation of innovative models of teaching technical and IT education, can be studied at the same time, in different places and in different circumstances.

This research focuses on studying teaching technical and IT education, at present, in terms of regular and emergency situations, as well as predicting what lessons of this subject will be in the near future learned.

Research methods - methods that will be applied in this study were selected according to: nature of the problem, objectives, goals, tasks and the hypotheses of research.

Descriptive method - involves collecting data on computer literacy of students, also collection students' attitudes about innovative teaching technical and IT education, the study of curricula and textbooks;

Causal methods (experimental use) - detection of cause-effect relations and relations between innovative teaching, on the one hand, and of the results of the updated model in terms of regular and emergency situations, on the other hand. The study is used an experiment with one group and parallel groups;

Comparative method - involves comparing the results of the initial and final measurements of experimental and control group, the calculation of significant differences, comparing the results of the initial and final test of knowledge in the experimental groups (establishing clear performance effects of experimental factors).

- A method of theoretical analysis - the method is used in the study of previous theoretical knowledge about modern teaching, the teaching of "technical and IT education" as well as how to adapt the content and methods of teaching this subject, interests, skills and abilities of students.

These methods in a single application are not independent nor comprehensive, and therefore combined and interconnected.

The research variables - variables include the level of knowledge, which is observed in relation: process - effect. In this study, there are: independent, dependent and control variables of research. Independent variable in the study represents the

cause, or the teaching process, and in this experiment, it is an innovative model of distance learning with students in teaching, "Technical and IT education" at selected educational institutions, which are designed according to experimental program. It is about independent variable, which in this study represents experimental factor. Independent variables, which are controlled in this study, we also call the independent control variables as: sex of students, basic computer literacy and knowledge of students "technical and IT education", presented by the success of students in the initial knowledge test; the dependent variable represent consequences resulting from the introduction of the experimental factors. Thus, the dependent variable represent the effects of learning that are achieved by organization of teaching shaped with Innovated model of distance learning, or - students achievement. The level of student achievement is measured by the final test of knowledge. Student's achievement is viewed by the difference of the results obtained with measuring initial and final test results.

As an experiment is introduced an innovated model of heuristic organization of teaching (the one with an adequate theory of thinking for solving a specific set of tasks). Problem solving create all the necessary conditions for its implementation in practice, and in the end is determined its impact.

Therefore may be immediately seen that this study was focused on determining the effects of a given innovated model.

4.4. Research Techniques and Procedures

- The research applies the following techniques (methods):
- Analysis of pedagogical documentation - analysis of teaching "technical and IT education" in primary schools, in order to determine the level of quantity that students need to learn,
- Systematic observation - observing the educational situation in traditional teaching and teaching that is done with the help of experimental variables,
- Survey - which will determine the degree of awareness and knowledge of teachers and students of distance learning in terms of ordinary and emergency situations before and after the experiment , to obtain students' opinions about the advantages and disadvantages of such a teaching organization;
- Testing - determining the prior knowledge students about "technical and IT education", i.e. initial testing of knowledge, and determination of the acquired knowledge after the application of the experimental program, i.e. final test of knowledge.

Research instruments
- The corresponding survey instruments for each technique are:
- School documents (curriculum "technical and IT education," the chosen school;
- Surveys and questionnaires-
- Proficiency tests

Initial test of knowledge (attachment .....) for the purposes of this study was designed as a set of tasks, and the implementation of this test was to determine the initial state of the experimental and control groups. The initial test was related to the content of "technical and IT education," which students adopted during their previous education. Good knowledge of the material is a prerequisite for understanding of the contents that are part of the experiment. The final test of

knowledge (attachment ....) was designed for this research as a sequence of tasks of the objective type and purpose of application of this test was to determine the final state of experimental and control groups. Tasks on the final test will include teaching content of the curriculum "technical and IT education" (for the school year 2011/12); Surveys for students and teachers - survey before the research will aim to provide insight on how much students are familiar with learning, and for the students of the experimental class aim was to provide insight into the impressions that students have about the implementation of the experimental program, and innovative ways of teaching and learning. Survey for teachers will aim to determine the extent to which teachers are ready for the preparation of educational materials necessary for the implementation of the updated model of distance learning in terms of ordinary and emergencies. The surveys will be anonymous, so students and staff could more freely express their opinions. Orientation was using technique of parallel groups, relatively equalized. With this technique we are able to compare the results between the two groups, one in the traditional mode and the other in an experimental mode. Groups were equaled in number, gender, and computer literacy. Determining computer literacy was achieved by using pre-knowledge test, after which are checked the effectiveness of teaching and learning realized after the experiment.

4.5. Characteristics of sample students:

- The population in this study consists of elementary school students "Djura Jaksić" in Zrenjanin, during the school year 2011/12. Predicted sample belongs to the category of intentional samples. Such sample was established, and it has a role to reduce parasitical effects of factors to a minimum, those factors that come from the environment, i.e. schools where the research is done, because the survey was conducted in a remarkable school that has adequate financial, physical and other conditions. Equalizing the experimental and control groups was performed according to the following criteria: the number and sex of pupils / of students, basic computer literacy of students; prior knowledge of pupils / students - initial test.
Methods of data processing
- In the statistical processing and analysis of collected data in the phase of descriptive statistics will be used measures of average (central tendency) and the corresponding measures of variability (dispersion): arithmetic mean and standard deviation, median, modus.
To test the hypothesis will be used the parametric statistical test - t test, Mann Whitney U test, ANOVA, Kruskal Wallis test and the Wilcoxon test to determine statistically significant differences of results at the initial and final test in the control and experimental groups.
It will be applied also multivariate technique that is used in structural studies of behavior - canonical discriminate analysis for determining differences between control and experimental groups in terms of the results of the initial test, the final test and basic computer literacy. Also, it will be designed the multiple differences, to determine the prediction of the final test of knowledge with basic computer literacy and knowledge of the initial test.
Regression analysis will be used to determine the relation between the basic computer literacy, knowledge of "technical and IT education" (prediction system) on the one hand, and students' success in teaching "Technical and IT education" (criteria system), on the other hand. Data were analyzed by statistical program SPSS 8.5.

The selected statistical procedures will aim to confirm or refute the hypotheses. Current knowledge does not deny the importance of the compatibility of draft research and applied statistical methods, but do not insist that there is only one statistical technique for one type of a research draft.

In the study, in addition to the quantitative dimension results will be paid attention to a qualitative dimension, because statistical analysis is based and derives from the unity of the qualitative and quantitative survey definition of the research problem.[6]

Scientific and social justification of research

Research needs are numerous. In the educational system must be installed mechanisms which will be reviewed constantly, updated, and modernized.

Determinants of new educational system are computerization, Internet, distance learning-innovated model.

The educational system of our country is in the process of significant change. An important determinant of success of educational institutions will be an indicator of how much they are able to provide to curriculum, the quality of teachers and teaching methods meet those needs and opportunities of future students in terms of ordinary and emergencies. Education is a matter of great importance, both for the economy and for society as a whole, especially in terms of specific situations. Many companies, schools and colleges would have interest to, through distance learning, educate their employees or retrained them through courses organized by the educational institution. Accepted concept of adult education and lifelong learning is just one of the elements that support the need for introducing some of the modern forms of distance learning. Internet classrooms with appropriate equipment offers new opportunities for improving educational work through distance learning, especially when it comes to organization and management of teaching in terms of specific situations (work, conducting and managing teaching in terms of epidemics, pandemics, the small number of students and professional teachers in rural areas, problems to transport students, education and training through work).

In such classroom, it can be set up such a labor organization, that all users receive tasks, to master them, to control themselves by appropriate modules, the teacher at any time have feedback on the performance of each student. In the classroom, it is possible to set up an efficient and rational organization of the teaching process. The introduction of Internet classrooms in the educational system with the support of modern telecommunication information systems would create a nucleus for further expansion of modern teaching technology in all conditions. This is how the educational system will more able to efficiently accept scientific and technological development. With this project would be, for the first time, developed and implemented innovated model for distance learning as a new form teaching realization, when it comes to organization and management of teaching in terms of regular and emergency situations (work, conducting and managing teaching in terms of epidemics, pandemics, small the number of students and professional teachers in rural areas, problems to transport students, education and training through work).

From these facts it can be concluded that there are numerous reasons that justify the introduction of modern forms of distance learning in educational institutions. And above all, it indicates the tendency of the development and implementation of new models of teaching and learning with the participation of modern information technology. It is necessary to determine the effects that teaching have realized by using Internet in the classroom with implementation of instructional content "Technical Education and IT", by distance learning.

4.6. Justification of research

Scientific and technical justification:
- Systematization of knowledge in these areas,
- Test methods, techniques and procedures in these areas by developing a single model,
- Verification of the model implemented in the form of the updated model of distance learning, which should be experimentally verified by applying the teaching of "Technical Education and IT", when it comes to organization and management of teaching in terms of regular and emergency situations (work, conduct and management of teaching conditions, epidemics, pandemics, the small number of students and professional teachers in rural areas, problems with transportation of pupils or students, education and training of the work).
Social justification: the updated model of distance learning in teaching, "Technical and IT education", which should be designed and implemented, should enable the development of professional knowledge, development of skills and abilities of students for solving real problems in terms of ordinary and emergencies. If we represent the view that investment in education increases the productive capacity and economic efficiency, if it is important quality, functionality and efficiency of education in all conditions, the distant learning and modernization of traditional teaching, deserves our full attention.

4.7. The research plan and expected results

Planned framework of research - The first phase of the research included the analysis of the previous theoretical knowledge of modern teaching 'Technical and IT education. "
The second phase included the creation of innovative models of teaching in order to reach greater success in teaching students' technical and IT education ", as well as experimental verification of the effectiveness of these models in terms of ordinary and emergencies. The experimental program will be implemented in the school year 20011/12. year.
The third phase of the research will include sorting of data, statistical analysis and interpretation of research results.
Distance learning, combined with a heuristic model of teaching, is a little explored and implemented in this geographical area, and some of the expected results will be indicators that will show the possibilities, advantages and disadvantages of this form of learning. It also will point out some directions for solutions to various problems that arise, as well as some new possible directions and areas of research on this subject in terms of ordinary and emergencies.

Scientific results
- Systematization of knowledge in these areas,
- Development of appropriate models of e-learning in the function of efficacy of the teaching process in terms of regular and emergency situations (work, conduct and management of teaching in terms of epidemics, pandemics, the small number of students and professional teachers in rural areas, problems with transport students, education and training in work).
- Implementation of the model in teaching, "Technical and IT education", in educational institutions.

Professional results
- Systematization of methods, techniques and tools, and
- checking methods in the implementation of the updated model of e-learning when it comes to organization and management of teaching in terms of regular and emergency situations (work, conducting and managing teaching in terms of epidemics, pandemics, the small number of students and professional teachers in rural areas, the problems transport students, education and training through work).
The social results
- Application of the results in the improvement of teaching activities in educational institutions in Vojvodina and wider;
- Consideration of the application of the results to the wider area of Serbia and the Euro region;
- Support to the Ministry of Education of Vojvodina and Serbia with a proposal to partner with who are signatories to the Protocol on Cross participate in the competition for funding from the EU IPA funds for equipping Internet in the classroom for emergencies.

5. DESIGNS AND IMPLEMENTATION OF DISTANCE LEARNING MODEL

The term distance education represents various models of education which have in common physical separation from the school / college and some or all of the pupils / students. Different models of distance education are characterized not only by the type of technology that is used, but also by place of control, pace and place where they give instructions. In some models, schools / colleges, or institutions have primary control, as is the case in traditional student environment. For other models, the control relies on the pupil / students. Media development represents focus point for the new process of distant tutoring, teaching and learning. The computer makes possible the interaction and manipulation of design data and content in a different way in comparison to traditional media communication processes. At the present time virtual reality accelerates this potential even more. Therefore, the development of information technology is foundation for planning the didactic program (as determined by important changes in the way information is produced and used).
In this way it is possible to:
- Creation of new communication links between pupils / students and teachers from a distance, favoring the transition from one-way communication (typical to early models of teaching) to the two-way communication;
- Use of computers as a systemic point, which rely on different media that allow achieving true integrated multimedia system modules: laboratory, library, multimedia products, data banks, the assessment-only system, exercises, evaluation sections, electronic boards.
The objectives of the distant learning are:
• To achieve a product that is sophisticated from a technological and educational point of view;
• The development and stimulation of pupil / student critical abilities so they can confirm, investigate and independently explain what they have learned;
• Developing opportunities in an independent movement of hyperspace in different research environments, in order to reach a better level of learning and understanding the phenomenon;
• Allowing better interaction with the professor - an important requirement for a good learning process;
• Using an integrated learning system, which allows achieving a high degree of interactivity and have access to a collaborative learning environment in which pupil / student must communicate with others (teachers and / or students). [89]
Model allows overcoming the physical and time constraints set by the educational process and enable the creation of rich, dynamic and stimulating virtual environment, creating new learning context that directly affects perception, action and memory, and new mindset is emerging.
Innovated model of distance learning in teaching technical and computer education is designed to emphasize individual skills of students. Navigation techniques give the opportunity to integrate open distant computer system, allowing the student to serve interface and constitutes new knowledge. These techniques make the interface suitable for an active, constructive, collaborative and interactive personalized learning on a shared Web workspace. Communicative relationship between the teacher and student can be enhanced by varying the features, images, or using animation. Joining the project in the educational area is shared without any

restrictions, each boundary, each and every distance barriers can be resolved thanks to new communication technologies - satellite bonding network to the Internet and share. With the development of new technologies, everything that student need to start entire process of learning from anywhere, is a personal computer. Interaction is achieved between distant users in different parts of the world as a process of intercultural education and cooperative learning strategies in an open system of spacing. Computer-assisted developing lesson provides access to knowledge through a variety of communication methods, types and forms. In such teaching, the student or pupil is free to move around in searching for contacts and interactions with each other and they were led towards the development of the learning process, and the structure of their knowledge is formed on collaborative but still personal way. Active learning is structured to avoid loss and confusion and to promote the transfer of knowledge. Learning is guided by a simple user interface: from simple to complex tasks, from guided exercises to research on the Internet, from the individual to the study of interactive dialogue between teacher and pupil / student and among the speakers (online forum). Without exception, effective distance education begins with careful planning or focusing on needs of pupils / students. Appropriate technology can be set only when these elements are understood in detail. Successful distant education program relies on efforts of pupils / students, faculty, administrators and staff. Getting to know the needs of the pupils / students is the essence of each distance education that operates effectively. The primary role of the pupils / students is to learn. This task requires motivation, planning and the ability to analyze and apply what has been learned. When the instructions are delivered from a distance, there are new challenges for pupils / students often separated from each otherby sharing interests, substitutability having little (sometimes it can happen that do not have any) contact with professors outside the classs, and have to rely on technology to fill the gap that divides those who participate in the class. The success of any distance education to relies on educational institutions.

The teacher must:

- develop understanding of the characteristics and needs of the pupil / student that is being taught from a distance, with little first-hand experience and limited face-to-face contact,

- adopt a teaching style, taking into consideration the needs and expectations of the majority,

- develop understanding of the technology that delivers it all, and still remain focused on their role in teaching, and to function effectively as a trained helper.

The most successful programs include distance education with pupils / student's registration, duplicate materials and distribution, security, regular report on the estimates and schedules. Although the administrators are influential in the planning of the program, they often lose contact with or a control to technical managers. Administrators of programs that operate make decisions about most things. They work very closely with the technical staff, assuring that on technical side, everything works as it should. They actually maintain an academic focus, understanding the needs of the pupil / student. Professors who teach in classroom are focused on: - who is writing notes, which is is trying to understand a difficult concept or who is about to make a comment. Pupil / student who is frustrated, confused, tired, or pupil / student who is bored also gets noticed. The professor has to decide by these data, what are in fact the needs of pupils / students, and to determine the lessons that would be appropriate. In contrary to all this, a professor from a distance has almost no visual contact. These contacts are are passed through the filter of

technological devices such as video monitors. Reasons why they should teach at a distance: - have a greater number of pupils / students, help pupils / students that are not able to attend classes in a traditional way, include an opinion on the side that is otherwise unavailable in most cases, linking pupils / students from different social, cultural, economic and experimental environment. Suggestions for improvement plans and organizations are: plan to begin course by providing for other study programs with distance education; before developing something new should be checked existing materials for the presentation of ideas; to analyze and understand the advantages and disadvantages of possible systems available for learning (data, video, audio and print), not only in terms of how they are delivered, but in terms of the needs of the learner; create rules and standards, and when they are set to obey them; make sure that each site is well equipped, and if the materials are sent by mail to make sure they were received long before class began and, in order to function effectively, it is necessary that the pupil / student fully agree with the way of teaching and learning at a distance, should invest a lot effort to keep pupils / students motivated and to find out the needs of the pupils / students; help pupils / students to become familiar with the technology and prepare them to resolve technical problems that can occur; about pupil / student should know as much as about professor; make pupils / students aware and familiar with the new forms of communication that will be used in the future; remember that pupils / students must play an active role by taking responsibility for their own learning.

It should be be paed special attention to the following:
- Each pupil / student who participates will have different learning styles. Some will be easy to learn in groups, while others will achieve better results if are separate.
- Avoid long and boring lessons. Combine presentations, discussions and a variety of exercises.
- Focus on pupils / students and not on delivery system of knowledge.
- Use short sentences and ask direct questions. It should be known that the technical connectivity can slow down time that pupil / student needs to answer.
- Develop strategies for displaying, repeating and strengthening students' knowledge.

Those who participate will quickly become familiar with the process of distance education and natural rhythm of teaching will be returned. Developing instructions enables systematic planning and development of instruction based on the needs of learner. This process is required in education programs from a distance, where the instructor and pupil / student can share certain things and have a minimal contact, face to face.

Most teachers follow basic steps:
- The design phase,
- Development,
- Evaluation and
- Audit.

I Design phase
It includes:
Determining the need for guidance-should first determine what led to these needs and which previous experiences have indicated that the instruction that is well planned cause these needs.
Analyzing the audience - To better understand the learners and their needs should be taken into account their age, cultural background, previous experiences, interests, and educational levels. It should be examined how much are familiar with

instructional methods and systems that are taken into consideration, determine how to apply the knowledge that will achieve during the course of distant learning, realize if the class consists of pupils / students with different characteristics.

When it is possible the teacher / instructor should visit the site and interview the pupils / students individually and in small groups. Such attention will show pupils / students that the instructor is not present only anonymous, but is also connected to electronic technology.

Achieving goals - Based on the nature of the problem as well as on needs and characteristics of pupils / students.

II Development phase

Presentation of existing materials - Instructor should show the existing materials. Instructional materials should not be used separately, but shall be used in virtual distant classrooms.

The organization and content developing – It is the biggest challenge facing those who teach from a distance.

Phase III evaluation

Displaying objectives - only purpose for evaluation is to determine whether the instructional methods and materials achieved their goal. Implementation of instructions represents the first real test that has been developed.

Develop a method of assessment - planning how and when to evaluate.

IV Review phase

Revision plans have been caused by evaluation process. The best choice of revision ideas are in fact teacherss observations. Because of this audit should be planned as soon as possible.

During the establishment of distant learning program, the first thing to be taken into consideration is the prices for that system.

Several components prices which affect the design of the distant learning systems:
- Technology - hardware and software;
- Transmission - transmission cost approach;
- Maintenance - repairing and upgrading of equipment;
- Infrastructure - fundamental and telecommunications networks and infrastructure;
- Production - technological and personnel support required to develop and adapt learning materials;
- Support - various costs are required to ensure that the system operates effectively, including administrative costs, registration, counseling, local support costs and excessive expense;
 - Staff - describe all the features in advance.

5.1. System for distance learning – dLearn

DLearn is a web-application which was developed for distance learning has emerged as a technological solution to one of the final phase of the project 3215 - Distance Learning System based on Internet technologies, with the use of multimedia educational software and Project 1825 - Distance Learning. The system was developed by design team from Zrenjanin's Technical University, under the auspices of the Ministry of Science, Republic of Serbia. After researching and comparing existing systems for distance learning, was created a system that is based on the concepts of instructional content for the Web and on-line testing. The biggest advantage of the system dLearn compared to other programs for distance education (Moodle, Joomla) is that it is created for the target population of pupilss / students,

while other software packages are universal and they have to be subsequently adapted to the needs. The system is still in the early development stage and, therefore, many options are not currently available, but are working on to their final design. Software platform is based on Microsoft solutions, witch is not cost effective, instead platform based on Linux would be more suitable for our needs. DLearn system is easily adapted to the needs of distance learning. It is especially important that the system is easy to implement and administer. Teachers need to know basic computer skills to use this system. With this basic knowledge every teacher can create a course and make full use of all the opportunities offered by the application. Pupils / students are required basic knowledge of computer and Internet use, in order to use system dLearn.

5.1.1. Definition of the system for distance learning

There are several popular definitions of distance learning (hereafter DL). The California project correspondence study (CPCS) uses this definition: Corresponding studies (CS) is an educational "delivery" system that connects learners / students with educational resources. DL provides education to persons who are not registered in educational institutions, and can increase the potential for learning. Implementation / execution of DL is a process that uses available resources, will be developed and include the upcoming technology. AT & T uses this simple definition: CS is focused / managed system or process that connects learners / students from distant sources. CS can be a primary or additional learning tool.
American Association for DL (USDLA) defines DL as:
Making possible the education or training through electronically delivered instruction including satellite, video, graphics, audio, computer, multimedia technology, and other forms of distance learning. USDLA says that DL is related to teaching and learning in situations where the teacher and the pupils / students are geographically separated and therefore contact only through electronic devices and printed materials.

Basic Concepts
Distance Learning (DL) represents completely new technology in relation to the entire history of learning and it has been developed for the last 150 years thanks to technology that is constantly improving since the Industrial Revolution, especially with development of transportation and communication.
It is characterized by the separation of the pupil / student from the teacher and the pupil / student from students group. Interpersonal communication is replaced with a conventional education communication technology. Cooperation between schools, open universities and other structures today complements and enrich conventional. The main characteristic is individuality.
Rapid development of information technology in relation to the technological revolution of the '80s has given rise for the first time in history an opportunity to learn "face to face" at a distance. Electronic connectivity of teachers and pupils / students on different locations by cables, microwaves or satellite has enabled creation of virtual classrooms and group methods of distance learning. Virtual classrooms are specially equipped electronic classrooms in which the class is learning, and that each may be associated by cables, satellitesand microwaves. Virtual classrooms can be one-way or two-way directional for audio and video.

Group-based forms of distant learning are significantly different from an individual-based system of logic and didactics.

Features of DL
The most important characteristics of UND are:
• Globalization.
• Individualized learning.
• Privatization of learning.
• Industrialization.
• Mobility of the new technology.
• Speed feedback.
• Less costly than other types of systems.
• Technology and education.
• Internet.
• Very large systems.
• Professionalism.
• Creating a learning environment.
• Flexible learning.
• Open learning.
• The industrialization of teaching and privatization of institutional learning.

Characteristic elements of DL
Several key characteristics define DL. These are:
-Separation of teachers and pupils / students for most of the educational process;
- The use of educational media that connects teachers and pupilss / students and carries the course content;
-Enabled two-way communication between teachers, tutors, or agencies for providing education to pupils / students;
- Temporal and / or spatial distance teachers and pupils / students;
- More important is the will for work of the pupil / student than teachers.
The rapid technological changes in the educational system should provide higher education opportunities without increasing the budget. Many educational institutions respond to this challenge by developing distance education programs. Basically to DL's coming when the teacher and pupil / student are separated physically distanced, and technology (voice, video, and print data) is often associated with face-to-face communication, that is being used to connect them. These types of programs can provide adults who are limited by time, distanced or are physically incapable, another chance to complete their studies, or modernize knowledge workers in their workplaces.

The problems of the conventional system of education
        Overcoming the problems of conventional education is also an important task of the system for distance learning. One of the main problems of schools in rural areas and college towns is that have a continuing lack of qualified personnel. In some states clearly is present distance of centers, schools or faculties by parent institution in which the instruction is given. There are students who are not able to attend classes. A small number of students have had bad experiences in education. Practical disadvantages of traditional education are writing complicated formulas, drawing scheme, the problem of expensive and inaccessible simulations, experiments and practical exercises, mechanical copying of content off the board by the pupils / students, etc…

The objectives of the DL

The objectives to be achieved by the introduction of such systems are:

• Increasing efficiency of the teaching process from the perspective of teachers (teaching) and from the point of pupils / students (learning).

• Availability of content and equality of pupils / students.

• The completeness, timeliness, correctness and unification of content and presentation style.

• Better management of teachingand identifying problems.

• Time saving for access and preparation for learning and teaching, it is also cheaper to change the content.

• Faster feedback on the acquisition of material.

• The obviousness (multimedia) and increasing the motivation of the pupil / student.

• Individuality (age, interests and regional affiliation) and socialization.

• Continuous learning.

• Teaching the teachers.

• Implementation of primary, secondary and university education.

• Continuous adaptation and development services for the last user - the pupil / student.

• Validation effectiveness of the methodology through the evaluation by the pupils / students.

Forms of DL system

The basic forms of DL system are:

• Multimedia systems (integrated audio, images, video, text) for distance learning.

• Hypermedia Courses - multimedia systems extended by links, links to other thematic areas - hyperlinks.

• Lessons real time in the affiliated classrooms (video conferencing, teleconferencing).

• Interactive lessons (via Internet, dynamic and static presentations, electronic instrumentation laboratories - remote control of physical and chemical tools in the laboratory).

5.1.2. Hardware Platform

Elements of hardware platforms

Hardware is the foundation that allows the the functioning DL. Hardware defines characteristics of DL program, DL presentation content and possibilities of making program DL.

In order to achieve a program that allows DL is necessary to identify computers on that will conduct certain activities in the process of DL. Computers in the system DL may be classified by functions they perform in the system.

Functional division of the computer within the system DL is:

• DL servers

• Access Servers

• Station for processing text content DL

• Station for processing graphic content DL

• Station for processing audio content DL

• User station.

Servers of DL

DL servers need to have high-speed processing user requirements, high level of security and reliability. High speed processing of user requirements is achieved by processing power and amount of RAM. Security and reliability in terms of hardware is achieved by using a RAID controller that allows the coupling of multiple hard drives. Coupling is implemented in mirroring mode in which data is written onto multiple drives at the same time and in case failure of one of the disks without interruption of work server data is read from the other drives. This provides the security of data and the speed is achieved by loop stripping the hard drive mode where the data is divided into several parts and each part is written on a separate disk. This provides the security of data and the speed is achieved loop stripping the hard drive mode where the data is divided into several parts and each part is entered on a separate disk. By combining mirroring and stripping mode it can be achieved high speed of operation and reliability of the data.

Access Servers

Platform central systems for distance learning make access servers that can provide access to following ways:
- Dial-up
- Access to local network
- Internet access

Dial-up is realized by direct link users to the server via a telephone line. The advantage of this system is greater access security in transfer data, but increases the effective cost of telephone calls. For this type of connection are required modem and a 56 kb / s for the substantially weaker slow data transfer.

The local network is implemented by using network cables which workstations are connected to the access server or wireless connections. Link can be realized with connection of 10 Mb / s or 100 Mb / s, depending on the content DL, or the number of users which are simultaneously accessing the server. The advantages of such links are transfer speed, security and stability in operation.

The most optimal way of connection in the local area network is being implemented through Ethernet technology. Internet connection has access through the global network and its benefits are that it is possible to access the server from anywhere in the world at any time allowing wider application of DL. The lack of such links is relatively imperfect protection from viruses and other invaders that can affect the security of data transfer.

5.1.3. The software platform

The operating system

Setting up an Internet-based system for distance learning is a very complex process. Two main steps in the process are:
- Installation and setup operating system
- Installation and Adjusting Web server

The first step is to select the operating system that will be installed on the computer - web server. This is a central part of the system, and to this step must be paid special attention because decisions that are here brought conditional on any subsequent steps. In fact, if we genuinely decide for one of the possible operating system then all other softwares will be adapted to that platform. As a solution in such case is impose two platforms. Since the use of the both platforms has its

advantages and disadvantages will be presented parallel solution for the both platforms.

The world's most popular operating system for web servers is UNIX. His popularity is even higher if we take into account the Linux operating system (http://www.linux.org). Much of its popularity these systems due to the fact that they are almost free systems, and high-reliability systems that do not require excessively heavy and expensive hardware platform to work with. All the necessary server software for the operating system is free and can be easily found on the Internet. Installation of the software is relatively easy and reliable services work. The software can be available in two forms. One is a binary format and such is only usable on the platform on which it was created. The source code is much more flexible solution, because it is can compile a large number of platforms. There are many types of UNIX operating systems, but for this purpose, currently the world's most popular operating system is Linux. Linux also exists in a number of variants, or different distributions (RedHat, SuSE, Debian, Ubuntu, Fedora ...). It should be noted they are all approximately similar in terms of environment, functionality and features.

Linux is an alternative to the BSD operating system, which is also available in a number of sub-variants, or different distributions of NetBSD (http://www.netbsd.org) and FreeBSD (http://www. Freebsd.com) Given the good experience and wide distribution in this region one of the best solutions would be a selection of Debian or CentOS Linux distributions.

Web server

During selection of a web server it must be paid attention to number of factors.Important factors that influence the decision are cost, ease of installation and configuration, and support for CGI scripts, or other scripting languages. There are plenty of web servers that are free or commercial, as in the previous case, there are two choices, depending on which platform has been chosen. Web servers are: - Apache, Nginx and Lighttpd. Apache Web Server is a web server version that was originally developed for the Linux platform, but which eventually ported to the Windows platform so it can be used in both cases described above. Apache web server is completely free and can be downloaded via Internet at http://www.apache.org.

Nginx

Nginx (pronounced "engine X") is the second most popular open source web server currently on the Internet. Though development only started in 2002, its currently used by over 6% of web domains. It is a lightweight HTTP server, and can also serve as a reverse proxy and IMAP/POP3 proxy server. It's licensed under a BSD-like license. It runs on UNIX, GNU/Linux, BSD, Mac OS X, Solaris, and Windows. Nginx was built with performance in mind, in particular to handle ten thousand clients simultaneously. Instead of using threads to handle requests, like traditional servers, Nginx uses an event-driven (asynchronous) architecture. It's more scalable and uses less and more predictable, amounts of memory. In addition to the basic HTTP features, Nginx also supports name-based and IP-based virtual servers, keep-alive and pipelined connections, and FLV streaming. It can also be reconfigured and upgraded online without interruption of the client processing.

Lighttpd

Lighttpd (pronounced "lighty") is the third most popular open source web server. This lightweight server was initially released in 2003 and currently serves less than 1% of web domains. It's licensed under the revised BSD license and runs on UNIX and Linux.

Like nginux, lighttpd is a lightweight server built for performance with a goal of handling ten thousand clients simultaneously. It also uses an event-driven (asynchronous) architecture.

Content protection and access rights

When you set a web-based system for distance learning certain users or certain groups of users will not be able to access all site content. For example, pupils / students can access all the material, but only those who are part of the material that is currently being taught. Then, the pupil / student's materials can not be accessed by those who are not pupils / students. And no one should have access to a piece of content that is related to test and correct answers except for an administrative person who is responsible for the completion and maintenance of the database. Distribution of user groups and assigning access rights to certain groups, ie determining which facilities are visible for some groups is beyond the scope of this topic, but an important question that should be taken in planning process. For this topic is important way in which this can be achieved in the described platforms. Apache server and Linux platforms can restrict access to specific users and groups with a specific directory. On this occasion, it is necessary to develop a system for authenticating users that will allow or deny users access based on entering a username and password. There is a way to prohibit access and individual computers, eg. with all computers outside of the LAN facility. This approach, however, is not suitable, since this is about installing and configuring the system for distance learning, and that such protection was unnecessary. Similar principle applies to other platform.

Connecting the server to the network and security

Server to be used needs to be assigned a unique public IP address from the IP address block of the organization. Additionally it needs to be assigned a domain name, according to which it become accessible to all users. One of the goals of this whole process is to connect the web server to the Internet. In this way, content which is located on the web server, also designed for distance learning will become available to any user with an Internet connection. Some of the potential users of the system will use its services for distance learning, but it can easily happen that this system becomes a target of some malicious users whose priority is damage, ie attempt to break in the system and then to other computers in the LAN facility. Therefore, as an important issue raises the question of security system itself. Use of new and safe server software and regularly upgrade to new and secure versions of the same software is a good way to reduce the possibility of intrusion system. Regardless of the platform, we have decided to Linux or Windows, Apache or ISS, the manufacturers of these software vendors are continually publishing new versions that remove detected vulnerabilities. In addition to the regular maintenance of server software is necessary to complete system protection and firewall software, which is used for packet filtering and restricting access to certain services system with individual IP addresses. For both platforms is available this kind of software. On the Linux platform, it is ipchains that comes along with the installation of the operating system. The program is easy to use. In the process of protecting the

system a useful tool could be one of many programs that can be downloaded free from the Internet, and that scan certain hosts and provide information about the security vulnerabilities of individual services. These programs are useful tools for all system administrators, as well as for system administrators of distance learning.

Installing other software required for the system
In addition to the basic functions that a Web server can provide, it is necessary to provide support for additional scripting languages and database. Databases can be helpful in preserving and presenting educational contents and they must be used. Again there are two possibilities. The first option is to work with the PHP scripting language. There are versions for Linux and Windows platform. PHP is a solution used in combination with Apache web servers and database management system MySQL or PostgreSQL which are also free.

Mail server
It may happen that there is a a need for a web server also used as a mail server. If in the LAN is not any other computer that serves as a mail server (depending on the environment), and email communications between participants in the process of distance learning is necessary, it should be installed proper server software for email communication. On the Linux platform, there is a software package sendmail, which is free and can be downloaded from http://www.sendmail.org or Postfix http://www.postfix.org/.

FTP server
The participants of this process, especially pupils / students should be allowed to download and upload material. Therefore, should be installed appropriate FTP server such as the vsftpd or proftpd.

5.1.4. Technological components of Web-based learning system

Technological components that make a web-based learning system are:
- Client software and hardware. Software and hardware pupil / student and teachers are using during operation in a web-based learning system.
- Server Software and Hardware: Software and hardware where is situated the learning system. It controls the system and the communication between the user and the system.
- The method of distribution. The method of distribution servers and clients use to communicate and share information.
- Technical support. Training, problem solving, documentation and maintenance are very important for the proper operation and use of the system. Information processing and communication in web-based learning system is conducted on one or more servers that provide all the necessary services, such as the table of contents in the form of web pages, e-mail, tracking the pupil / student, check authenticity of participants in the learning process. The servers have a dominant influence on the possibilities of the system.

An overview of possible architecture for web-based learning system
An important aspect of a web-based system that makes it easier to use and maintain is design and construction of simple and efficient system architecture. Given the variety of technologies used to build web-based learning system and the diversity of users, the dislocation of the system and the user, web-based learning

system should be designed as a system with a multi-layer architecture. Applications should be scalable, component-based, that support distributed and easily customizable layers by constant demands for changes, which are the most dynamic in the web environment. Web-based learning system is based on a client / server application architecture, which are a natural choice given the characteristics of the system and the choice of Web technologies as the basis for the system. Basis architecture of client / server is the existence of client and server computers. Essentially, clients require the services and servers can provide. The client is computer software used by the user to communicate with the system. The simplest is a two-layer architecture, which basically contains the client and the server, which in most cases has a database accessed by clients. Systems with two-layer architecture has many drawbacks, such as the incorporation of application / business logic or the client, or in the database, and is generally not the best solution for developing complex web-based systems such as the system of distance learning. Expansion of two-layered architecture is three-tier architecture that introduces middle layer consists of a web server jointly with the program logic that extends the server services (Server Extension Program). Three-tier Web-based system is shown in (Figure 5.1.) The introduction of three-tier architecture achieves reduction of network traffic, better use and sharing of components that make system, increasing security. To communicate in such a system is used the HTTP protocol. The layers that exist in the three-tier architecture based on the service provided can be divided into:
- Customer Service (User Services). These services provide user view of the application, which is usually implemented through a graphical user interface.
- Business services. These services are a central part of the application and they implement the basic application logic that defines how the application will work.
Business services have a dominant influence on all aspects of the application.
- Data services. These services control access to data.
Most of these services are implemented in the form of a system for database management. The purpose of these services is to users hide the implementation details of the database system.
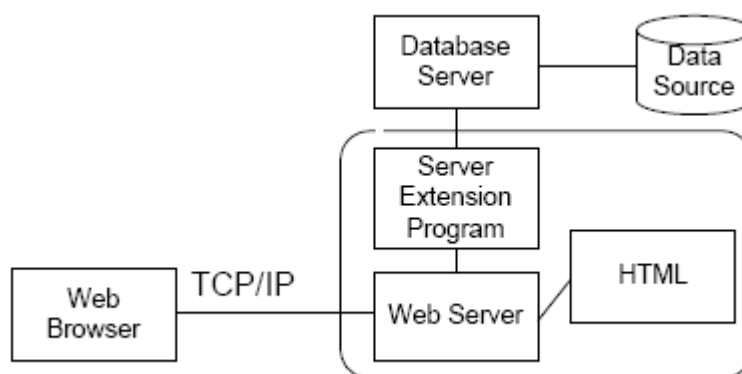
Figure 5.1. Three-tier web-based systems

Use of programs that expand the server in the middle layer, is the separation the web server and database server for which there are already standards. This ensures ease of system maintenance through independent maintenance of the web server and database server, as well as programming logic, which is located in this software

extension. Also significantly facilitates the management of communication between layers and reduces network load. Server software extension can be accomplished in several ways, which can be roughly divided into: CGI scripts and server API. CGI allows writting programs for Web servers that are portable to different platforms of Web Server. Communication between web server and CGI programs is performed by environment variables (Environment Variables) and the standard input of the operating system. CGI programs to extend web servers are usually written in the programming language Perl and C or shell script language operating system. A server side can use a variety of scripting techniques. The choice depends on the scripting language platform web server. The common techniques scripting are ASP on Microsoft NT server platforms and PHP, Perl or shell scripts on a Linux/UNIX server platforms. The advantage of expanding web server with server scripts is primarily ease of use scripting languages to the standard CGI or API. Web server provides an API for programmatic expansion server that can be used instead of CGI. In this architecture, software extension is implemented as a DLL library on Windows NT server or shared object on Linux/UNIX servers. Basically, the software extension in this case is implemented as compiled object-library routines which are called by the web server. Extensions by using programs written with the help of APIs are significantly more flexible and more efficient than use of CGI programs or scripting on the server side. Every web server has its own specific API, and there are commercial extensions for server APIs.

As usual extension of the programming environment appears ODBC server layer. ODBC creates a layer between the server program and database. ODBC is an API that provides a uniformed way to access relational databases, and can be used with databases of different vendors. ODBC layer that allows software extension server can function unchanged when changing the databases. (Figure 5.2) shows the extension of the three-layer model by adding the ODBC layer between the server and the database.
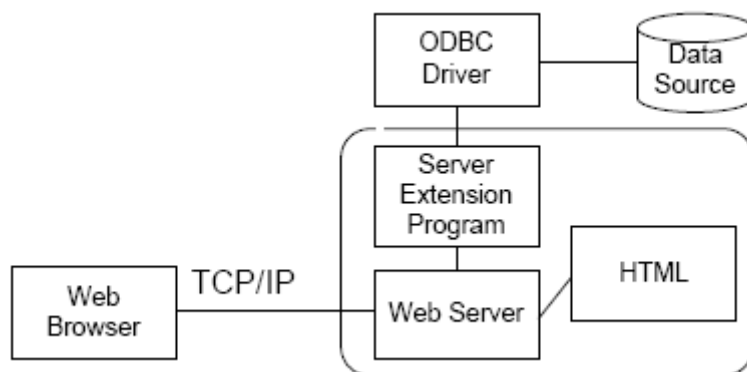
Figure 5.2. Architecture of a web-based system with an added layer of ODBC

In addition to expanding on the server side, the web-based systems can appear and expansion on the client side (Client-Side Extension) that adds new features web browser. Most expansion means adding validation input form fields through which to enter data. In (Figure 5.3) web system is shown expanded on the client side.
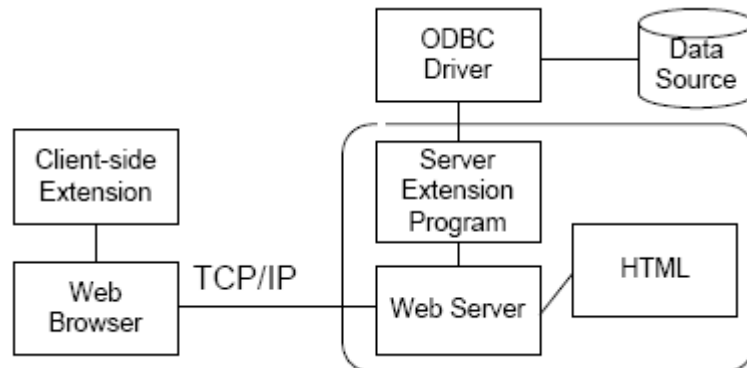
Figure 5.3 Architecture of a web-based system extended to the client side

Extensions on the client side can be divided into the following categories:
- Support application (Application Helper). The stand-alone applications can be called from a web browser, which requires retooling browser. These applications are not integrated with the browser.
- The application inserts (Pluggable Applications). They are used to process and display the data that a web browser can not directly handle. They are much better integrated with the web browser-player of the auxiliary applications.
- Client-side scripting is used to extend the functionality of Web pages, such as the validation of data input by the user and add dynamic elements. The most commonly used is JavaScript.
- Java applets (Java Applets). Compiled programs that are downloaded with the HTML page when it is required and then run in browser. Java applets are downloaded every time the HTML page is request. Java applets are programs written in the Java programming language, and are therefore the most powerful extension to the client.
Combined web-based system is used as a pair of two-layer applications that run concurrently. In this system, web components and database components work together, but not in the three-tier architecture. In such a system the browser takes over the client database application that runs as an extension of the client. In Figure 5.4 is shown a combined web-based system.
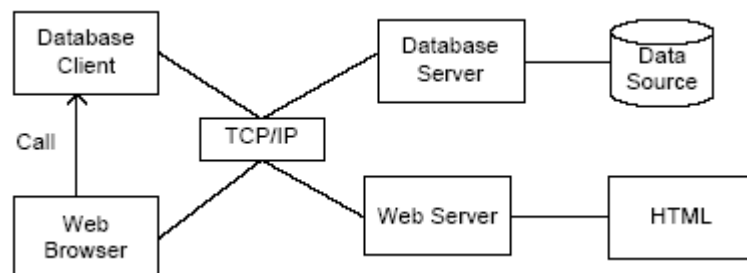
Figure 5.4 Combined web-based system

The study in order to elect architecture that best suits the project is one of the most important tasks. In general case three-tier architecture is robust enough and meets the needs of most projects. It can be used and N-tier architecture that is an

extension of the three-layer architecture. N-tier architecture subdivides the three main layers of the three-layer architecture for additional layers, which are based on logical or physical services that the application provides. In multi-tier applications middle layer loses its meaning, and the layers based on service they provide is easier to identify. Sharing the layers we reach the level of components that are organized to meet the needs of identified services. Services are implemented as a collection of components that are distributed and can be dynamically reconfigured. Solution which is suggested is a multi-layered architecture of of Web applications to a central server databases, web servers and application servers and clients which will be used to access the database and application delivery of Web-based distance learning system. To implement the system, officially approved are web technologies based on the Linux platform, which is shown in (Figure 5.4.).

This solution includes:

- The existence of so-called thin clients that are used on client computers, which are implemented by using web browser.

- For the realization of the web server will be used Apache, which is supplied as part of any Linux distribution and provides an excellent collaboration with MySql database, as well as support for PHP (*Hypertext Preprocessor*) as server scripting technology.

-For the implementation of the database server would be used MySql as a reliable, fast and highly scalable platform with great potential. Specifications of the system database management provide excellent performance and easy expandability.

5.1.5. Specification of user and system processes

Designing systems for distance learning means that the first are defined system users and processes in the system.

The system users
System users for distance learning can be divided into three main groups: teachers, students and administrators. The model class of system users, with the presentation of attributes, is shown in (Figure 5.5).
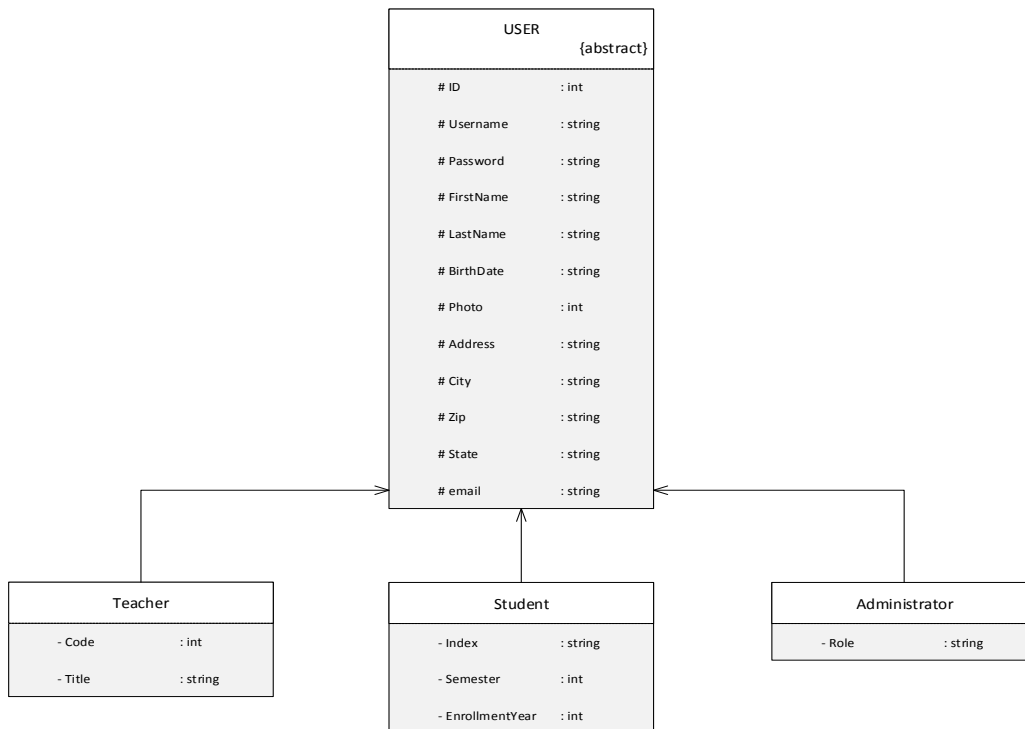
Figure 5.5. Model of system users in distance learning

Teacher

It was assumed that a teacher within the system of distance learning should have the following features:

Applications to the system for DL;

Activities of teachers related to courses:

- Creating a new course - equivalent to teaching subjects
- View a list of all existing courses in the system for distance learning
- Review of private list courses where he participates (dynamically changes depending on the number of courses created and / or associated courses)
☐ Selection of courses for joining many teachers in the same course,
- Creation of teaching themes, teaching lessons, adding attachments, exercises, tests, knowledge creation,
- Updating the teaching contents,
- Placing news related to the course,
- Access to the list of those who attend his course (with their status improvement, possibility to send message),
- Monitoring the learning and progress of pupils / students;
- Send and viewing a message;
- Logout of teachers from the system for DL.

It has been designed a diagram of using cases of system for DL with functions of teachers in order to indicated assumption be implemented, which is shown in (Figure 5.6).

Figure 5.6 Teacher actions in the system for distance learning

Aiming to complete description of the system for DL provided an overview some of the use cases:

Applications to the system in the following cases:

- Old user, the correct username and password - the message about the successful accession into the system and depending on the user's status, go to portal for teachers and students / student;

- The old user, incorrect password or user name - followed by the message of the unsuccessful accession into the system with the ability to return to the login page;

- New user - following form to enter information about the new user, which will be forwarded to the administrator who performs account activation. Creating a new course - for what is planned to define the name of the course and the number of credits the course carries. After creating the connection with the selected course follows the formation of educational topics. This includes: a topic and a number of the topics in the course. This is followed by creation of new teaching lessons to the selected topics with the following characteristics:

- The lesson,
- Number of lessons to subject,
- Text content of the lessons,
- Type of interactivity (active, frontal, combined, undefined)
- The level of complexity (very low, low, medium, high, very high),
- The level of interactivity (very low, low, medium, high, very high),
- Areas of application (primary education, secondary education, higher education, vocational education, postgraduate education, professional training (additional specialist courses))
- Type of material (lecture, exercise),

- Time teaching (teacher determines the estimated time required to master the lesson).

Teaching lessons may include one or more attachments for which there is: the type of attachment, the name and path of the file string.

Forming tests - includes: name of the test, the number of questions in the test, the date of the duration, type (test or exercise exam test). The teacher forms the basis at least as many tasks as they will be on the test and thus one task can be found in several different tests. In relation to the tasks is defined by teacher: the task, the level of difficulty, whether it is or not exam, and responses that were offered. Answers could include:

Individual (when is required entering correct answer) or multiple choices. Monitoring the learning and progress of pupils / students-the progress of pupils / students can be seen through insight into completed lessons and passing tests. Send and view messages - which enable communication between system users. Each message has a title, the content and the date of mailing. Messages enabled consulting and content creation of individual courses by the pupils / students.

News - are set automatically when the teacher declares a particular message of the news within the course. News may include the date of the test, the appointment of new content and so on. Follows teacher's logout of DL system.

Pupil / Student

User (pupil / student) in the system of DL enabled the following:

- Login to the system of DL;
- joining a group set up by teachers in order to attend the course;
- Selection of lessons that will be learned whereby the completed lesson is considered that which pupil / student approached. Order in which the lessons are learned is arbitrary and can vary from pupils / students;
- solving tests - there are two types of tests: test for practicing and final test.

In the test for practicing there is information on the number of correct answers, and it can be handled at any time within the stipulated time limit. Final tests may examine and evaluate teacher, they are implemented at the foreseen time and only on a predetermined date;

- Send and view messages;
- monitoring learning progress in a course through a review of completed lessons and passed tests.

Use Case Diagram for the pupil / student is shown in (Figure 5.7).
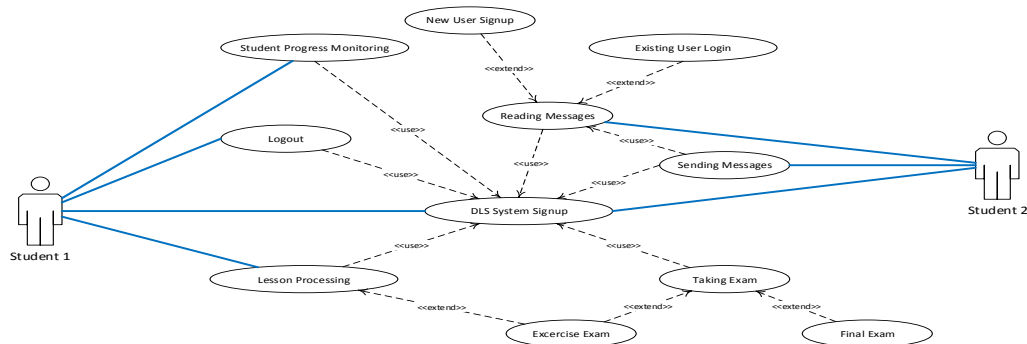
Figure 5.7. Actions of pupils / students in the system of distance learning

Administrator

In the dl system administrator is allowed following:
- Login to the system;
- User Administration - activate new user accounts, teachers and students, after they complete the application form of the new users, updating existing users (changing access rights if there are reasons);
- Send and view messages;
- Overview statistics system - an overview of all customer data, search users, insight into how much the users is in the system, how many teachers and how pupils / student, the total number of lessons that prepared teachers, the total number of questions and answers, exercises and tests to assess the knowledge and the total number of messages in the entire system.
- Administrator's logout

Use Case Diagram for the administrator is shown in Figure 5.8.
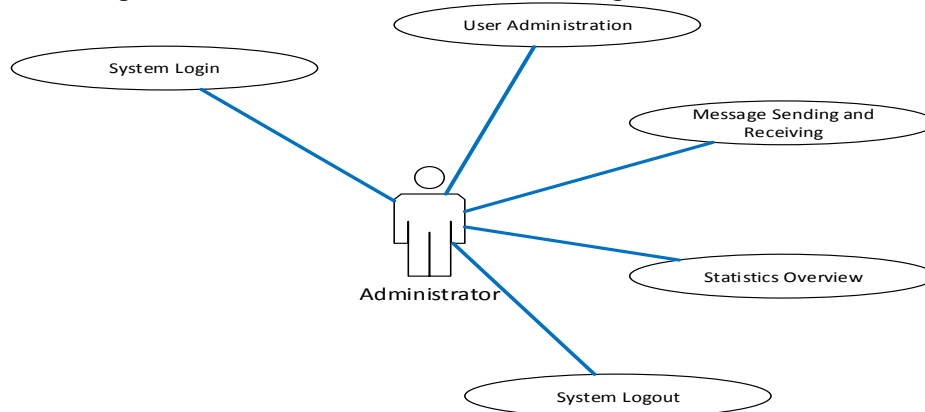
Figure 5.8. Administrator actions in the system of distance learning

As it can be seen, the system of distance learning use different users with different security level to access the system. It is therefore necessary to define a security model that enables assignment of different roles to the user. Based on the assigned role IS determined whether the user has access to a resource or not. One user can be assigned to multiple roles.
The typical processes of system
Processes in the system of distance learning can be grouped into modules within which they are implemented. Below are presented typical processes for user administration system.

Signup process to the system is shown in (Figure 5.9).

Login Initialization

Users DB → User Login

User Authentication

Is user logged-on? — No → Deny Access

Yes

Grant Access

User has signed in

User can not sign in
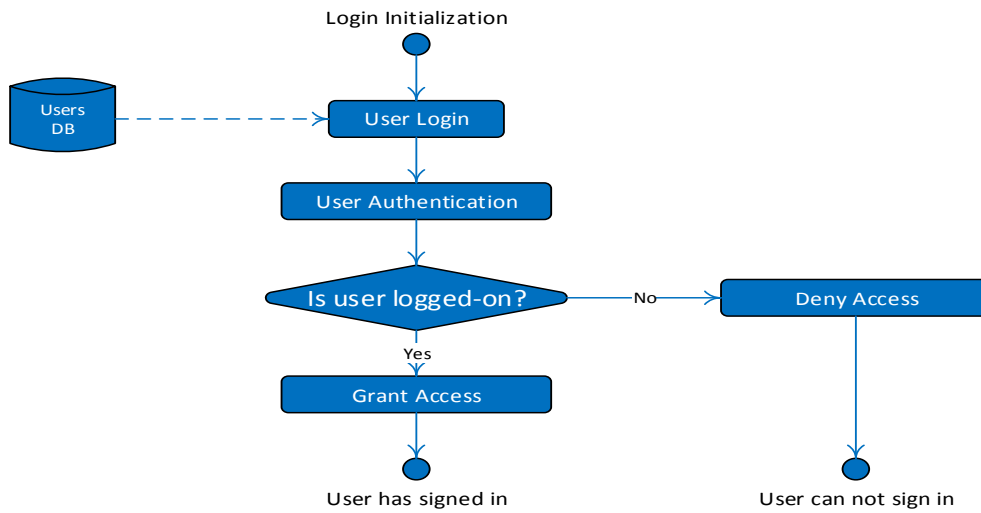
Figure 5.9. Model of application process to the system

The process of registration involves filling out forms for accessing the system and is shown in (Figure 5.10).

Filling out Login Form

Displaying Login Form

Entering Username

Entering Password

Login Confirmation — No → Display Information that login process was aborted

Yes

Grant Access

User has signed in

User has quit
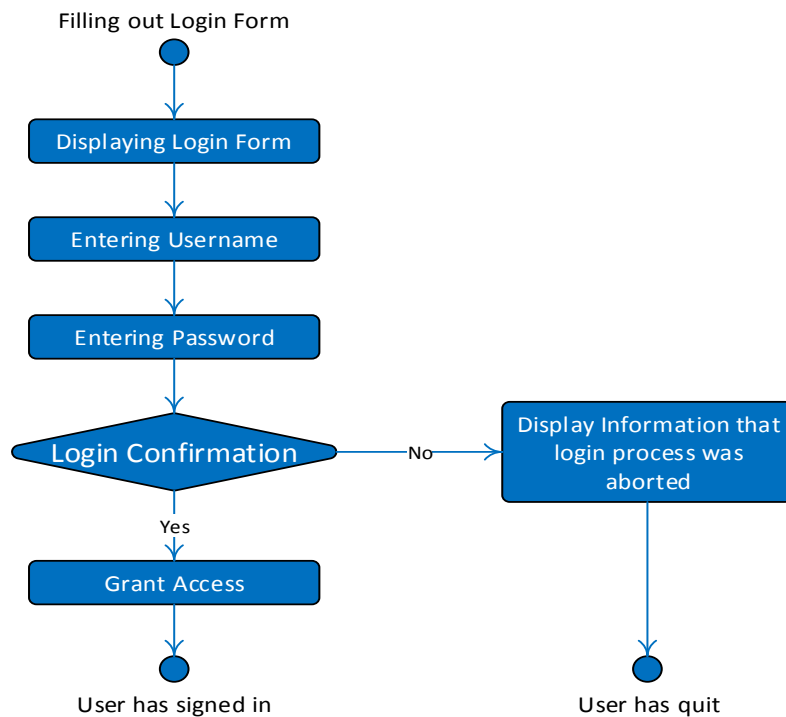
Figure 5. 10. Filling out the application form

The process of adding a new user is shown in (Figure 5.11).
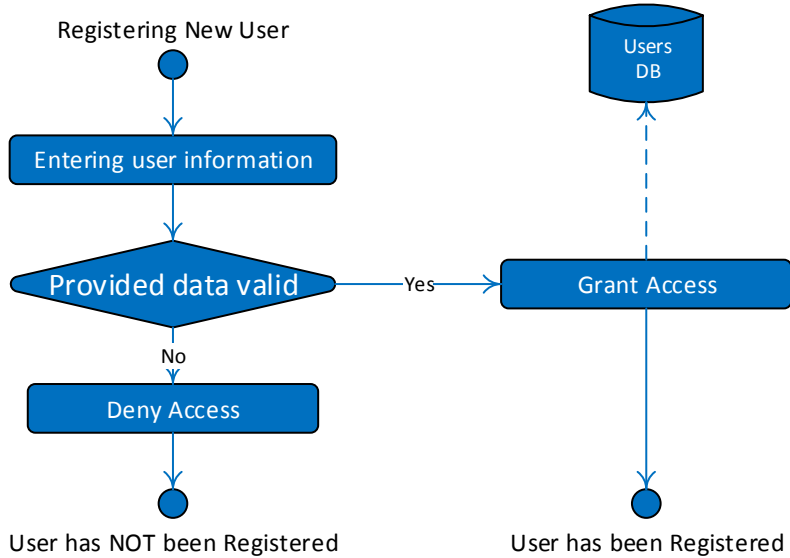
Figure 5. 11. Adding processe of new system users

(Figure 5.12) shows the process model of editing user's data.
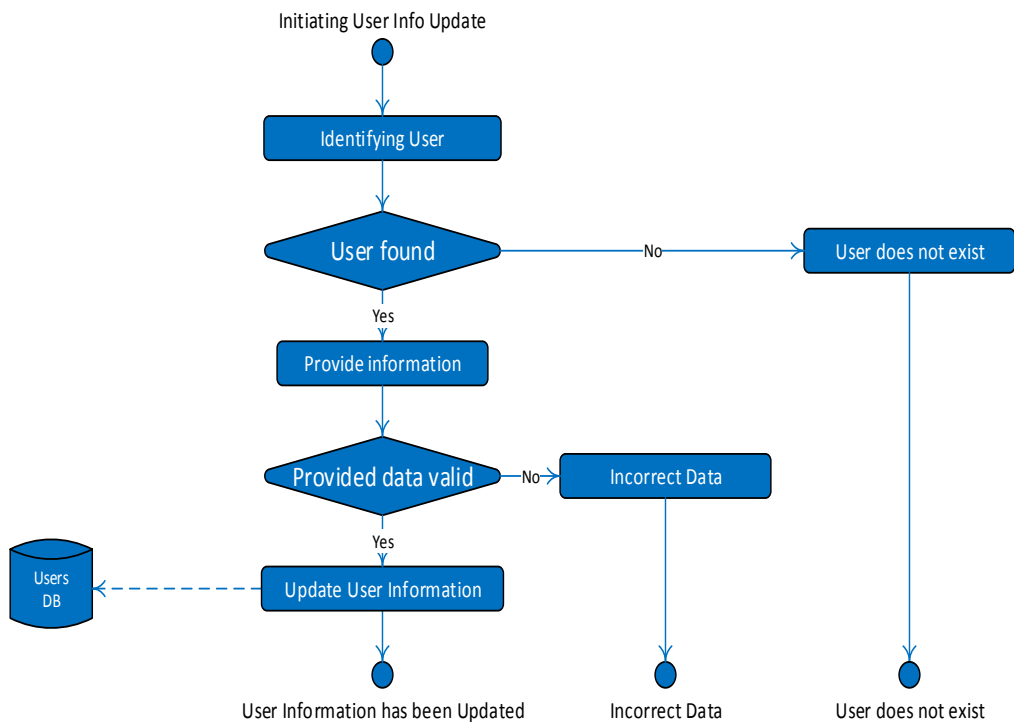
Figure 5.12. Model of the process editing user

(Figure 5.13) presents a model process deleting the user.
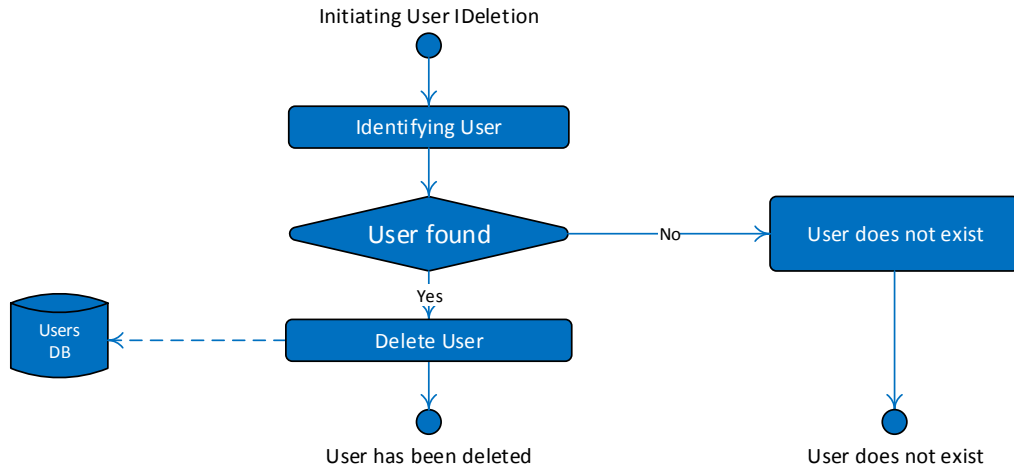
Figure 5.13 Process model of deleting users

(Figure 5.14) shows a model of process archiving the user.
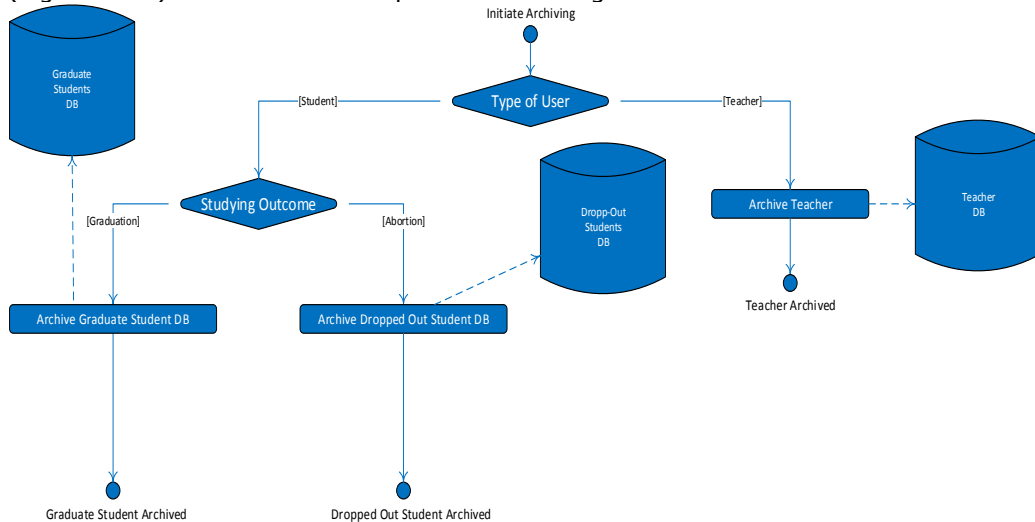
Figure 5.14. a process model of archiving user

5.1.6. The database specification

The main requirement for the system of distance learning is a web environment, as can be seen from the name of the system. Relevant provision of the system is its technological requirements in the way of data management. For managing data system in distance learning will be used relational databases. The reason for this is simply more choice, because systems for relational databases are still more "mature" compared to the object database. Greater choice of tools for

working with relational databases, and a large number of "free" RDBM system in its performance and security do not fall behind "commercial" systems. For the implementation of the database will be used MySql server, which effectively integrates with Debian server platform and PHP, which is used for application server systems for distance learning.

In designing a database system for distance learning SCORM standard is used to specify the entity. Example of using SCORM standards in designing database systems is shown in (Table 5.1).

Table: Teaching lesson

Required attributes: Lesson ID, contents, sequence number in the topic and the theme ID (taken from Table: TeachingTopic)

Predefined attributes

Interactivitytype: Active frontal, combined, undefined

Interactivitylevel: Very low, low, medium, high, very high

Semanticdensity: Very low, low, medium, high, very high

Context: Elementary education, high school education, higher education, specialized education, postgraduate education, professional training (additional specialization courses)

Learningresourcetype: Lecture, practise

Typicallearningtime: Teacher enters assessment of time required for mastering the lesson

Table 5.1. defining a table Teaching Lesson with fields

Required attributes: Lessons ID, title, content, ordinal number in the topic and the topic ID (taken from Table Topics Teaching).
Predefined attributes:
- Type of Interactivity (interactivity type): active frontal, combined, undefined.
- Level of interactivity (interactivity level): very low, low, medium, high, very high
- Level of Complexity (semantic density): very low, low, medium, high, very high
- Application Areas (context): primary education, secondary education, higher education, specialist education, postgraduate education, professional training (additional specialized courses).
- Type of material (learning resource type): lecture, exercise.

- Learning time (typical learning time): the teacher enters assessment of the time required to master the lessons.

A logical database model is designed to include relevant information about system users (teachers, pupils / students and administrator), created courses (subjects), teaching topics in the courses, lessons covered in class topics, attachments and tasks with the lessons, exercises and tests for final tests to verify the acquired knowledge, the level of evaluation tests of the system tasks (questions) in tests and messages that users sent to each other. Logical database model system for distance learning should ensure implementation of solutions that will support the relevant characteristics of distance learning. Such a system would allow teachers to create courses: they can be objects or parts of objects, sections, additional or remedial classes, and while groups distributed pupils / students may be of identical grades, departments, groups or the whole year colleges. Conceptual model of a database system for distance learning is shown in (Figure 5.15).
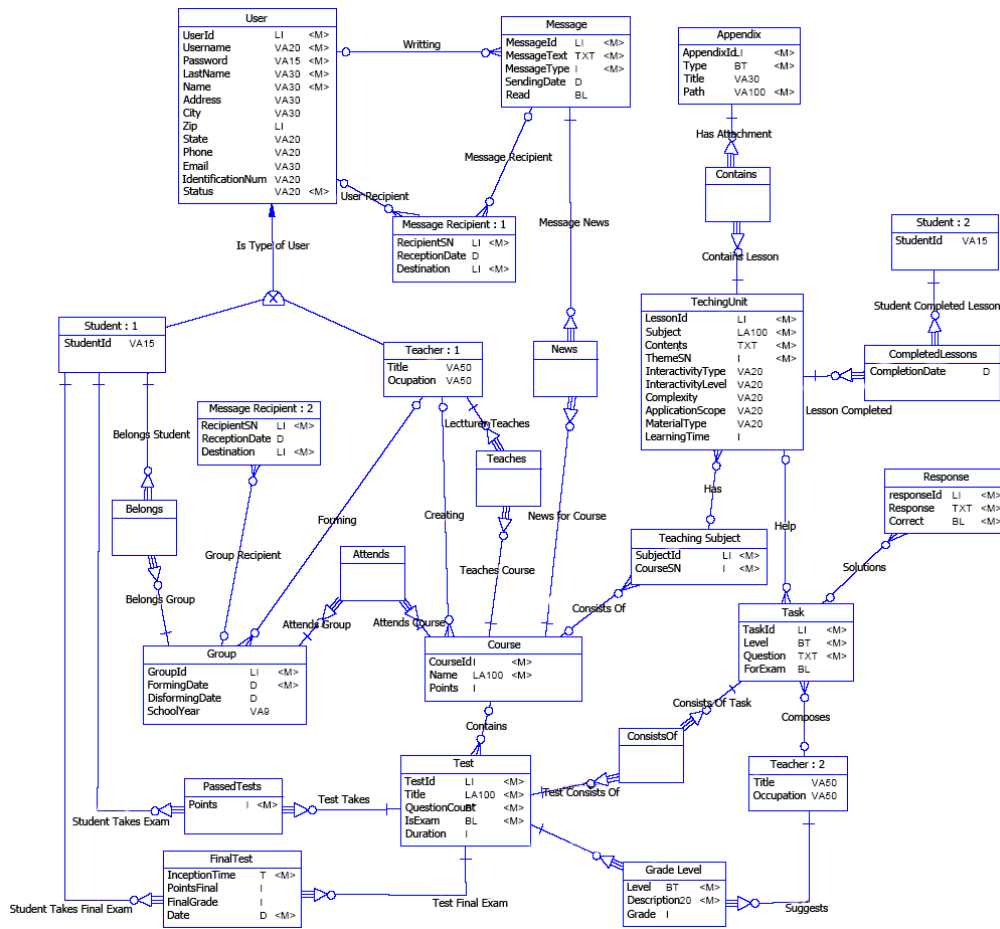
Figure 5.15 Conceptual model of database system for distance learning

5.1.7. Description of modules

The functions of the system for distance learning are grouped into modules. The modules are designed to be as independent as possible from each other because it greatly speeds up the development of the system.
System for distance learning includes the following modules:
• Managing users and permissions
• The administrative module
• Module for managing pupil / student's data,
• Module for maintenance of teaching materials (CM - Curriculum Module)
• Module to assess the knowledge,
• Module to send e-mail messages,
• Module to generate various reports,
• Module for publishing the SCORM standard.

Modules communicate with each other which make them interdependent. Communication between interdependent system components is defined at the system as a whole, and approaches to the development of individual components - modules. It is necessary to make a correct specification, interface, through which the modules communicate with each other. Most object-oriented programming languages have support for such approach to system development. It is enough to declare what methods (description of the behavior of the object) object must have in order to implement a particular interface. When a component uses other components of the system functions, it makes through the interface, not directly. For example, a module for testing knowledge must communicate with the module for managing pupil / student's data because of getting their current year of study, names and last names. This means that the module used for testing knowledge, depends on the the management module pupils / student's data. Below are the shown individual system modules for distance learning.

Module for managing educational content
One of the most important segments of distance learning is the creation of educational content. Teaching content in the broadest sense includes the whole human generational experience that should be passed on to generations to come, and such process to enable them to continue to enriching the stock of experience. More specifically, the teaching contents are specially chosen and didactically processed the educational values of nature, society, culture, art, science, technology, work and everyday life. It provides a comprehensive and successful development of pupils / student's personality, his entire contemporary manners and educational level, as well as systematic approach to active and creative social and personal life, work, leisure and vacation. Therefore, the modeling of the teaching content and method of their use must be given special attention. Suggested structure of segment to manage class content in the system for distance learning include: courses, teaching topics and teaching lessons, which is consistent with the general structure of subject matter where the subjects, ie subject areas are divided into program areas, and those in the program themes and units. Schematic structure of teaching content is shown in (Figure 5.16).
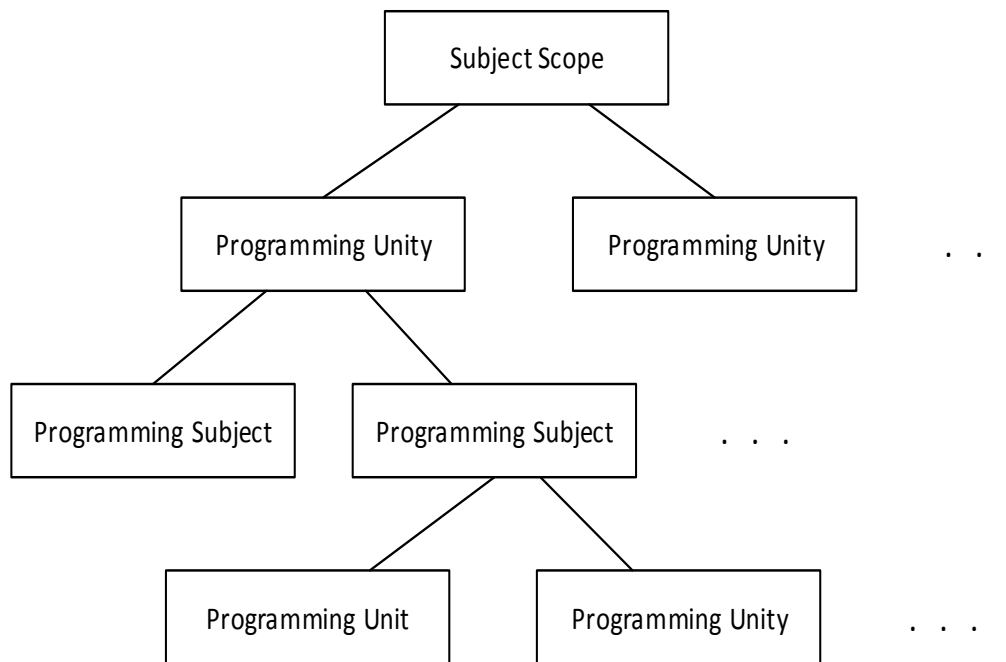
Figure 5.16. Schematic structure of teaching content

Prerequisite for the development of this module is that the teaching contents are organized through courses, which may correspond to subjects in the regular classes, but can also be used for other types of classes, such as additional, elective and optional. Courses can form only teachers, while creating and updating educational content in a course can join the other teachers who teach the same subject, and who had joined teaching the same course in the system for distance learning. Students can participate in creating educational content in a way that provides suggestions and materials for the aforementioned content. Delegating these materials is done through messaging segment, which in this study will not be given special attention. Course contains teaching topics, and those teaching units that represent the lesson. Teaching lessons can contain tasks and attachments. Contribution can be in the form of teaching materials for download, documents, images, simulation and sound. In database are stored only information related to the location of each attachment in the appropriate electronic medium, which is usually the hard drive. Students can access the syllabus, materials, and take contributions for the same, which begins the process of learning in the system of distance learning. Segment of the DL system for creating educational content includes the following use cases:
- Creating a new course - includes activity of review a list of existing courses, in order to avoid duplicating courses when designing;
- Creation of teaching topics - is based on the list of existing courses by selecting one of them. This does not prevent the deployment a single topic in the more different courses;
- Creation of teaching lessons - includes a selection of topics from the list of existing within which are addresses these lessons;

- making contributions to the lesson - independent of the creation of the lessons which means it can connect the lesson afterwards. It is not certain how many attachments must be learned;

- creating a task that is part of the lesson - it is possible to add them to lesson later, but is required to define a solution to created task.

Figure 5.17 displays use case diagram that shows basic actions related to creating teaching materials, which are described above. The information necessary for creating learning content can be described by the following entities:

- Course,
- Teaching content,
- Teaching lessons,
- Attachment for lesson,
- Task assigned to lesson and
- Task about solution.

For creating new course is planned defining name of the course and the number of credits the course carries. After creation a teaching course follows creation of educational topics, which can be done immediately after creating a course or later. Creating teaching topics includes: the name and number of the topics within the course topics. This is followed by creation of new teaching lessons in the chosen topics. Lesson can be created in the course design, or later, when choosing course which joins the lesson.

Figure 5.17. Use Case Diagram of creating learning content

Teaching lessons can contain one or more items, for which should be defined:
- Type of attachment,
- Name and
- String address file that contains an attachment.

The task is described by levels of complexity and the text may have one or more solutions.

Teaching lesson as the most important part of the learning content, based on the SCORM standard, includes the following features:
- The lesson,
- Number of the lessons of subject,
- Text content of the lessons,
- Type of interactivity (active, frontal, combined, undefined)
- Complexity level (very low, low, medium, high, very high),
- Interactivity level (very low, low, medium, high, very high),
- Application areas (primary education, secondary education, higher education, vocational education, postgraduate education, professional training (additional specialist courses))
- Type of material (lecture, exercise),
- Time learning (teacher determines the estimated time required to master the lesson)

The description of these entities and their mutual relations are shown in class diagram in (Figure 5.18).
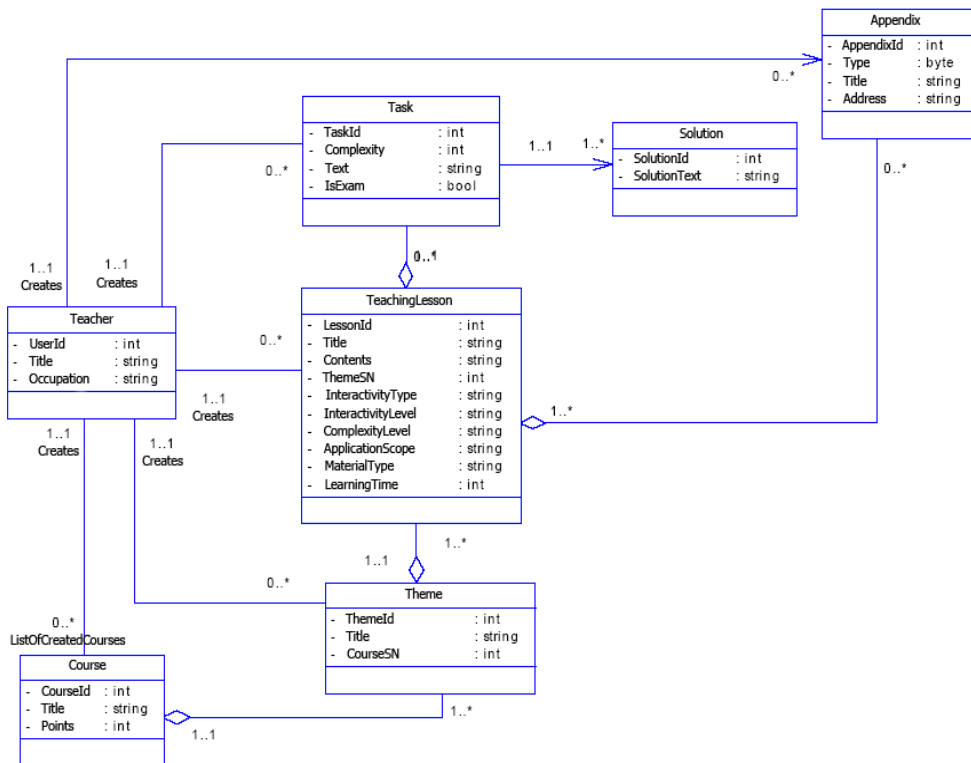
Figure 5.18. Class diagram that describe data in the teaching content

The process of creating teaching lesson is shown on the diagram in (Figure 5.19). Creating a teaching lesson begins with chosing teaching topic, and then fills the form for defining teaching lesson. If lesson into should contain an attachment, it is necessary to create this attachment and join him to lesson. Creating a teaching lesson ends by selecting "Confirm", which enter the lesson into database.
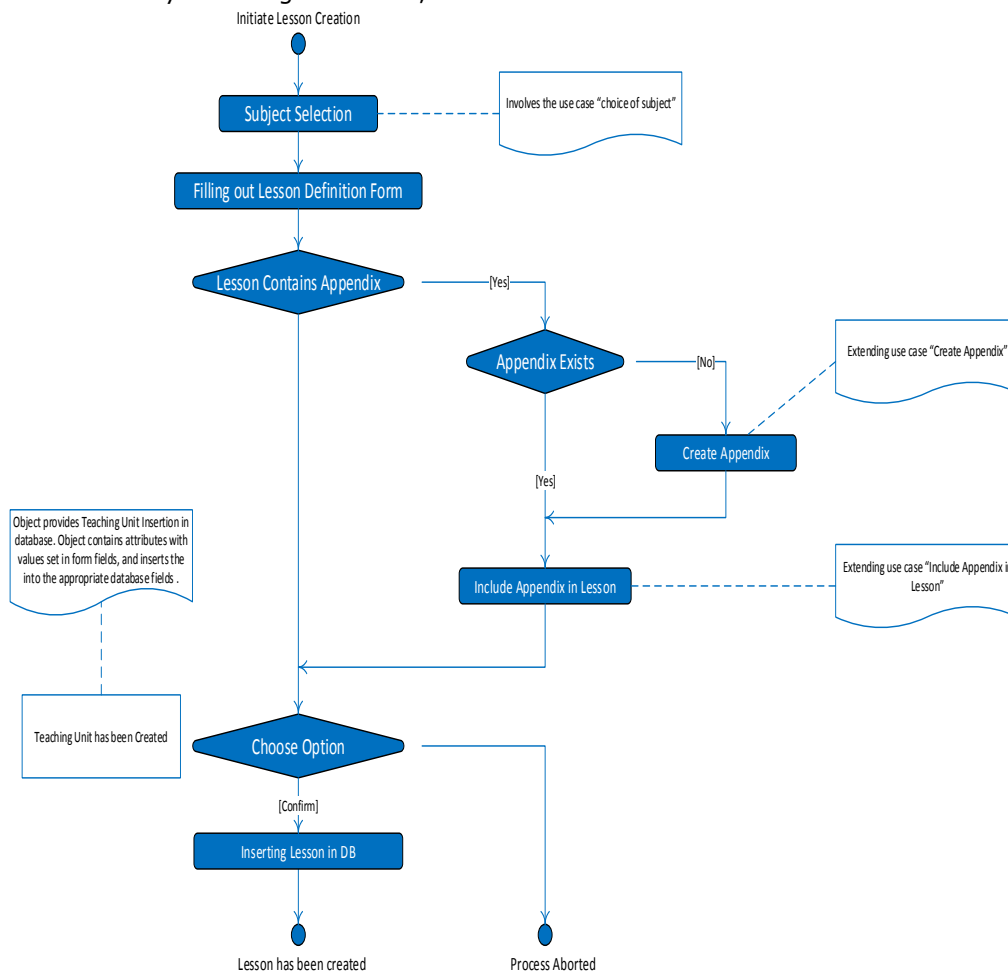
Figure 5.19. Activities Diagram of creating teaching lesson

Module used for testing knowledge

Module for testing knowledge includes tests that solve pupil / student. The tests are designed to facilitate their implementation on a computer. Written exams that are used in schools to measure student achievement can be divided on essays and exams with short answers. For essay exams, which generally require the pupils / students to discuss, compare, give reasons and so it is necessary to give a detailed verbal response to the question. On the other hand, the short-answer tests consist of questions that correspond to the student by selecting one or several given alternative answers, giving or by inserting words or phrases, or in some other way that does not require a detailed written response.

Module for testing knowledge consists of the following entities - databases:

- Teacher
- Pupil / student
- Test and
- Subject.

Between these entities are certain associative links, which are:

- Lecture - between teachers and subjects,
- Attendance - between pupils / students and the subject,
- Examination - between pupils / students and the test

In addition to these associative links, there are also relationships between teachers and test, as well as between subjects and test.

(Figure 5.20) shows the conceptual model of the database for testing knowledge.
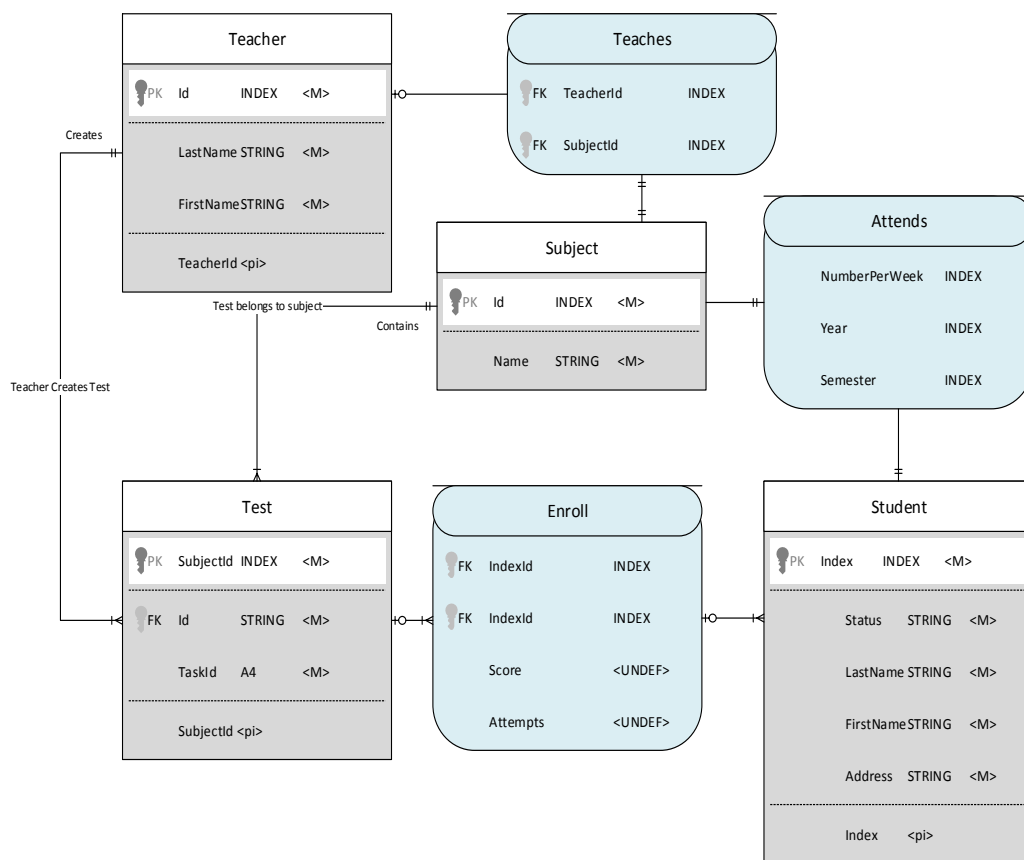
Figure 5.20. Conceptual database model, used for testing knowledge

Entity test has attributes:

- ID subject - determining the subject which test belongs
- ID number of tests - defines the number of tests in the subject. One subject can have multiple tests
- ID Problem Number - defines the type of test or assignment which is included in the test (test of a subject may represent a combination of different types of tests. For example, two tasks are the type of supplement, four types of multiple choices, one alternative type, etc.).

5.1.8. Description of system implementation

Modules of system

There are three types of system users: students, teachers and administrators. Their roles are clearly separated and implemented in different access rights to individual modules of the application. DLearn is designed modularly and conducts the following units:

- Management module curriculum,
- Communication module (messages, news)
- Module for managing users,
- Module testing and
- Module for system administration

The relationship between these units is shown in (Figure 5.21) and will be shortly explained each module.
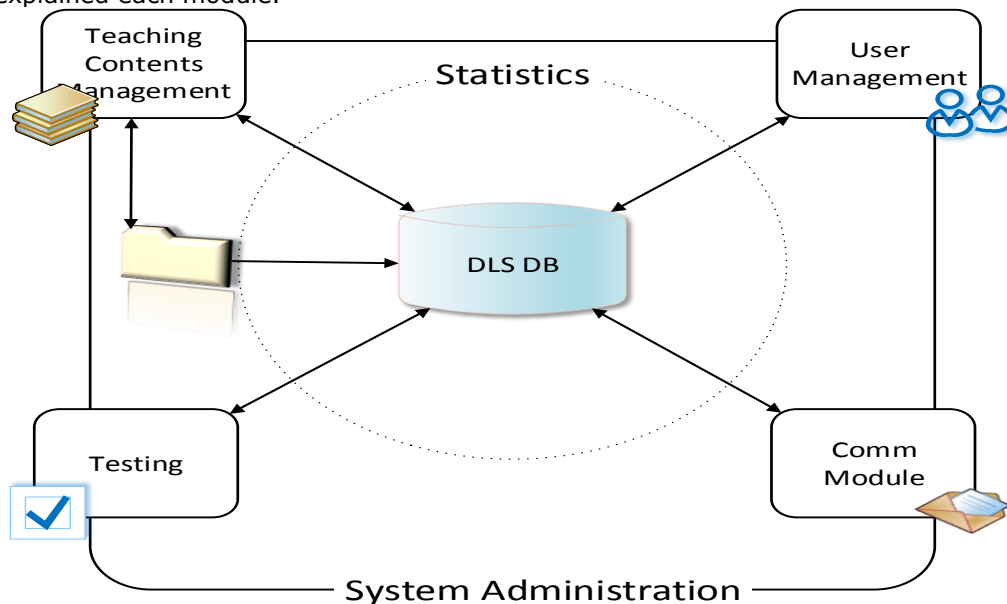
Figure 5.21. Modules of dlearn system

Statistics are not physically developed as a separate module, it exists at the logical level and statistics data are collected in each of other parts of DL system.

Managing the teaching content (Figure 5.22)

The teaching content is arranged as courses, which are equivalent to teaching subjects. Courses can only create users in the role of teachers, and the right to modify certain courses (and all learning content, in a course) may be delegated to the teacher who is the creator of the course (for easier maintenance of the content if there are more teachers). The course consists of teaching topics, and those from units representing the lessons.
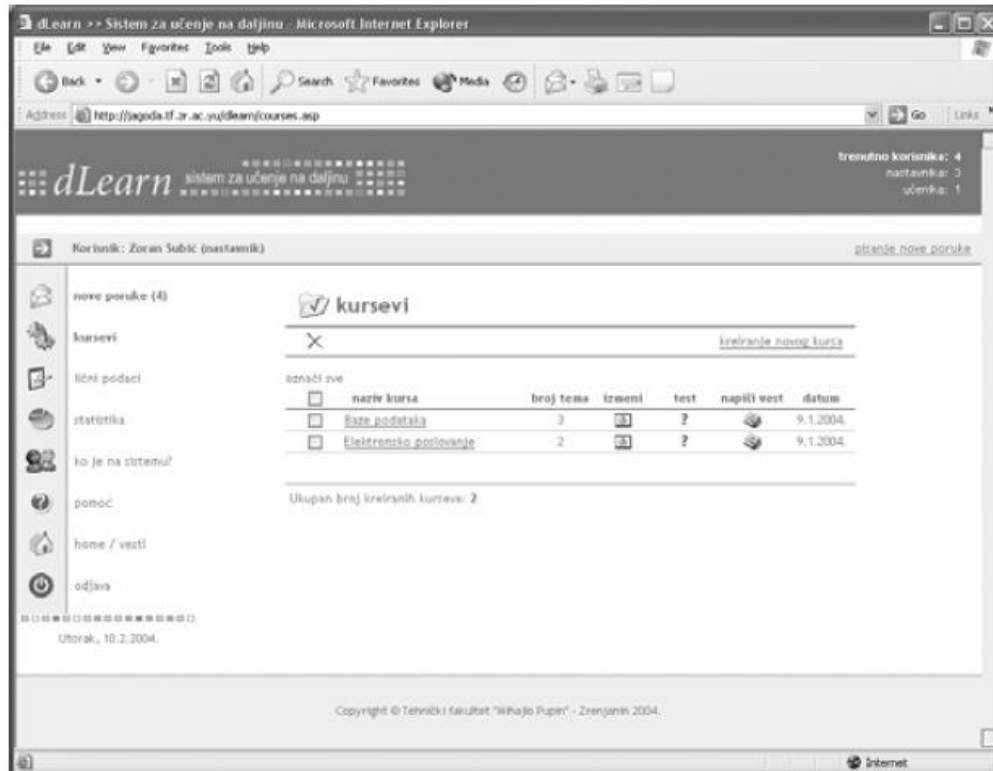
Figure 5.22. Managing the teaching content in the system dLearn

Teaching units are entered via a WYSIWYG online editor (TinyMCE). This editor is used when composing messages and news (communication module) - it is a JavaScript client that lets you format text in HTML page, which features built-in access (inline) document through DOM (Document Object Model) specifications. In this way the TinyMCE wll generate HTML that later can be entered into the database. Thanks to this online HTML editor, the teaching content can be formatted in a way that satisfies aesthetic and pedagogical criteria and at the same this content users as necessary can enrich hyperlinks and images (from any site, or to upload graphic files). Very often teachers need to offer system users a sort of teaching materials for downloading (compressed files, documents, PDF files ...). After the initial solution - uploading such material directly into the database and their placement in the field of type text or image (MySql) - which would be a more elegant from the point of content search and compactness of the system, we chose a classic HTTP uploading file to disk Web server, with creating a folder for each course (materials are related to teaching lessons).

Communication module

Through this module is intended the communication between users dLearn systems, and communication between teachers and pupils / students who listen to their courses (messages are addressed to the name of the course, and is reported as news for some courses). Deliberately is avoided the e-mail communication (although this short message system is very similar to it) for simplified distribution

system in schools. Because of choice of technology for realization of system for sending e-mails it would be necessary to install and properly configure the virtual SMTP mail server, which would impede the entire process. Editor which is used for messages is completely the same as the one for entering / changing teaching content, and is shown in (Figure 5.23). Again, there is the possibility of creating rich formatted messages. Messages can be sent to multiple addresses at the same time, simply by repeatedly specifying system user name in the address bar. Up to these names can be reached easily by reviewing the main menu option "who is on the system" (if the user has not chosen option that his presence on the system is not public). User creates and maintains a "buddy list" by which he can easily address own message, by selecting names from the drop-down list right from address bar.

Figure 5.23. Sending new message

Module for managing users

Users of the system when first sign on to the system enteres into the database certain personal information, which can later be updated. Account on the system can be obtained automatically after entering the data, or after approval of UND system administrator (this the option system settings, part of the administrative module). Account may also be temporarily deactivated if the user does not behave according to the rules of good behavior on the network. The potential expansion of the module would be related to the possibility of electronic payment of certain taxes, by pupils / students.

Testing module

Teachers form tests, which we define as a collection of questions related to individual teaching lessons. Questions have multiple answers, of which only one is correct. Teacher for each teaching lesson defines issues and then from a list of those issues form the tests associated with each lesson, topic or entire courses (there are three levels of assessment). This is made possible by simple editor of questions and tests, in which teachers enter questions and answers and then make tests. Pupil /

student can solve the test after studying the lesson / topic / course (or downloaded material, if the teacher defines the material as required). All of pupil/student's answers the pupil / are recorded, and during the examination process, the system immediately evaluates the pupil / student by counting his points. At the end of the test, the pupil / student has the opportunity to look at the statistics of all their answers, indicated by hyper links to lessons that include insufficientlystudied material. DL system automatically (as a message) sends the report to the teacher, who is a pupil / student's mentor from a certain subject. Teacher when creating issues can determine the time required for the response, and during the examination, may define if test will be time limited or not. Pupil / student after starting the test gets the browser window without any unnecessary details (no menu, toolbar, address bar, status bar ...), but the question and potential answers, and via JavaScript is disabled F5 key, which serves as a key return to the previous page, etc. In this way, are eliminated all possibilities to refresh the page (the pupil / student does not to come up with additional time, if the test is time limited). In solving tests, re-generate many Statistical data - how many pupils / students took a test, how many passed, how many the pupil / students has answered to a question, and so on. So the teacher selecting the main menu option Statistics, has detailed insight into the performance of their pupils / students.

Module for system administration
Access to this module is provided only for users in administrator role, which, by means of simple forms operate the system. Under management we mean various administrative tasks, ranging from the smallest (setting the school's logo in the upper left corner of the page, for example) to the most crucial for the system (the path to the database, the password for the application DL database access to, and so on).

Technology and Security
DLearn is originally based on the ASP 3.0 server scripting technologies. Our goal is to create a software that is based on free and open source technologies, PHP 5.5 or higher.

For the functioning of the system is necessary to ensure the following requirements:
Web Server: Apache 2.4 or higher - available in Debian's repository.
Server Database: MySQL 5.5 or higher.
Web Browsers: Firefox, Chrome, Safari, Opera, Microsoft Internet Explorer 8 or newer. Security of applications is based on the security of MySql and Apache server, but also on the implemented check user data by dLearn system. Since the management of user sessions is done by standard PHP Session object for proper operation of the system, clients must allow the use of cookies in their browsers. Furthermore, the system itself monitors the work of users by recording every important event in the system log table in the database. Through administrative tools of dLearn can easily be reconstructed the history of the system. Extract from the log table is shown in (Figure/Table 5.24). For example, the last entry is related to attempt to gain unauthorized access to the system - someone with recorded IP addresses six times unsuccessfully attempted to enter the system.

	Id	Description	UserId	Time	IP
1	1974	Login	31	2013-01-07 11:22:56.000	212.48.62.34
2	1979	New Course Created	31	2013-01-07 11:26:00.000	212.48.62.34
3	2179	Session Timeout	31	2013-01-19 18:38:49.000	212.48.62.34
4	2180	Login	14	2013-02-02 20:29:20.000	213.240.29.104
5	2181	Session Timeout	14	2013-02-02 20:50:55.000	213.240.29.104
6	2182	Login	31	2013-02-10 16:22:43.000	213.240.29.104
7	2183	Logout	31	2013-02-10 16:25:27.000	213.240.29.104
8	2184	Intrusion Attempt 6th time	0	2013-02-10 17:18:52.000	212.48.62.32

Figure/Table 5.24. Log records from system of dLearn

System installation

It is anticipated that installation of the system is done by unpacking the archive to the servers web root directory. Installation procedure will perform the installation and configuration of database, creating DL database, web applications configuration, so that the system will be fully operational by the end of the installation process. After successful installation the administrator is logged on to the system and performs basic settings that will be offered in the form of wizard for initializing system.

Application of distance learning would greatly facilitate new approaches to learning and raise the quality of teaching, which is one of the most important goals of education. Today there are various multimedia programs that have been created for personal computers. These programs allow for the creation of electronic books with text, images, audio, animations and movies. Using these computer capabilities, pupils / students are given the opportunity to independently progress in mastering the learning content, and also they have the opportunity to return to contents which are not clear to them, and to obtain additional feedback according to their abilities and interests. Practical contribution of the dissertation is the design and development of electronic materials in the form of text, images, video tutorials that accompany the chosen subject areas.

In order to determine the effects of application of the model of distance learning in teaching technical and computer education in elementary schools, has been designed electronic material, supplemented by video tutorials that monitors the content of these subject areas. Educational material in English is dominant and therefore there is a need all contents to be presented in various European languages to make it available to multiple users. This thesis is an attempt to give our pupils / students, the Serbian-speaking provide access to these materials, which can be found collected in one place and they can use when they need arises with no time limit. Development of a system dLearn enabled distance education. Pupils / students and teachers is provided quick and easy access to the content system, thus increasing the efficiency and quality of the educational process. Teachers are able to successfully perform the activities necessary for the implementation of distance education: preparing the course content by using the Internet, course design, creation and installation of educational content, monitoring and consultation with pupils / students, assessment of pupils / students. Pupils / students are able to: access to courses, access to educational contents, access to various resources on the Internet (digital libraries, online journals, etc) communication with teachers and

other pupils / students (various synchronous and asynchronous forms of communication), testing, and monitoring progress in acquisition of knowledge, exams. The entire material posted on the website of the Technical Faculty "Mihajlo Pupin" in Zrenjanin (http://www.tfzr.uns.ac.rs/dlearn) and is attached to an electronic (CD) that comes with this thesis. For the purpose of this thesis was designed an electronic learning material teaching contents of Graphic Communications. This material is designed as a text that contains algorithms of work, paintings, drawings, diagrams, schematics, video tutorials of some lessons for this study. Designed materials, presenting educational programs in the field of graphic communications, encourages pupils / students to work and allows it better understanding. Teaching was based on a weekly structure and lasted for seven weeks. Activities and obligations of pupils / students of the experimental group were defined in advance. On-line activities: pupil / student were required to learn the lesson units planned for the current week, for each teaching unit pupils / students are supposed to solve a series of tasks based on which we got the data about the success of learning; the use of consultation; _ after the teaching unit, their work was based on self-test. Pupil / student of the experimental group's material have found on the site http://www.tf.zr.ac.rs/dlearn. Following the proposed structure of segments for management teaching content in the system of distance learning, are envisaged teaching contents classified into a number of educational topics, and each topic in teaching lessons (Figure 5.25).

Figure 5.25. Teaching topics in distance learning

5.2. Research experiment model

Studies show that the use of computers in education has a significant influence and positive impact in education. The point of this experiment is to determine: the effectiveness of teaching technical and computer education in elementary schools , the implemented by applying the updated model of distance learning and the degree of impact of new educational directions in the realization of teaching content using modern information technology. The research was conducted in educational institutions in Vojvodina. The experiment was conducted on the existing network infrastructure and existing computers at classrooms in Novi Sad, TF "Mihajlo Pupin" in Zrenjanin and the elementary school. Before the start of the research consent was obtained from the dean of faculty, school principals and teachers who teach at these schools, ie faculty. For selected models of experiment: -1 with a group, and 2. with parallel groups; was required to follow the following steps: create an experimental program of work, prepare a parallel form of instruments for determining the results of the initial and final measurements, equalize experimental (E) and control group (C) to the relevant variables (individual subjects: sex, basic computer literacy predisposition to the distance learning, knowledge of the field geometry). Students were divided into the control group, ie the experimental group and it was on the basis of random selection. The sample included 254 students, of which 85 in the control group and 85 in the experimental group E2 (experiment with parallel groups) and 84 in the experimental group E1 (experiment with one group). Implementation of research activities first included the pre-investigation. In the pre-investigation checking have been made on the basic computer literacy of students (Table 6.1), determining their predisposition for distance learning (Figure 6.1), conducted a survey on the attitudes and opinions of students on distance learning (Table 6.2), a survey of the views and opinions of teachers about introduction of distance learning (Table 6.3 and 6.4.) was measured achievement motivation of students and made an initial test about their knowledge of technical and computer education. After pre-investigation came the performance of experiment. Initial testing has been done at the beginning of the first semester of 2011/12 year. This was followed by the application of an experimental program that lasted until the end of the school year 2011/12. The final measure was followed by the middle of May 2012th, as well as checking the durability of knowledge. In case research selected were evaluated implementation of innovated model for improving the effectiveness of teaching technical and IT educationin accordance to set objectives and tasks of of research, experimental approach is examine research hypotheses. The experiment was conducted as follows: teachers with pupils from the control group teaching implemented in the traditional way and processed the teaching units. While the students in the experimental group dealt with the teaching unit by the use of distance learning, innovated model of heuristic teaching. After completing the the experiment were performed again surveys on the attitudes and opinions of students in the experimental group on distance learning, in order to establish whether they resulted in different opinions and views, and a final test in order to establish to what extent and how has mastered the study material which was provided. Completing the experiment and collecting the data, it was possible to start processing the results. (Figure 5.26) represents a project of pedagogical experiment.

```
┌─────────────────────────────────────────────┐
│          E                    C               │
│        Group                Group             │
└─────────────────────────────────────────────┘

┌──────────────────────────┐  ┌──────────────────────────┐
│ INITIAL STATE            │  │ Initial state            │
│ (initial measurement)    │  │ (initial measurement)    │
│ initial test of          │  │ initial test of          │
│ knowledge                │  │ knowledge                │
└──────────────────────────┘  └──────────────────────────┘

┌──────────────────────────┐  ┌──────────────────────────┐
│ THE EXPERIMENTAL         │  │                          │
│ PROGRAM                  │  │                          │
│ (innovative models of    │  │ USUAL METHOD OF          │
│ work: problem solving,   │  │ WORK                     │
│ directed learning,       │  │                          │
│ independent research     │  │                          │
│ tasks, work with the help│  │                          │
│ of computers)            │  │                          │
└──────────────────────────┘  └──────────────────────────┘

┌──────────────────────────┐  ┌──────────────────────────┐
│ FINAL STATE              │  │ FINAL STATE              │
│ (final measurement)      │  │ (final measurement)      │
│ final test of knowledge  │  │ final test of knowledge  │
└──────────────────────────┘  └──────────────────────────┘

          ┌──────────────────────────┐
          │ AVERAGE                  │
          │ DIFFERENCE EFFECT        │
          └──────────────────────────┘
```

Figure 5.26. Pedagogical project experiment with parallel groups

The teaching of technical and IT education took place in the first half of 2011/12 school year, traditionally in the classroom and in parallel at a distance by applying innovated model of teaching. Defined learning goals for the students were:
• learn the material provided by the curriculum,
• think critically about their learning,
• learn together.

Elements of the environment that can not be affected and important for understanding the entire educational experience of students are:
• Students predisposition (to use the Internet, distance education, respect for authority, etc.)
• Culture which students belong,
• External environmental conditions at the place where the student access website,
• Hardware and operating system used by students,
• The quality of the Internet connection to the Web site (availability, bandwidth)
• Students interest.

Also, the study included self-critical reflection on the use of the system dLearn as a tool for designing and managing online classes. DLearn system for distance learning in teaching technical and computer education has been applied in real educational system of the elementary school population in Zrenjanin, in order to verify the validity of:
- Functionality and acceptance of a system of learning by students,
- The efficiency of learning,
- Frequency of returning on the last teaching unit because of insufficiently approved material.

Cybernetic characteristics formed model of teaching

Cybernetic characteristics of innovative model of teaching technical and computer education designed for the needs of this research are:
- Characteristics of the black box - conclusions about the behavior of the system were derived based on the observed changes in output variables (student achievement), because it is the study of system whose internal structure is complex; also was observed dependence of the input and output variables, based on which envisages further behavior of the model;
-in function models are descriptive, because the program content of teaching is described verbally;
- In terms of time, the models are dynamic, because their characteristics change over time;
- In terms of the level of randomness, the models are deterministic, because are represented real situations;
- In terms of the generality of the modeling teaching, models are specialized, ie they are represented by the specific characteristics of real systems;
- In relation to the level of quantification it is about qualitative mental and verbal models.

5.2.1. Preparation of teaching content

Educational materials are the most important element of distance education. In traditional education, they are only support to learning process in which the teacher

plays a major role. In distance education, educational materials are a major source of new knowledge and skills. They also control the course of teaching process, because each student learn and direct to the desired goal. Their role is very complex, and the impact on the quality and result of distance education is crucial (Figure 5.27).

Analysis → **IDENTIFICATION OF LEARNING NEEDS** Students, Existing knowledge, Performance, General learning objectives

Design → **METHODS FOR ACHIEVING GOALS** Define precise guidelines, Required experience (knowledge, skills) for achieving goals

Development → **CREATING NOWLEDGE** select appropriate technology and the media

Evaluation → **EVALUATING THE EFFECTIVENESS OF THE COURSE** Monitor the results versus set goals

Figure 5.27. Process of preparing and developing the e-materials

In the process of transition from traditional to electronic textbook, and the development of electronic materials, should be considered as a feature of the electronic teaching and learning:
- Lectures are punctual.
- Completely individualized learning.
- Learning in an arbitrary time.
- Learning at any place.
- Learning with the appropriate device.

When it comes to costs, technology and resources, it can be concluded that the main characteristics of distance education in relation to classical education are as follows:

- Lower implementation costs of education,
- higher costs of developing of textbooks,
- Faster learning,
- Need of new knowledge and skills,
- developed support department,
- Cheaper hardware and software,
- No travel and absence from the jobs,
- Possibility of multipled knowledge use.

Conversion of traditional electronic textbook is done gradually, extending in each iteration level of implementation e-materials and interaction between the participants in the educational process:

- Replication materials without interactivity,
- Support audio and video recordings,
- Type of interaction evaluating answers to the questions,
- Interaction through an acquired evaluation, further limiting access until master the task, making decisions in a simulation of the real situation,
- complete interaction and guided learning through support for solving specific tasks - the simulation scenarios, practical exercises, evaluation and decision-making.

Teaching, in which educational content is presented through distance learning, as mentioned , enables:

- Individualization,
- High degree activities of students,
- Flexibility of students' abilities and interests,
- Differentiation of the pupil / student's qualities and capabilities,
- Presented multimedia content,
- Quick and easy modification of curriculum content,
- Decentralization and the similarly.

5.2.2. Model of Distance Learning at the Technical Faculty "Mihajlo Pupin" in Zrenjanin

After the creation of educational topics (Figure 5:29) were created teaching lessons in the selected topics. Below will be further explained and presented lessons related to teaching selected topics.

Realization of program contents of technical education, the heuristic strategies
Choice of teaching content for heuristic modeling
Starting from the analysis the curriculum of technical and computer education (V, VI, VII and VIII class) from the point possibilities of innovated model of distance learning heuristic model of teaching this course we made the choice of those who have teaching content polytechnics character and represent a baseline of knowledge (base) in to its realization heuristic strategies. The conception of task solving and work exercises have a heuristic character, and the ways of solving algorithms will certainly lead to finding at least one of all possible solutions. The setting of these problems takes the form of a heuristic algorithm (Figure 5.28), which looks like:
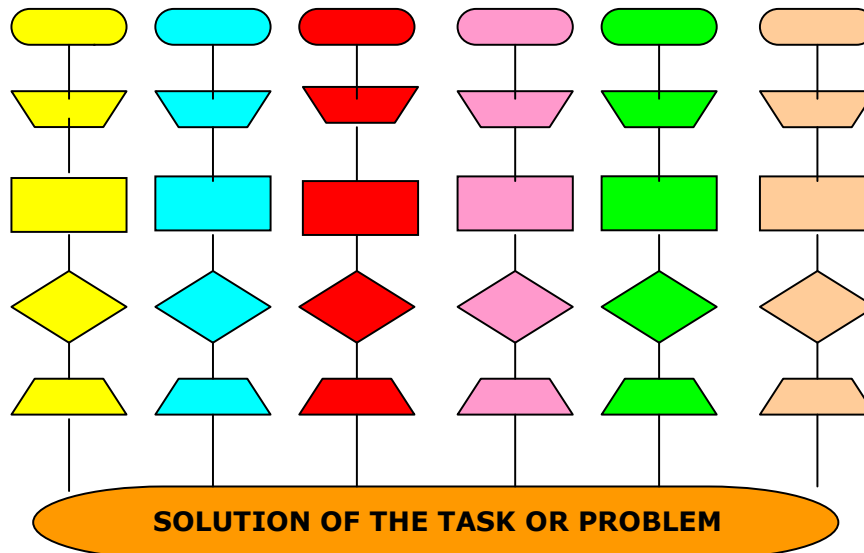
Figure 5.28. Ways of solving problems – tasks

Learning through heuristics conceived tasks or problems is one of the possible ways to rationalize higher education and activating students to individualized teaching and equal favor to the weaker and talented students to attain their maximum.

Previous research in the field of of algorithms in teaching technical and IT education and noticing deficiencies of algorithms encouraged us to consider further study of the theory of resulting heuristic approach to solving the problem of teaching and problems in teaching this course by distance learning in regular and emergency situations. Analysis of the curriculum technical and IT education (V, VI, VII and VIII class) were determined by the unit we can process by heuristic strategy.

5.2.3. MODELS IMPLEMENTED CURRICULUM SUBJECT - UNIT

We have chosen implementation of educational topics listed above, their teaching units, since they contribute to development of logical and dialectical thinking among students while teaching technical education provides scientific and dialectical character and polytechnic orientation, as well as pedagogical and didactic category stems from the goal of teaching this subject . In developing the model of realization of the theme - unit was thought to be necessary to point out the educational levels that need to process new concepts and separate the educational tasks for a given teaching topic - unit. Special attention is paid to methodological approach of the class, the creation of heuristic problem situation and formulation of problems with heuristic character (instructions are given to students on teaching leaves). Each block of class (model teaching topics - units) in the E1 group ends with a short test, and E2 and C group issues, which are designed to give the teacher feedback on acquired knowledge and subjects. Examples of model teaching topics - units are presented in the order they are in teaching practice and implement specific teaching materials (processing new material with heuristic approach, a heuristic problem, solving heuristically conceptualized tasks).

Methodical and didactic processing of subject programs - units:
Teaching topic: "From idea to product"
Teaching lesson: The "Technical drawings"
Number of classs: 2 (as a whole)
Type of the lesson: Processing new material
Educational level: Application of acquired knowledge
Type of course: Heuristic teaching
Pedagogical objectives:
- The development of thinking, creativity and persistence, perseverance and patience, logical conclusions, ability to work independently and intellectual potential.
Educational objectives:
- Mastering the basic concepts of technical drawing and their connection with practical work.
- Training students for the proper use of drawing instruments.
Forms of work: - frontal, individual.
Teaching methods: verbal, demonstration, work.
Educational means: Computer, electronic multimedia material.
References: Textbook "Technical and Information Education for the fifth grade of elementary school."
Lesson Procedures:
1. Creating a heuristic problem situation.
2. Defining the problem.
3. Hypothesis.
4. Decomposition of the problem.
5. Individual problem solving.
6. Analysis of the results, draw conclusions and generalizations.

1. Creating heuristic problem situations
Motivation and activity of the entity (student) who learns represent basic learning conditions. In order to follow the class the student must be encouraged to cognitive activity in order to participate in it. Independent work of students is an important didactic category in teaching, because the student is encouraged by the fact that individual should come up with something that will be a little discovery which results in creation of certain psychological atmosphere, and a good working situation as a prerequisite for effective teaching.
In the heuristic problem situation teacher causes students' attention by setting tasks that are formulated by heuristic strategies, for example: "Carefully observe the items that surround you. You will notice that some items that serve the same purpose are different. See, for example, cars. Please list some items by your own memory. In order to construct a new, modern subject, we need an idea."
The teacher suggested students to write down answers to questions in their notebooks, to think about the items that they themselves constructed, and to write them. Time to answer is 5 minutes.

2. Definition and decomposition of heuristic problem

Each student has their freedom of choice to write down in his notebook item that he constructed. In this way, there was the birth of the idea ie the problem situation with heuristic strategy that should be defined. The problem can be defined as a problematic issue discussed in the teaching topics or units. In heuristic strategy teaching content would represent a problem, and teaching units decomposition of

problem. Problem issue contains a lot of answers, to which students come through self-defined problem solving.

Within the teaching topics, problem questions as: "What subject you wrote in your notebook must have in order to be constructed? What is the name for the first drawing that represents the realization of your ideas? What is the name drawing that shows the components of your subject? What is the name drawing that shows the dimensions (size, length, width, etc.) of an object? ". All these drawings are called _____. How are they called? (Answer: Technical drawings).

Motivation:
- thinking in the right direction (intellectually teacher directs students in a well - desirable direction);
-Hypothesize.

3 The hypotheses
Proper application of hypothesis ie assumptions may have a significant role in activating and encouraging students when it comes to the development of cognitive interest in educational process. Hypothesis suggests something, but it does not claim.

The hypotheses discussed in the teaching topics or educational units we have formulated in the affirmative form: When want something to do or make, a man previously considering how to accomplish that. Can thereby to have multiple possible solutions and ideas, which most frequently indicate a technical drawing. Technical drawings are sketches, workshop, switchgear, installation and schematic drawings. Technical drawings we draw using basic stationery for technical drawing. Of drawing instruments used are: two triangles, lead pencil, sharpener, eraser, ruler, caliper and tape. Making sketches is done arbitrarily-manually lines.

4. Problem solving
Students will disclose solution, working in its own project, ie selected object by the given algorithm, provided that they mutually exchange ideas, completing previously acquired knowledge and implement them in practice. Teaching as an organized process should provide certain motivation that students bring into the situation of the creative act, to confirm their ego to new experiences and agreements, to develop analogies to place new hypotheses, to discover the logic of the process that they want to know, to be confirmed as a creative being.

The algorithm is in general terms use students to individually draw its ideas (see Algorithm times from the idea (Figure 5.29). Organization of heuristic teaching opens great possibilities for frontal and group studying problems and exchanging information in order to solve their own individual ideas. All the above features of heuristic teaching came to the fore in the case of a new processing teaching topic "From concept to implementation."
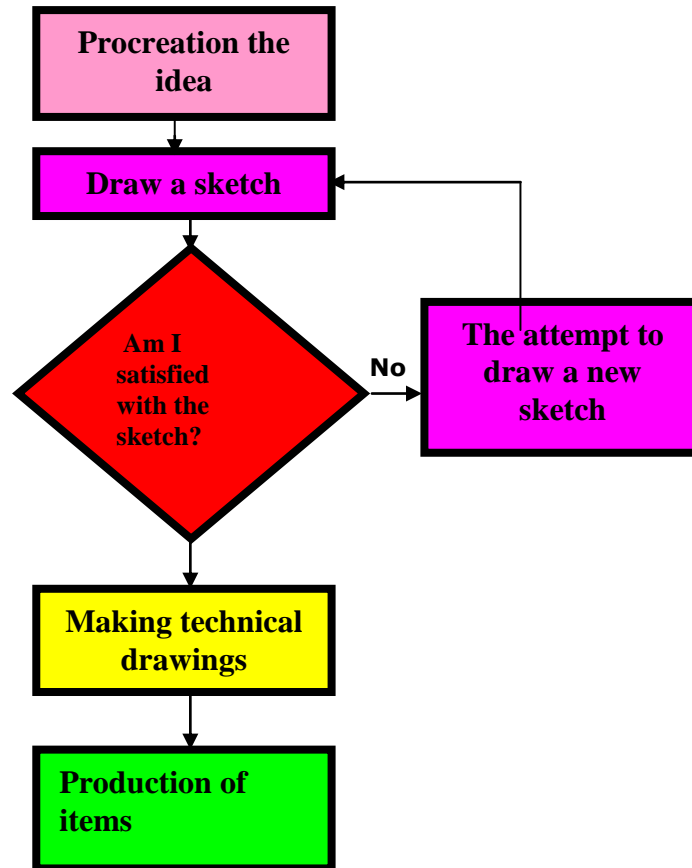
Figure 5.29. Algorithm times from idea to realization

5. Analysis of the results, drawing conclusions and generalization

After the individual preparation of technical documentation for the chosen object (sketches, technical drawings and relay) students report what they have observed during its development, and to which conclusions are reached constructing an independently. At the end, summarize the results and displayed on the projector, overhead projector or didactic panel. All solutions are complemented by the preparation for the development of the chosen item.

The following bloc class (2 hours) of heuristic teaching presents an example of the implementation laboratory exercises, organized heuristic approach. Is designed to help students with individuallyteaching sheets no. 1 (on the overhead projector film or sheet) to prepare a laboratory exercise. Each student develops a model of the constructor's element objects from the fields of civil engineering, mechanical engineering, electrical engineering and so on, according to their own ideas and technical documentation created on previous bloc class.

Teaching topic: "Modules"
Teaching lesson: The "Making models according to their own design"
Type of the lesson: Laboratory exercise - determining
Educational level: application of knowledge
Teaching Methods: The laboratory
Type of work: Individual
Type of course: a heuristic approach to laboratory exercises

Nastavna sredstva: Modules - Constructors elements (sets)
Didactic materials: instructional sheet no. 1

Educational objectives: Based on the acquired knowledge should independently demonstrate practical application of technical documents in the realization of their ideas by developing models of machines.
Pedagogical objectives: the development of independence, applying knowledge, creativity, logical reasoning, systematicity and regularity.

In addition to instruction by teaching sheets, a teacher with students at the start analyzes the problem, read the instructions of a set constructors elements, studies how to connect individual elements and features that provide manufacturers' sets, ie in all proceed according to the general algorithm given in the teaching sheet No.1. Further cooperation with students is individual; this is in the form of individual student's speech, in the case of unclear and problematic situations. At the end of the class are analyzed once again the entire process of work and the resulting model.

For teaching of Technical education most natural laboratory problem heuristic is designed as a heuristic teaching system. Heuristically designed laboratory problem is very different from laboratory exercises, given the participation of consciousness and intellectual activity of each student. Laboratory exercise that is processed as a heuristically designed laboratory problem is selected so that the student's use of variety resources at their discretion without destroying or damaging the constructor elements and accessories, as well as to students at various attempts can not injure. Heuristically designed lab problem is a good method for students to demonstrate that they know so well Technical Education, to independently solve problems that they themselves have formulated.

Teaching sheet no. 1
Today you will learn by using your idea and technical documentation (technical drawings) that you've made in previous classes for the preparation of model constructors elements. To solve the problemhas to be observed the given algorithm of use constructors element, which specifies the sequence of operations and aims to help you properly use a set of constructors and technical drawings and successfully immplement own conception of the model. The algorithm is general and is applicable to any chosen model, when it comes to sets of elements constructors (Figure 5.30).

| Study the instructions of a set, how to connect individual elements and the possibility that these set of constructors provides. |

| Check the content of kit. |

| Missing a part? | YES → | Contact the teacher |

NO

| According to the technical drawing allocate th According to the technical drawing allocate the parts for assembling your model e parts for assembling your model |

| Compose model |

| Try out the functionality of the model, and write observations in your notebook |

| Upon completion of exercise separate the model and elements return to the constructors' box. |

Figure 5.30. The algorithm of using a set constructors elements

Teaching topic: "Electronics and radio engineering"
Teaching lesson: The "Digital Communications"
Type of the lesson: laboratory exercise
Educational level: application of knowledge
Teaching methods: experimental laboratory
Form of work: work in pairs and individually.
Type of course: a heuristic approach to laboratory exercises
Educational means: PC, video beam projector, mobile phone.
Educational objectives: clear idea about the capabilities of mobile phones and their operating spectrum of programming functions (phonebook-"Phone book", message - "Messages", list of calls - "Call Register", Phone settings - "Setting", diverting - "Call divert ",games -" Games ",tools -" Office tools ",sections -" profiles ",Internet -" Internet ",sessions -" Appointments "and others.). Introduce operational functions that have practical application in everyday life and work of citizens.
Pedagogical objectives: encouraging students working mood, opposing opinions and acquisition of new knowledge, encourage independence, systematicity, logical deduction and finding new solutions applicable in practice.

Creating a heuristic problem situations

The teacher reminds students to the field of binary numbers, the term "analog - digital", A / D and D / A converters, the modulation and demodulation of digital messages on the previous teaching of the "mobile telephony" and "Basic functions of mobile phones," which students had to repeat as homework in order to successfully follow laboratory exercise. The teacher sets the students questions in the form of a heuristic algorithm on the overhead projector foil, video beam projector, ie teaching sheet No.2 with the following content:

Teaching sheet no. 2

Today you will learn by trying to independently solve the given problem situation, displayed heuristic algorithm, ie based on the facts and data that you collected and way of thinking towards solving the problem try to hypothesze (of a solving the problem). Today's problem has a many of heuristic solutions, which may be observed in a given heuristic algorithm. Your task is to hypothesis towards finding a large number of solutions, and thus you'll confirm the main hypothesis "previously acquired knowledge and proper use of knowledgeable practice allows the practical use of all the basic functions of a mobile phone, its use in everyday life and work."(Figure 5.31).

Figure 5.31. The heuristic algorithm of operational functions of mobile phones

- Students are doing experiments.
- Activity of teachers is focused on inciting students to finding new, original solutions, and practical testing on the mobile phone (every student has a mobile phone, those students who do not have a mobile phone provides a teacher).
Motivation: - thinking in the right direction, to continue with new solutions
            - Try to hypothesize.
Students hypothesize:
Based on the central hypothesis "previously acquired knowledge and proper use of knowledgeable practice allows the practical use of all the basic functions of a mobile phone, its use in everyday life and work," are set sub hypothesis in line with prior knowledge and motivation of each student to explore new solutions previously unknown to him, as well as the capabilities of mobile phones that they own. If the

entrance-(functional soft keyboard mobile phone) specifies a signal in the form of a driver, an output display comes to activating and registering the selected option and its practical implementation. The teacher alleges students at verifying the hypothesis: Students individually checked his driver, confirm its validity, and therefore the hypothesis. On the overhead projector foil were written mobile numbers of all students in order to communicate with each other. The teacher monitors the work of each student and leads him to come to one of least of all possible solutions to the problem heuristically conceived.

After checking the hypothesis students make a general conclusion:

Proper preparation of the driver who is at the entrance - the function soft-keyboard mobile phone is secure management access and its registration in the display, as well as the practical implementation of the selected option.

Therefore, the use of a mobile phone has a lot of options and wide application in everyday life and work.

Following the proposed structure of the segments for managing teaching content in the system of distance learning, provided educational contents are classified into teaching topics, and each topic in teaching lessons (see Annual Work Plan - *Figure 5.32*).

ANNUAL WORK PLAN

Technical and Information Education

Teacher _____School 20....... / 20 ...... year

Grade - fifth

Ordinal number of teaching topic	Title of the teaching topic	Number of classes per topic	Number of classes specified for:	
			Processing new contents	Other types of classes
1	Introduction	4	4	
2	Graphic Communications	8	4	4
3	Information Technology	16	6	10
4	From concept to implementation	8	2	6
5	Materials and Technologies	12	5	7
6	Energetics	4	4	
7	Constructors modeling - Modules	12	2	10
8	Transportation	8	6	2
	T O T A L	72	33	39

Grade - sixth

1	Introduction to Architecture and Construction	4	2	2
2	Technical drawing and plans in	8	2	6

	construction			
3	Information Technology	16	4	12
4	Construction Materials	4	2	2
5	Energetics	4	2	2
6	Technical resources in construction	4	2	2
7	Transportation systems	2	1	1
8	Culture of living	4	1	3
9	Constructors modeling	22	2	20
10	Technical resources to agriculture	4	2	2
	T O T A L	72	20	52

Grade - seventh

1	Introduction to mechanical engineering technology	2	2	0
2	Drawing techniques in mechanical engineering	8	4	4
3	Information Technology	14	7	7
4	The materials	2	1	1
5	Measuring and Control	2	1	1
6	Treatment of materials technology	4	2	2
7	Machines and Mechanisms	16	10	6
8	Robotics	2	2	0
9	Energetics	6	3	3
10	Constructors modeling	16	4	12
	T O T A L	72	36	36

Grade - eighth

1	Information Technology	16	12	4
2	Electrotechnical materials and installations	10	6	4
3	Electrical machinery and devices	14	8	6
4	Digital Electronics	12	6	6
5	From idea to implementation - Modules	16	2	14
	T O T A L	68	34	34

Table 5.32. Annual Work Plan

6. RESEARCH RESULTS WITH DISCUSSION of the innovated model of distance learning in regular and emergency situations. Mixed methods of teaching "e-learning"

6.1. EMPIRICAL RESEARCH – BASIC METODOLOGICAL CHARACTERISTICS OF RESEARCH

Survey of students and teachers / professors - during 2010 / 2011th school year was conducted empirical research with the aim of gathering information, views and opinions of our participants on the need for the updated model of distance learning in elementary school. Also, we wanted to perform the observation and analysis of the current situation (educational practice) and identify potential problems and shape the alternatives. The subject of our research was related to application of of the innovated model in elementary school, and research population was consisted of teaching staff and students of elementary schools. The research sample consisted of 112 teachers and 254 students (ages from fifth to eighth grade) from elementary schools in Vojvodina. In the descriptive research method, we used a questionnaire as the main research instrument. We started from the hypothesis that our respondents showed interest in the use of e-learning, have expressed the need for training in this area, but they are aware of the many problems that stand in the way of introducing this kind of work in our primary education system.

Results of the experiment - Innovative model of distance learning in regular and emergency situations have been implemented within teaching subject "Technical and IT education." Teaching materials were generated for use in the experiment and are aligned with the subject program. They are designed as a "multimedia CD" with a lot of interactive elements and simulation. Two CD containing lessons were created for the experiment, and lessons are stored in database.

Students access their tasks via the school intranet and the Internet at home. Automatic analysis of students' tasks is performed in LMS (Learning Management System) which can be used to help teachers by providing the student.

The experimental results were evaluated in two ways - through a survey and comparison of student grades obtained before and after the experiment. At the beginning of the experiment, the initial survey was conducted with 254 students (ages from fifth to eighth grade elementary school) who participated in the experiment and 112 elementary school teachers trained to work on the updated model of distance learning in regular and emergency situations.

6.1.1 The results of student surveys

The results of the initial survey showed that the population of students generally uses computers for playing games, downloading music, watching movies, chatting and collecting information for their assignments on their own initiative and for independent learning.

Assessment of students' possession of their own computer skills is shown in Table 6.1.

It can be seen that most of them have average computer skills, and only a few have mastered the advanced skills and is qualified for programming.

Almost all students (97%) believe that they need to learn advanced computer skills. They believe that is the only way to find a place in the information society and at the same time it is a prerequisite for finding a good job.

The level of computer skills	The percentage of students [%]
Low – e-mail comunication	8.95
Basic – word processing	5.97
Midle – usual aplications	70.15
Advansed – complexed aplication programs	11.95
High – programing	2.98

Table 6.1 The level of computer skills

Regarding the purpose of using a computer, there is a slight difference between the results of the initial and final surveys. Students usually use the computer for: entertainment, communication with other people in country and abroad, acquiring knowledge in different areas, increasing the knowledge and preparation of homework. Percents distribution of the purpose of using a computer is shown in Figure 6.1: entertainment 30.07%, email 11.61%, 19.60% acquisition of the knowledge, expanding knowledge 27.11%, and 11.61% homework.
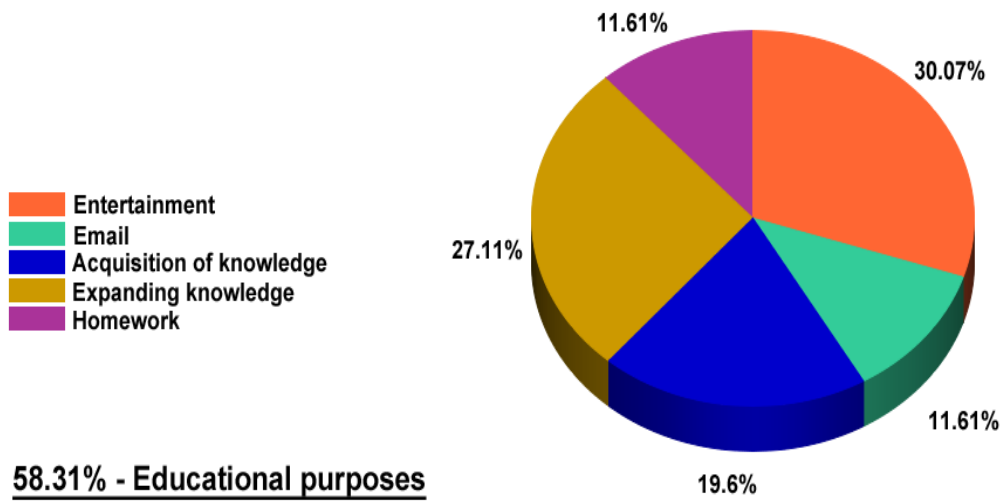
Figure / Diagram 6.1 Distribution of purpose for using computer

Final Results of the survey show that 88% of students tested is highly motivated to use computers in the experiment.
They find it more interesting to use a computer to learn than to learn only from books, such because they are provided by different information. The remaining 12% of the students are still intimidated by computers as they were before the

experiment. They find justification for their opinion saying that the individualization of the learning process leads to mutual segregation and alienation.

Approximately 85.22% of students believe that their computer skills have improved through the activities of the project, while the remaining 14.78% did not notice improvement. The average time that student spends on the computer did not change during the experiment, but it is mainly devoted to the activities of the experiment.

It is important that students have a positive opinion of the applied mixed methods, 92% of them, while the remaining 8% have a negative view. More than half of the students (52%) stand out as very important that this method allows the individual learning process and provide support to their individual interests and abilities.

6.1.2 Results of the survey of teachers

At the beginning of the experiment, 69% of teachers believed that the use of computers will help them to establish better cooperation with their students, to increase students' creativity and improve informing of parents about their children's success in school and to generally improve the interaction between students, teachers and parents.

At the end of the experiment, 81.65% of the teachers were very satisfied with the project, because they think that the use of computers in education can improve operational efficiency, enhance their professional and personal potential of creativity. They generally believe that if used rationally, computers can help students to learn faster. On the other hand, teachers fear that students can become antisocial or use computer for fun instead of using it all the time for learning.

In addition, most of the teachers are convinced that the implementation of the updated model requires much more work than the conventional preparation for teaching. Both teachers and students are afraid of the health consequences caused by spending too much time on the computer.

6.1.3. A REVIEW OF SOME EMPIRICAL RESEARCH

We were interested whether our respondents are familiar with the forms and possibilities of e-learning.

To the question "Do you know what electronic learning (e learning) is?" The responses are located in Table 6 2. The results showed that 25 respondents or 22.32% of teachers have said they did not know what e-learning was, then the value of chi-squared ($\chi^2 = 49.32$), and the correlation coefficient (C = 0.493) showed association of medium intensity.

Answers	number of respondents	PERCENTAGE %	DO YOU KNOW WHAT IS E-learning?	
YES	87	77,68	Chi-square χ^2	49,32
NO	25	22,32	df	1
TOTAL:	112	100,0	C	0,493

Table 6.2 Knowledge of possibilities of e-learning

To the question "Have you ever (during university studies, professional training, etc.). used some form of distance education?" Answers are located in Table 6.3. Value of chi-square ($\chi^2 = 136.80$) showed deviations obtained (empirical) frequencies from the expected value.

ANSWERS	NUMBER OF RESPONDENTS	PERCENTAGE %	Have you ever (during the studies, PROFESSIONAL TRAINING ETC.) used some form of distance education?	
YES	19	16,96	Chi-square χ2	136,80
NO	93	83,04	df	1
TOTAL:	112	100,0	C	0,690

Table 6.3. The use of some form of distance education

To the question: "Does the school should organize special forms of training for teachers to use modern educational technology in teaching?" Answers are located in Table 6.4. Offered were three responses closed type with two degrees of freedom. We wanted to know whether elementary school teachers to accept innovations in teaching based on the application of information technology (IT), and whether they believe that for it need additional training. With this question we wanted to know if there is confirmation of the hypothesis that distance education is the appropriate for organizational requirements and IT literacy of teaching educators.

Offered answers	NUMBER	PERCENTAGE %	Whether the school should organize special forms of specialization of teachers for the application of modern educational technology in teaching?	
Yes, this is especially important	86	76,79	Chi-square χ2	58,97
It may, but is not so important	24	21,43	df	2
No	2	1,78	C	0,590
TOTAL:	112	100,0		

Table 6.4 Attitude to IT training and development of teaching staff

As the results show only 1.78% of respondents believe that it is not necessary for the school to organize any special forms teacher training for the application of modern educational technology in the classroom. Actually, the results confirm our hypothesis that teachers express interest in IT training, in order to use various forms of e-learning. E-learning in primary education motivates students, provides more information and more easily renewal of processed material and therefore makes teaching more interesting, more dynamic and successful. Certainly, the use of the electron learning involves computer literacy of students and teachers. Research results confirmed our **hypothesis that teachers know what is involved in e-learning**, but they have not applied it in educational work nor did they have the appropriate professional / IT or methodological training in this area. Computers open up significant didactic - methodological options for the implementation of the teaching-learning. Teachers and students becoming researchers, and it make classes more interesting and creative. In such a process, the emotional component is considerably better - the acquisition of knowledge resembles a game, therefore take pleasure and positive emotions. The results reveal significant educational needs of our patients when it comes to IT training and education.

6.1.4. The results of experiment

The sample was representative, and it has similar characteristics as the population. For accurate determination of the sample is necessary to know the population. Based on the analysis of the population, set goals, objectives, and hypotheses, we have chosen a deliberate pattern, in which the groups, by composition, size and abilities of students are mutually appropriate. With a selected sample we have provided secure consent of school cooperation and appropriate minimum requirements for experimenting in accordance with the requirements of research.

In our sample participates an elementary school "Djura Jaksic" Zrenjanin, which has the characteristics of rural and urban areas, as part of the students traveling from the neighboring village (Janko's Bridge). During opting for this kind of pattern we made sure that we can objectively organize and monitor the experiment. The population of our sample consists 254 pupils in the fifth, sixth, seventh and eighth grade elementary school "Djura Jaksic", divided into 12 classes. Summary view of the groups:

- Experimental group: E1 = 4 classes (84 students)
                               E2 = 2 classes (85 students)
                               C = 2 classes (85 students).
                               TOTAL: 254 students (Diagram 6.2).
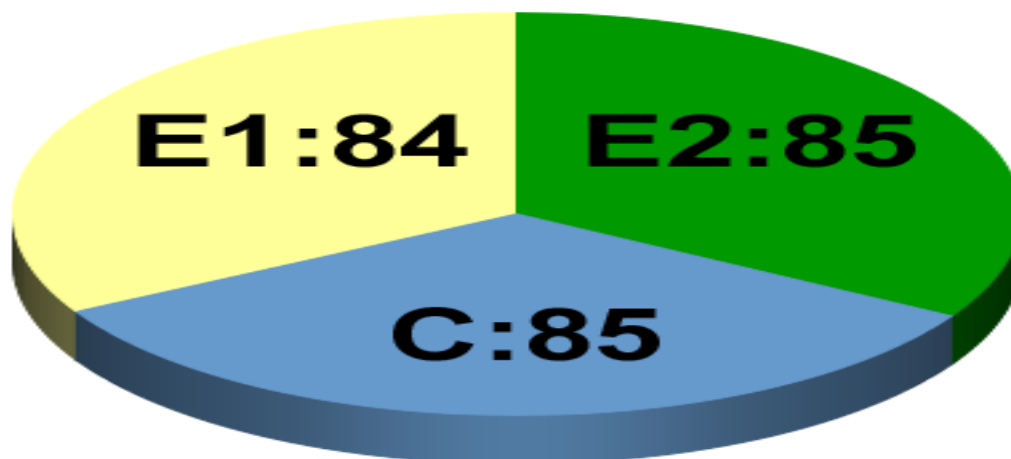
Figure /Diagram 6.2. Distribution of students by gender

Teaching Technical and IT education implemented by two teachers, university professors, and with a degree in this teaching subject. Their volunteerism and willingness to cooperate had great importance for the outcome of the experiment.

The insignia of the sample:
- Gender students,
- Parental occupation,
- Educational level of parents,
- The overall success of the previous year,
- The overall success of the Natural and Social Science, Physics and Technical and IT education in the previous year.

Data was collected on two occasions, first, the initial measurement before the start of the experiment, and the second, the final check after processing teaching content, i.e. end of the experiment.

CLASS	E KXPERIMENTAL G R UOUP						CONTROL GROUP		
	E1			E2			C		
	M	F	TOTAL	M	F	TOTAL	M	F	TOTAL
V	11	10	21	9	11	20	9	11	20
VI	4	11	15	11	9	20	12	8	20
VII	10	14	24	12	13	25	10	15	25
VIII	12	12	24	9	11	20	8	12	20
TOTAL	37	47	84	41	44	85	39	46	85

Table 6.5. Distribution of students by gender

(Table 6.1), which is a constituent part of this work, shows the numerical strength of students in the experimental groups:

E1 - Experiment with one group of male : female = 37: 47 = 0.79;

E2 - Experiment with parallel groups M : F = 41: 44 = 0.93, and

C - Control group in the experiment with parallel groups M : F = 39: 46 = 0.85.

Students in this table are categorized according to gender: male, female, all - total.
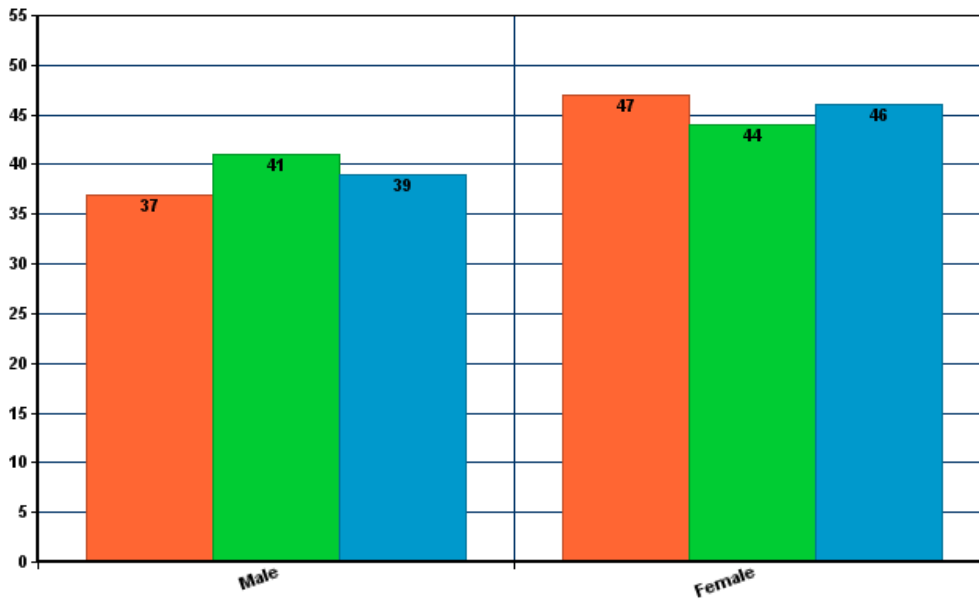
Diagram 6.3. Distribution of students by gender

PARENTS'S OCCUPATION		University degree		College degree-skilled		High school degree		Semiskilled		Unqualified and other		TOTAL	
EXPERIME NTAL GROUP	CLA SS	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%
E1	V	3	14,29	1	04,76	12	57,14	3	14,29	2	09,52	21	100
	VI	2	13,33	1	06,67	11	73,33	0	00,00	1	06,67	15	100
	VII	5	20,84	2	08,33	13	54,17	2	08,33	2	08,33	24	100
	VIII	4	16,67	2	08,33	17	70,83	1	04,17	0	00,00	24	100
SAMPLE:		14	16.67	6	07,14	53	63,10	6	07,14	5	05,95	84	100

Table 6.6 A: The educational level of the parents in the E-1

In order to obtain a better estimate of the initial state was carried out data processing for the educational level of a parent, the parent that has a higher level of education, as follows:
-University degree (UD) 5 points
- College degree (Associate degree- AD) - (skilled): 4 points
- High school degree (HSD) 3 points
- Semiskilled 2 points
- Unqualified and other 1 point.

PARENTS'S OCCUPATION		University degree		College degree-skilled		High school degree		Semiskilled		Unqualified and other		TOTAL	
EXPERIME NTAL GROUP	CLA SS	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%
E2	V	3	15,00	1	05,00	15	75,00	1	05,00	0	00,00	20	100
	VI	2	10,00	1	05,00	13	65,00	2	10,00	2	10,00	20	100
	VII	5	20,00	2	08,00	14	56,00	3	12,00	1	04,00	25	100
	VIII	2	10,00	1	05,00	13	65,00	2	10,00	2	10,00	20	100
SAMPLE:		12	14,12	5	05,88	55	64,71	8	09,41	5	05,88	85	100
PARENTS'S OCCUPATION		University degree		College degree-skilled		High school degree		Semiskilled		Unqualified and other		TOTAL	
EXPERIME NTAL GROUP	CLA SS	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMB ER	%	NUMBE R	%	NUMB ER	%
C	V	2	10,00	2	10,00	14	16,47	2	10,00	0	00,00	20	100
	VI	1	05,00	3	15,oo	15	75,oo	1	05,00	0	00,00	20	100
	VII	4	16,00	3	12,00	15	60,00	2	08,00	1	04,00	25	100
	VIII	2	10,00	2	10,00	14	70,00	2	10,00	0	00,00	20	100
SAMPLE:		9	10,58	10	11,76	58	68,24	7	08,24	1	01,18	85	100

Table 6.6 B: The educational level of the parents in the E-2 and C

Tables 6.2 A and 6.2 B represent the educational level of parents in numerical and percentage form, while Table 6.6 C is processing data from Table 6.6 A and 6.6 B in accordance with the afore mentioned scoring method of education.

CLASS	E1			E2			K		
	n	X	$\overline{x}$	n	X	$\overline{x}$	n	X	$\overline{x}$
V	21	63	3,00	20	66	3,30	20	64	3,20
VI	15	48	3,20	20	59	2,95	20	64	3,20
VII	24	78	3,25	25	82	3,28	25	82	3,28
VIII	24	81	3,34	20	59	2,95	20	64	3,20
TOTAL:	84	270	3,22	85	266	3,13	85	274	3,22

Table 6.6 C: The educational level of parents

n - The number of students - parents
X - The sum of the group grades
$\overline{x}$ - The average score (an educational level of one parent)
From Table 6.6 C can be seen that the average educational level of parents is 3.22: 3.13: 3.22 which is in the range between secondary and higher education levels.
The experimental groups E1 and E2 and the control C group are quite consistent.
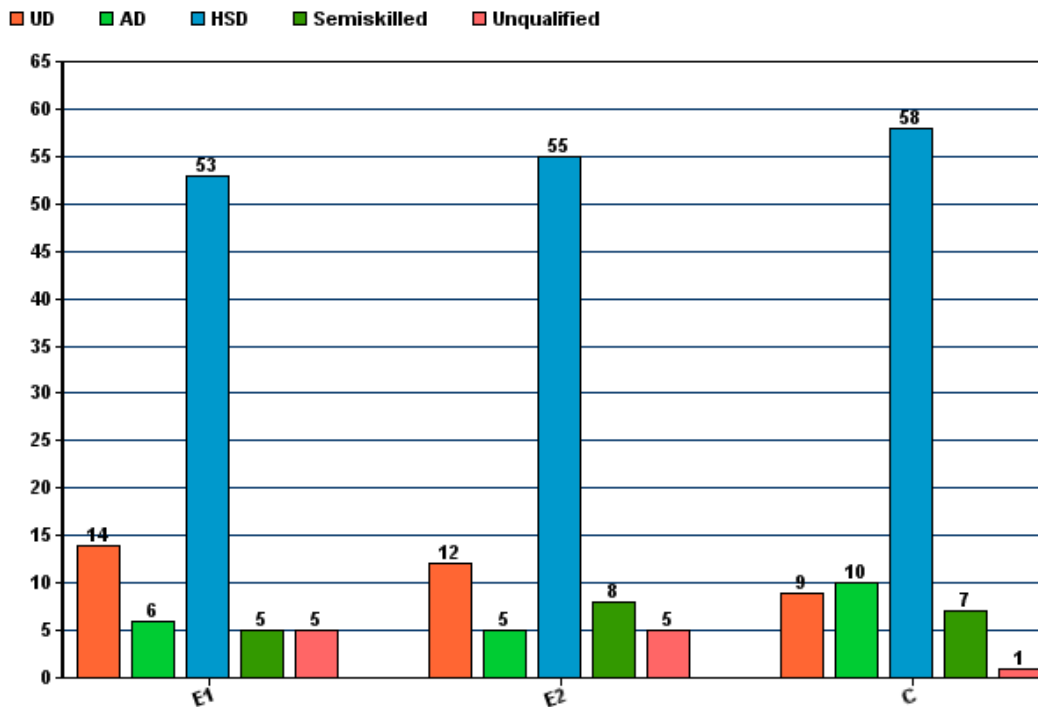
Figure/Diagram 6.4 Educational levels of parents
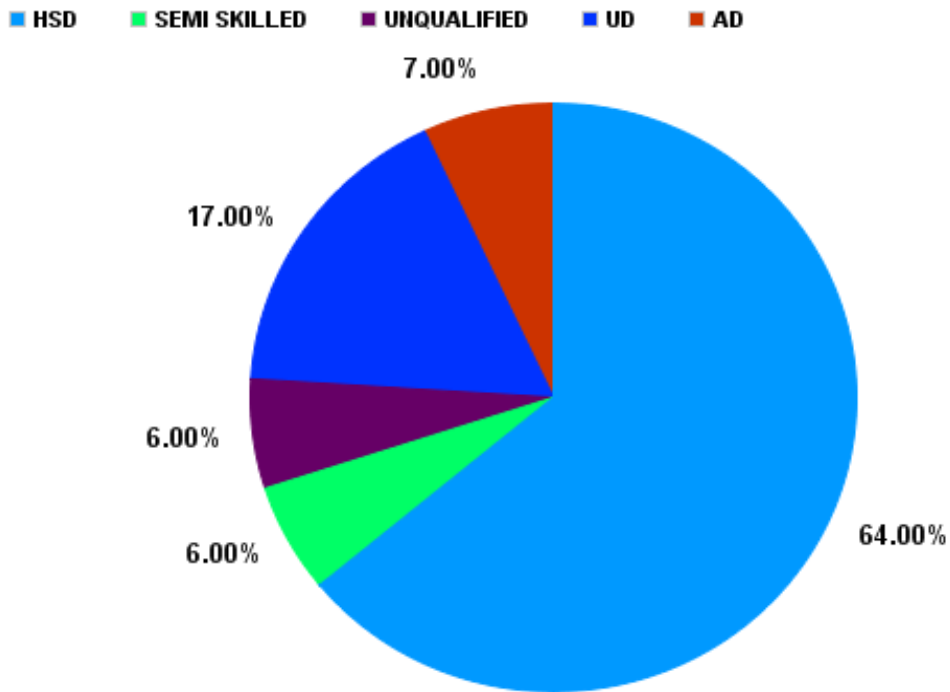
Figure/Diagram 6.5 The educational level of parents (%)

ACCOMPLISHMENT		EXPERIMENTAL GROUP				CONTROL GROUP		TOTAL	
		E1		E2		C			
		Number	%	Number	%	Number	%	Number	%
V CLASS	A	15	24,59	13	21,31	14	22,95	42	68,85
	B	5	08,20	7	11,48	6	09,83	18	29,51
	C	0	00,00	0	00,00	0	00,00	0	00,00
	D	1	01,64	0	00,00	0	00,00	1	01,64
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	21	34,44	20	32,78	20	32,78	61	100
VI CLASS	A	8	14,55	10	18,18	12	21,82	30	54,55
	B	5	09,09	7	12,73	5	09,09	17	30,91
	C	1	01,82	3	05,45	2	05,54	6	10,91
	D	1	01,82	0	00,00	1	01,81	2	03,63
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	15	27,28	20	36,36	20	36,36	55	100
VII CLASS	A	11	14,86	14	18,92	13	17,57	38	51,35
	B	8	10,81	8	10,81	9	12,16	25	33,78
	C	3	04,06	2	02,70	2	02,70	7	09,46
	D	2	02,70	1	01,35	1	01,36	4	05,41
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	32,43	25	33,78	25	33,79	74	100
VIII CLASS	A	13	20,31	11	17,19	10	15,63	34	53.13
	B	6	09,37	4	06,25	4	06,25	14	21,87
	C	5	07,81	4	06,25	5	07,81	14	21,87
	D	0	00,00	1	01,56	1	01,57	2	03,13
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	37,50	20	31,25	20	31,25	64	100

Table 6.7. Sample and groups according to the overall success in previous year

CLASS	E1			E2			C		
	n	X	$\overline{x}$	n	X	$\overline{x}$	n	X	$\overline{x}$
V	21	97	4,64	20	93	4,65	20	94	4,70
VI	15	65	4,33	20	87	4,35	20	88	4,40
VII	24	100	4,17	25	110	4,40	25	109	4,36
VIII	24	104	4,33	20	85	4,25	20	83	4,15
TOTAL:	**84**	**366**	**4,37**	**85**	**375**	**4,41**	**85**	**374**	**4,40**

Table 6.7 A.The following table presents statistical analysis of the data from
n - The number of students;   X - The sum score of the group; $\overline{x}$ - Score

	1	2	3	4	5
E1	0	4	9	24	47
E2	0	2	9	26	48
C	0	3	9	24	49
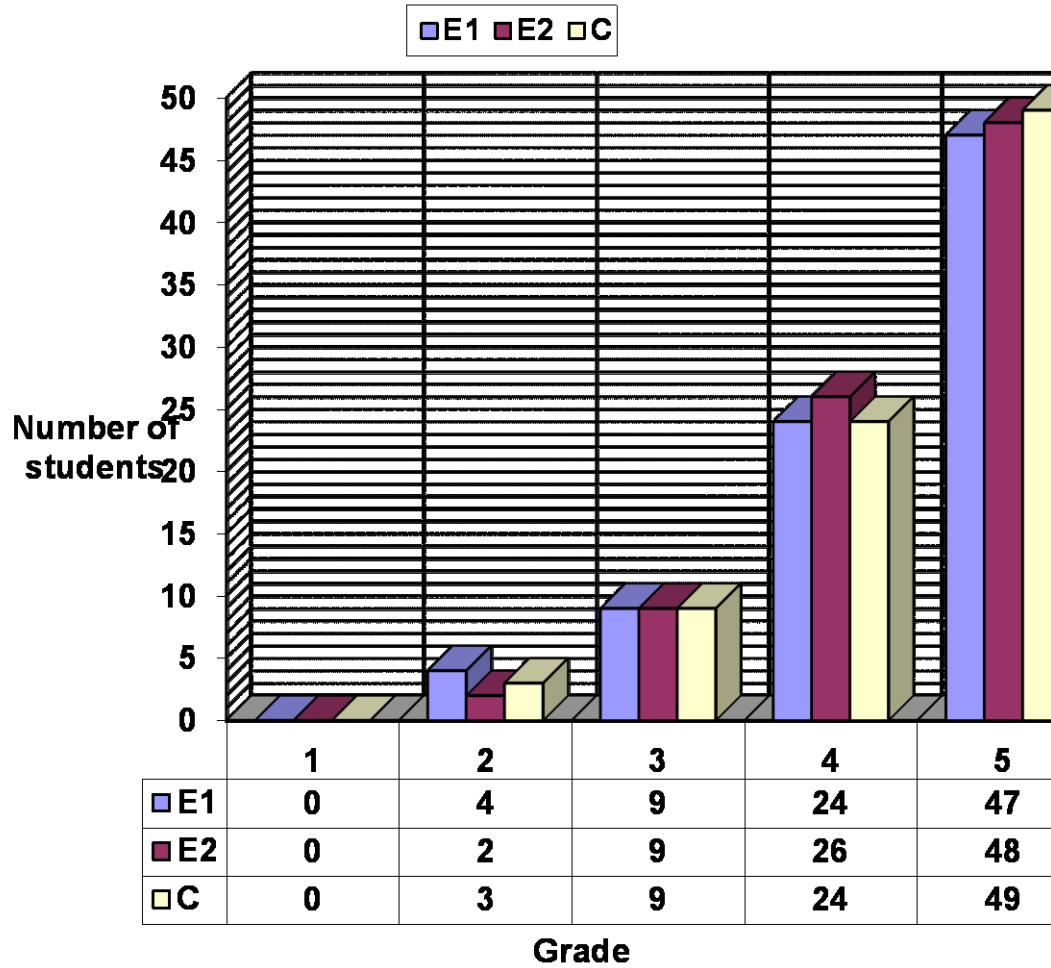
Figure/Diagram 6.6. The overall success in previous year

ACCOMPLISHMENT		EXPERIMENTAL GROUP				CONTROL GROUP		TOTAL	
		E1		E2		C		Number	%
V class- n & s	A	15	24,59	15	24,59	17	27,87	47	77,05
	B	5	08,20	4	06,56	2	03,28	11	18,03
	C	1	01,63	1	01,64	0	00,00	2	03,28
	D	0	00,00	0	00,00	1	01,64	1	01,64
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	21	34,42	20	32,79	20	32,79	61	100
VI CLASS –TE	A	9	16,36	15	27,27	13	23,64	37	67,27
	B	3	05,45	2	03,64	4	07,27	9	16,36
	C	2	03,64	2	03,64	2	03,64	6	10,91
	D	1	01,82	1	01,82	1	01,82	3	05,45
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	15	27,27	20	36,36	20	36,36	55	100
VII CLASS-TE	A	17	22,97	19	25,68	21	28,38	57	77,03
	B	3	04,05	4	05,40	2	02,70	9	12,16
	C	3	04,05	1	01,35	1	01,35	5	06,76
	D	1	01,35	1	01,35	1	01,35	3	04,05
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	32,43	25	33,78	25	33,78	74	100
VII CLASS-	A	8	10,81	10	13,51	8	10,81	26	35,14
	B	9	12,16	8	10,81	10	13,51	27	36,49
	C	4	05,40	5	06,76	5	06,76	14	18,92
	D	3	04,05	2	02,70	2	02,70	7	09,46
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	32,43	25	33,78	25	33,78	74	100
VIII CLASS-	A	8	12,50	8	12,50	10	15,63	26	40,62
	B	4	06,25	5	07,81	3	04,69	12	18,75
	C	6	09,37	4	06,25	6	09,38	14	21,87
	D	6	09,38	3	04,69	1	01,56	9	14,06
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	37,50	20	31,25	20	31,25	64	100
VIIi c;ass- TE	A	18	28,13	16	25,00	17	26,57	51	79,69
	B	4	06,25	3	04,69	3	04,69	10	15,63
	C	1	01,56	0	00,00	0	00,00	1	01,56
	D	1	01,56	1	01,56	0	00,00	2	03,13
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	37,50	20	31,25	20	31,25	64	100

Table 6.7 A: Sample and groups according to success in the previous year
 LEGEND: TE - Technical Education   N and   S-Nature and Society

The following table presents statistical analysis of the data from Table 6.7. A

Class	E1			E2			K		
	n	X	$\overline{x}$	n	X	$\overline{x}$	n	X	$\overline{x}$
V(N & S)	21	98	4,67	20	94	4,70	20	95	4,75
VI(TE)	15	65	4,33	20	91	4,55	20	89	4,45
VII(TE)	24	108	4,50	25	116	4,64	25	118	4,72
VII(Physics)	24	94	3,92	25	101	4,04	25	99	3,96
VIII(Physics)	24	86	3,58	20	78	3,90	20	82	4,10
VIII(TE)	24	111	4,63	20	94	4,70	20	97	4,85
TOTAL:	132	562	4,27	130	574	4,42	130	580	4,47

n - The number of students
X - The sum of the group grade
$\overline{x}$ - The average grade

Table 6.7 presents' data on the overall success of the students at the end of the previous school year, while Table 6.7. A, contains information about the students' achievement in the following subjects: nature and science, physics, and technical education in previous year.

To equalize the experimental group E2, and the control group C in the experiment with parallel groups were collected ahead presented and statistically analyzed data in order to assess all the relevant factors which may affect the outcomes and results of the experiment, and we have presented them for further processing and statistical inference.

Summing up the overall success of students at the end of the previous school year, we are pleased to say that the experimental and a control group began education up with solid knowledge, which was some guarantee that students will successfully master the teaching material of the Technical and IT education, the subject in which we explore the effectiveness of the updated model of teaching.

Based on the review and information about the sample, we can conclude that the experimental group E2, and a control group C, are mostly equaled by all elementary and important features.
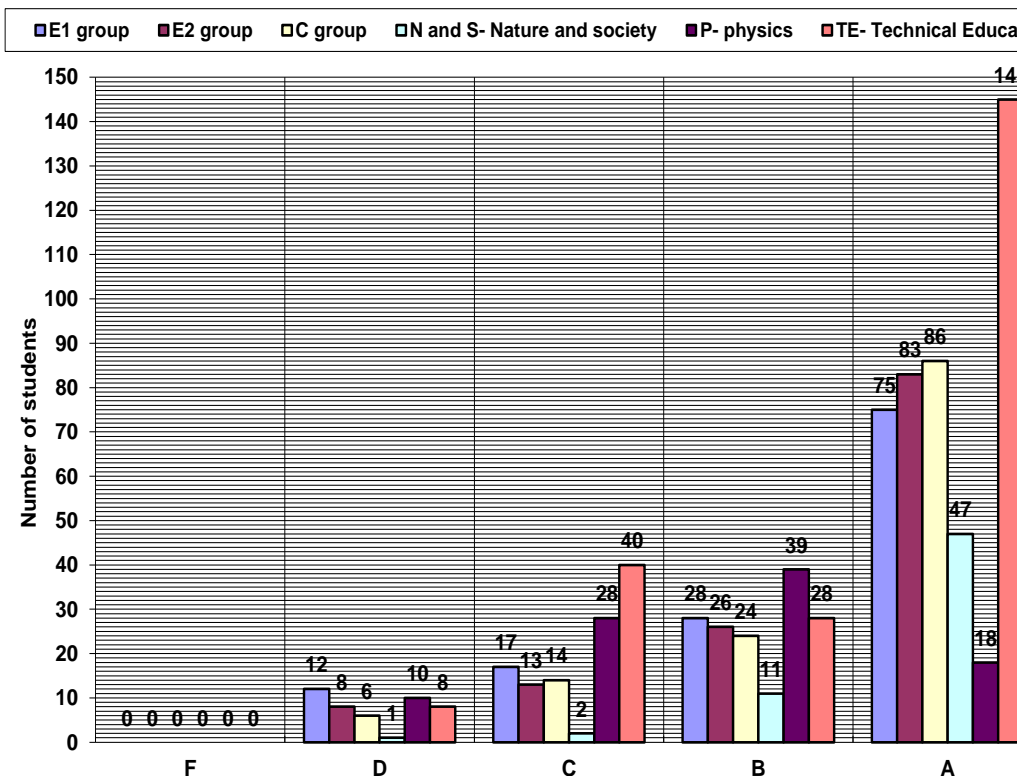
Figure/Diagram 6.7. The general success in professional courses

6.1.5. Applied instruments and techniques in research

For the study, we applied the instruments and techniques that are consistent with the character and purpose of the study and have the main purpose to provide objective and reliable information about the changes that have occurred because of the introduction of the experimental factors (Innovated teaching model - heuristic teaching contents of the Technical and IT education).

Those measuring instruments and techniques are:

1 Initial test for measuring knowledge

2 The final test for measuring acquired knowledge

3 Observations

4 Test for measuring general ability

5 Protocols of teachers on the progress of the experiment

6 The ratio of teachers to experiment.

The tests

Knowledge test of technical and IT education in the initial examination represents measure of knowledge that students have acquired in their previous education, up to the beginning of the experiment. As a basis for the design of the test is taken curriculum of technical and IT education from the schools 2011/12 year when the experiment was performed. Test structure includes a number of selected topics of teaching, provided by curriculum.

The final test of knowledge of technical and IT education included provided material for processing to during the experiment (from the beginning to the end of the school year). The task of the test was to capture knowledge, adopted during processing, and to provide an exact basis for determining the clear effect - the effect of teaching in an experiment with a group, that is, the exact basis for the analysis and comparison of success in the experimental and control group, i.e. experiment with parallel groups, and the conclusion about the effect of the updated models in the teaching of technical and IT education.

Tests include four types of tasks:
- Alternation tasks - an alternative;
- Tasks compensation (recollection or supplementing);
- Combinations of tasks (sorting or comparison), and
- Selection tasks (multiple choices).

6.1.6 Experimental work in teaching technical and IT education

Our experiment in teaching began with great interest of teachers for the achievement of the experimental program.

The experiment was started in an elementary school with 12 classes (each of 3 classes V, VI, VII, and VIII) and lasted for one school year 2011 / 2012th (2 hours per week as a whole) just as much as the curriculum provided for learning technical and IT education.

In the experiment with parallel group's investigation was performed simultaneously at the end of the experimental program, in the classes E2 and C group in order to avoid the possibility of agreement among students.

Observation

Observation as evaluative techniques we have applied for identifying valuable research data of individual students' abilities, and as an instrument we have used protocol of observation.

The questionnaire of achievement motive

Motivating students we have established using testing techniques, surveys (questionnaire), and as an instrument we have used the initial and final questionnaire of achievement motive. We also used analysis of documentation, observation and testing.

Protocols of teachers about the course of the experiment

To obtain information about the course of the experimental work, the teachers for all school classes applied prepared in advance protocol, which contained the following sections:
- Characteristic moments in the phases of teaching units;
- Teaching hours;
- Observations on the reaction of students, and
- The effects of teaching.

Through protocol analysis, we could conclude that:
- Processing of teaching subjects is realized according to pre-defined instructions;
- Classes were held in a spirit of intellectual curiosity, tenacity, perseverance, increased activity and independence of students;
- The introductory parts of the class is designed in heuristic strategy, in the form of problem issues, claims, thesis or alternative.
- Heuristic problem situations initiated students' intellectual activity, interests, creative imagination, created the tension and motivation for research.

- Some classes lasted longer than usual norms because the cognitive students' curiosity to solve a specific problem, i.e. reduce results and verify them in new heuristic problem situations.

In the protocol, the teachers were grading and gave an opinion on the effect of experimental modes, while stressing their positive attitude towards teaching heuristic and heuristic problem solving strategies as the highest form of education.

We can quote two typical teacher statements:
"The updated model of distance learning and heuristic problem solving approach to the teaching content, the heuristic strategy for selecting elements to create problem situation, extracting the main problem, the selection of active methods and forms of work for the realization of listed targets, preparation of teaching materials and the other is extremely difficult intellectual effort for teachers before the class, and during class the teacher is just a skilled organizer that motivate, guide and review the implementation of planned goals." (Professor Peter Padejski, from" Djura Jaksic" in Zrenjanin).
"A significant feature of the Innovative model of distance learning and heuristic teaching is the emphasizing the role of students in the educational process and intensive development of his thinking and creative skills. For these classes the teacher must know the principles of modern educational technology: to recognize, select, analyze, compare, combine, modify, evaluate and notes many things that characterizes the class." (Professor Dragan Mijatov).

The ratio of teachers to the experimental factor
By attending the classes in the experimental classes, we registered the following pedagogical phenomenon:
- The skill of student responses;
- Private conversation between students (sharing experiences);
- Debate and discussion; and
- The teacher's coordination and encouragement of student activities.
Based on the registered data we have found:
- That there were no significant deviations from the planned structure teaching classes planned curriculum and basic heuristic concept of the learning process;
- That teachers entered some elements that did not affect the basic idea of the class;
- That teachers with extreme curiosity critically analyzed implemented classes and in other instances successfully corrected some inconsistencies.
- Efforts of teachers to promote students as active collaborators in the teaching process, as researchers who develop their own initiative, their creative abilities, thinking and judgment.

The course of the experiment
In accordance with the formulated objectives, object, task and hypotheses of the research, we have approached the development of the experimental program, and a draft of its implementation. The experiment was conducted in the cabinet of the Technical Education Elementary School "Djura Jaksic" in Zrenjanin, according to the current curriculum, and aims to experimental verification of research hypotheses. As described above, the experiment involved 12 classes (each 3 classes V, VI, VII, and VIII). It have been applied an experiment with one group and experiment with parallel groups, so that the department is divided into E1 and E2 the experimental groups and the control group C in the experiment with parallel groups.

Development of an experimental program was made in the following order:

- Determining the overall structure of the class;
- Processing new contents with heuristic and algorithmic strategy;
- Identifying the most important content as a basis for the experimental program;
- Determining the number and distribution of teaching topics and units;
- Processing teaching topics and units with a heuristic strategy in the form of written preparation for class by which teachers work, and
- Implementation of the teaching topics in distance learning model.

Based on the results of theoretical analysis about education through problem-solving heuristics conceived strategy, we concluded that the most effective processing the teaching topics and units is being implemented in a logical order that looks like:

- Setting problem to a heuristic strategy (a heuristic problem situation);
- Definition of the problem that has a heuristic character;
- Hypotheses;
- Decomposition of the problem and its parsing to narrower problems;
- Problem Solving - verification hypotheses;
- Conclusions.

Deviations from the above-mentioned phase of heuristic problem solving were negligible in situations when teaching topics or units were not suitable for processing heuristic strategy.

Number of teaching classes was determined on the basis of verified curriculum of technical and IT education for V, VI, VII and VIII grade.

Repetition and practice of teaching material using timely, regular and complete information, was performed whenever possible, using heuristic teaching implemented in the updated model of distance learning. Experimental exercises that provides curriculum were included in regular classes to acquire new knowledge and lessons of school materials practice and not as separate sample exercises.

Developing teaching topics and units generally contain the following elements:
- The basic idea of bloc hours and tasks;
- Skills that student should acquire;
- New term;
- Experimental exercises and teaching materials;
- Teaching forms and methods, and
- Class course.

In order to provide the best possible working conditions, the precise articulation of the content of teaching topics and units, as well as the planning of the educational process in the classroom, it is prevented possible, teacher's improvisation that would violate the experimental conditions in the classroom.

In C - control group, the teachers worked in the usual way, i.e. presenting and explaining the teaching content.

Additional information of teachers for work in C - control group, and in E1 and E2 experimental groups, was performed during the initial testing and just before the experiment. Through seminar and additional information, teachers aim of the experiment was explained, mode of work, application of modern teaching materials, teach schedule of topics and units and method of keeping protocols.

In E1 and E2 experimental groups, learning provides a heuristic strategy, students are instructed to technique of learning and self-learning of heuristic teaching, as

well as increasing the ability to use a variety of sources of knowledge and practicing intellectual work (development of curiosity, creative and critical thinking skills through individual work in the updated model) which resulted in noticing, formulating and heuristic problem solving. Teachers had freedom of presenting some educational content with a heuristic strategy for their way of work, respecting the established procedures and retention of heuristic concepts of the class.

Same program contents and for the same time, were analyzed in the C (control) group, but with a classic - verbose conception (lecture, book, stencil solving problems, etc...).

Previous statement we will illustrate with an example of processing teaching unit in both experimental groups E1 and E2 (V, VI, VII and VIII grade).

Educational topic: "From Idea to its Realization" planned number of classes 8.

Class: V - the fifth, the realization of the two (2) classes in a block.

Teachers have initially set class objectives, according to the methodical and didactic teaching topics (see No. 5. Didactic and Methodology design and heuristic modeling program contents of technical and IT education).

It is important to emphasize objective of the class for a specific teaching unit as part of teaching unit, in order to thoroughly prepare students for school materials (read literature, perform some preparation and observation, collect necessary information, and etc.). Besides, the goal must have issue character that students need to independently respond on, during the work, and should not contain statements that allege students to conclusions.

While processing a specific topic, and within it the teaching unit, teachers have just done exactly that. Students were announced that will alone solve problems of a given task, i.e. problem situation that has a heuristic character.

They were also told that the success of each depends on the skill to solve the problem situation - IDEAS - discover solutions and correctly apply them in new situations. This note served as a means of motivation among students at begin of work.

Class begins with the task which is formulated by heuristic strategy. The teacher sets the task: "Carefully observe the objects that surround you. You will notice that some items that have served the same purpose are different. Consider, for example, cars. Please list some items on your own memory, electronically via computer.

To build a new, modern subject is required........... (Idea)."

There was a problem situation: uncertainties, the current confusion, expectation and curiosity. Students formulate a problem: on suggestion of teachers they write in their notebooks item that construct themselves. Then receive the research tasks they will work independently. The atmosphere of the so conceived heuristic teaching is stimulating and natural. Among students occurs naturally and easily controlled competitive ambitions, comparison with other students encourages to work, mutual co-operation in the exchange of experiences brings together distant individuals and guide them to safe solidarity in work, motivation to work becomes stronger, more controlled and evaluating their own results is wider, more realistic and objective.

The teacher refers students to mutual cooperation and agreement on the use of different views in the creation, design and implementation of their own ideas. A variety of ideas (how many students, so many ideas) that the students write down in their notebooks, with the suggestion that each student precede to the realization their own ideas, among students causes discussion, debate and critical thinking.

The teacher, on the computer sets the students problem questions in electronic form as follows:
- What subject that you wrote down in your notebook must have to be structured? (Idea)
- What is the name for the first drawing which represents the realization of your ideas?   (Draft)
- What is the name of drawing that shows components of your items? (Conceptual design)
- What is the name drawing showing the dimensions (size, width, length, etc...) of an object? (Manufacturing sheet)
- All of these drawings are called   How?
(Answer: Technical drawings). Students write answers.
Thus, the students, with teacher's suggestions, define and expound main into narrower problems. Next step was decanting ideas into technical drawings (design, workshop drawings, and conceptual design) each for their subject.
Through the formulation of hypotheses, students acquire new knowledge, working on the development of technical drawings meet the basic equipment for technical drawing and are trained to handle the equipment with it.
At the end of the block of class teachers have received feedback as the primary outcome criterion in the process of acquiring knowledge, skills and habits, and have prepared the students for the next course unit, by setting goals for the next class.
In the same or similar manner, are elaborated all course units of the theme "From idea to its realization," and other educational topics of technical and IT education that we have chosen as suitable for heuristic modeling and implementation of innovated model of distance learning, in regular and emergencies.
After drafting technical drawings, students accessing the individual problem solving by working their own project, i.e. selected subject. (With using Constructors sets of elements).
As we've talked about work of the experimental group E1 and E2, it is necessary to say something about the work of the control group.
Class usually begins by talking about the previous lesson and would be followed up by to it new content. After the introductory part of the lesson follows points the goal, processing new material, and in the final part of the class repeating, and knowledge checking and the teacher specifies homework. It is understood that class phases are more favorable to reproductive and receptive intellect, rather than independent acquisition and creative participation of students in the learning process. The classes with control group C, was dominated by lecturing method which did not attracted the interest of students, did not more motivated his individuality, because it is not an equal participant in the design of his ability to work autonomously.
If learning according to contemporary understanding of the process of eternal, active, permanent and progressive alteration of personality (in this case, students) is under the influence of external factors, then at this class is not fully endorses the actions of the subject that studies (i.e. students).
The teachers in the control group used predominantly frontal method of work; all students solved the same tasks for the same time at the same pace with the same expected results. Learning is understood as an individual task of the individual, or as a process of receiving information transmitted by a teacher, or as a course of pre-defined steps in the acquisition of knowledge through the exchanges of teacher's questions, and student responses.

It can be said that in the control group C was applied the usual type of class that are commonly encountered in traditional teaching.

ANALYSIS AND INTERPRETATION OF EXPERIMENT RESULTS
Starting with the research project, which provides verification of the subject, objectives, tasks and research hypothesis, was collected, arranged and processed a large number of empirical data and information.

According to the usual methodological procedure in the analysis and interpretation of experimental studies we have performed a quantitative analysis of the empirical data and information in order to compare the effects of traditional and heuristic (the usual) mode in order to perform certain conclusions.

In the interpretation of the research results we will check the general hypothesis and specific sub-hypotheses: learning outcomes achieved through the application of heuristic models of education, the role of students as subjects and active collaborators in the educational process, how education through heuristic model results the motivation of students. We shall indicate on the relationship that exists between general abilities and initial knowledge on the one hand, and student achievements in final test of technical and IT education, on the other hand.

Student assessment in the initial (T-i) and final (T-f) test was performed according to Table 6.7.B.

MAXIMUM POINTS (SCORE)	NUMBER OF ACHIEVED POINTS	GRADE
100 BODOVA	0 DO 30	F
	31 DO 50	D
	51 DO 75	C
	76 DO 90	B
	91 DO 100	A

Table 6.7 B : Converting scores (points) in the grades

The following table shows the effects of education through problem solving heuristically conceived in terms of increasing the educational outcomes.

	accomplishment	EXPERIMENTAL GROUP				CONTROL GROUP		TOTAL	
		E1		E2		C		Number	%
V CLASS	A	2	03,28	3	04,92	3	04,92	8	13,11
	B	7	11,48	6	09,84	6	09,84	19	31,15
	C	9	14,75	9	14,75	8	13,11	26	42,63
	D	3	04,92	2	03,28	3	04,92	8	13,11
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	21	34,43	20	32,79	20	32,79	61	100
VI CLASS	A	2	03,64	2	03,64	2	03,64	6	10,91
	B	5	09,10	3	05,45	4	07,27	11	20,00
	C	7	12,72	8	14,54	7	12,73	21	38,18
	D	1	01,82	7	12,73	7	12,73	17	30,91
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	15	**27,27**	20	**36,36**	20	**36,37**	**55**	**100**
VII CLASS	A	2	02,70	5	06,76	4	05,41	**11**	**14,86**
	B	5	06,76	5	06,76	4	05,41	**14**	**18,92**
	C	13	17,57	10	18,18	12	16,22	35	50,00
	D	4	05,41	5	06,76	5	06,75	14	18,92
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	32,43	25	33,78	25	33,79	74	100
VIII CLASS	A	5	07,81	3	04,69	2	03,13	10	15,63
	B	7	10,94	7	10,94	6	09,37	20	31,25
	C	8	12,50	7	10,94	8	12,50	23	35,94
	D	4	06,25	3	04,68	4	06,25	11	17,18
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	37,50	20	31,25	20	31,25	64	100

Table 6.8 Sample and groups, according to success of the initial test T-i

CLASS	E1		$\overline{x}$	E2		$\overline{x}$	K		$\overline{x}$
	n	X	x	n	X	x	n	X	x
V	21	71	3,38	20	70	3,50	20	69	3,45
VI	15	53	3,53	20	60	3,00	20	61	3,05
VII	24	81	3,37	25	85	3,40	25	82	3,28
VIII	24	85	3,54	20	70	3,50	20	66	3,30
TOTAL	84	290	3,45	85	285	3,35	85	278	3,27

Table 6.8 A: Statistical analysis of the initial test T-i

First we analyze the overall educational outcomes in terms of the general level of knowledge, researched by achieved score (grade) of the Technical and IT education. In order to comprehend the growth of educational performance of students in the E1, E2 and C group, it was previously demonstrated a level of prior knowledge. All in all groups E2 and C are have entered into the experiment approximately equal in their knowledge of the subject areas of Technical and IT education. Overview of measurement results of initial test is shown in Table 6.8 and 6.8 A.

	V Grade	VI Grade	VII Grade	VIII Grade
Average score	3.48	3.03	3.34	3.4
C group	3.45	3.05	3.28	3.3
E2 group	3.5	3	3.4	3.5
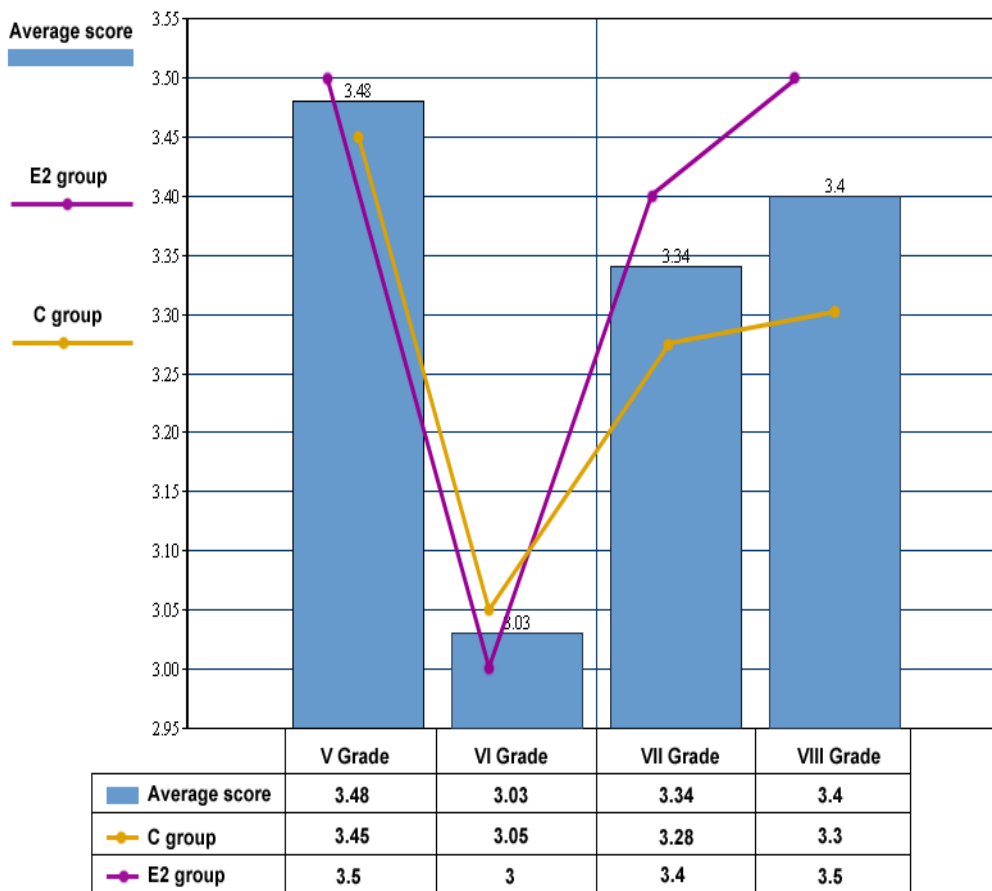
Figure/Diagram 6.8 Initial measurement of the achievement motive (Test Ti)

accomplishment		EXPERIMENTAL GROUP				CONTROL GROUP		TOTAL	
		E1		E2		C			
								Numbr	%
V CLASS	A	7	11,48	9	14,75	4	06,56	20	32,79
	B	9	14,75	7	11,48	7	11,48	23	37,70
	C	4	06,56	4	06,56	5	08,20	13	21,31
	D	1	01,64	0	00,00	4	06,56	5	08,20
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	21	34,43	20	32,79	20	32,80	61	100
VI CLASS	A	7	12,73	8	14,55	4	07,27	19	34,55
	B	7	12,73	8	14,55	4	07,27	19	34,55
	C	1	01,82	4	07,27	8	14,55	13	23,64
	D	0	00,00	0	00,00	4	07,27	4	07,26
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	15	27,27	20	36,36	20	36,36	55	100
VII CLASS	A	9	12,16	11	14,86	7	09,46	27	36,49
	B	10	13,51	11	14,86	8	10,81	29	39,19
	C	4	05,41	3	04,05	8	10,81	15	20,27
	D	1	01,35	0	00,00	2	02,70	3	04,05
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	32,44	25	33,78	25	33,78	74	100
VIII CLASS	A	10	15,63	9	14,06	4	06,25	23	35,94
	B	9	14,06	9	14,06	6	09,38	24	37,50
	C	5	07,81	2	03,13	5	07,81	12	18,75
	D	0	00,00	0	00,00	5	07,81	5	07,81
	F	0	00,00	0	00,00	0	00,00	0	00,00
	TOTAL:	24	37,50	20	31,25	20	31,25	64	100

Table 6.8 B: Sample and groups for success at the final test T – f

The results of final status are shown in Table 6.8. B and 6.8 C, where the accompanying table shows the level of previous knowledge of the students, as well as the growth of educational performance in the experimental groups E1 and E2 and the control group C. Of course, we have not manipulated the results of individual students in the tables, but a contrary, we have considered the arithmetic mean.

CLASS	E1			E2			K		
	n	X	$\overline{x}$	n	X	$\overline{x}$	n	X	$\overline{x}$
V	21	85	4,05	20	85	4,25	20	71	3,55
VI	15	66	4,40	20	84	4,20	20	68	3,40
VII	24	99	4,13	25	108	4,32	25	87	3,48
VIII	24	110	4,58	20	87	4,35	20	69	3,45
TOTAL:	84	360	4,29	85	364	4,28	85	295	3,47

Table 6.8 C: Statistical analysis of final test T-f

	V class	VI grade	VII grade	VIII grade
Average score	3.9	3.8	3.9	3.9
C group	3.55	3.4	3.48	3.45
E2 group	4.25	4.2	4.32	4.35
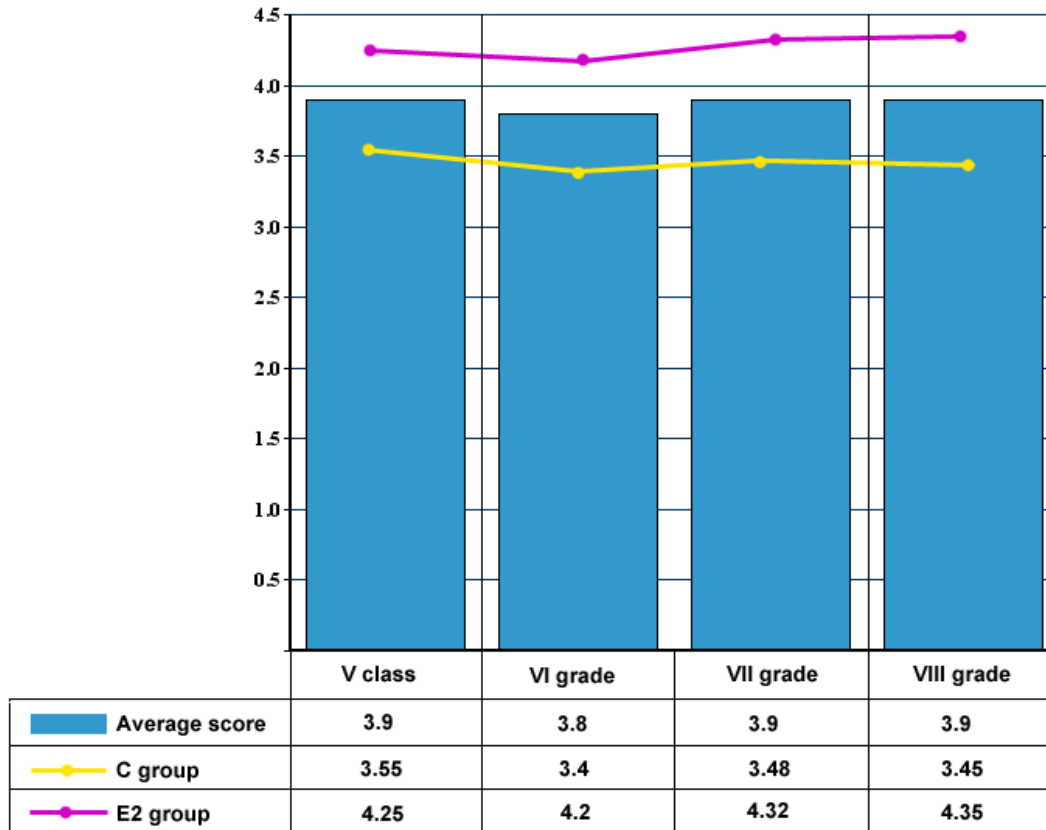
Figure/Diagram 6.8 A: Final measurement of the achievement motive (Test T-f)

Experiment with one group (E1):

-The effects of the experimental program - net effect of the experimental program in the class with the group E1, we determined by students we have tested at the beginning of class, with initial test (T - i) and with final test (T - f) at the end of the class, after the completion of teaching unit by heuristic strategy.

$\overline{x}F = \overline{xf} - \overline{xi}$ net effect of the experimental factors - a general image

$\overline{x}F$ - the effect of the experimental factors-differences in arithmetic means

$\overline{xF}$-the arithmetic mean of the final state

$\overline{xi}$ - the arithmetic mean of the initial state

PARAMETER			THE VALUE OF THE PARAMETERS					
NAME	MARK	FORMULA	E1		E2		C	
			T-f	T-i	T-f	T-i	T-f	T-i
THE AVERAGE GRADE VALUE	$\overline{X}$	$\overline{x}=\Sigma X/N$	4,29	3,45	4,28	3,35	3,55	3,27
THE STANDARD DEVIATION	σ	$\sigma =\sqrt{\Sigma xo/N}$	2,86	3,52	2,86	3,69	4,26	3,66
STANDARD ERROR OF THE ARITHMETIC MEAN	Sx	$Sx=\sigma/\sqrt{N}$	0,31	0,38	0,31	0,40	0,46	0,40
DIFFERENCES IN ARITHMETIC MEANS	$\overline{xF}$	$\overline{xF} = \overline{xF} - \overline{xI}$	0,84		0,93		0,20	
			0,73					
STANDARD ERROR OF DIFFERENCES IN ARITHMETIC MEANS	σxF	$\sigma xF =\sqrt{\frac{\sigma E}{nE}+\frac{\sigma K}{nK}}$	0,33					
IMPORTANCE OF THE DIFFERENCE BETWEEN ARITHMETIC MEANS	t	$\tau =xF/\sigma xF$	2,21					

Table 6.9 Calculation of the important parameters for statistical inference

xo - deviation from the arithmetic mean

Based on the above presented data and tables showing the results of the research we will complete statistical inference and testing the main, as well as planned sub-hypotheses derived from the general hypothesis.

Differences in arithmetic means (t), is significant if is at least two times greater than the standard error of arithmetic mean, i.e. **2SX < t.** In our case it is 2 x 0.46 <2.21, which means that there is a statistically significant difference in the success of students in the experimental and control group.

The analyzed data showed that students in the experimental group, formed by using the Innovative models with heuristic concept of teaching, were more successful than students in the control group, especially in those teaching units where the emphasis is on the logical understanding.

Pronounced observation is another confirmation of the hypothesis that innovated model with heuristic teaching has a greater effect on the educational outcomes of students from traditional teaching classes, indicating that the obtained differences in arithmetic means is not accidental, but is a result of the experimental factors (work by heuristic model). The difference arithmetic means is statistically significant at the 0.01 level of confidence (t = 2, 21).

As the **t**0, 05 = **1.96** and **t**0, 01 = **2.58**, **we conclude with a risk of 5% the difference in the average values of knowledge of students from E2 experimental and control group C is significant, and that students from E2 group are better** (statistical tables, Dr. Svetozar Vukadinovic "Elements of the theory of probability and mathematical statistics page. 477).

ANALYSIS OF GENERAL ABILITY OF STUDENTS

Measurement of general skills and prior knowledge of students from technical education to the beginning of the experiment as in section of this paper, "The applied instruments and techniques in research" as stated above, was performed by a standardized questionnaire for the assessment of achievement motive, Department of Philosophy, University of Novi Sad.

The purpose our study of general abilities of the students, was to determine whether there are significant differences between the groups.

On the basis of data on the general characteristics of the sample (gender, occupation and education of parents, the success of the previous year of technical and IT knowledge) and the correlative object (nature and society in the fourth grade and physics in seventh and eighth grade) could be assumed that there is no significant difference in the relevant characteristics between the groups.

General skills of students we monitored and compared in the E2 and C group, through success achieved in both applied knowledge test (T-i and T-f).

It is known that the final test results are better in the experimental group E2 compared to the control group C, while in the initial test (T-i), the difference is not noticeable. An example of the claim, are graphs Graph / Diagram 6.9 (Graphic achievements of the initial test) and Graph / Diagram 6.9.A (Graphic achievements at the final test).

From the obtained data it can be concluded that the innovated model of with heuristic distance learning classes, activate students 'cognitive activity, independent work and creative approach to the problem, so that talented students in the same time solved a number of tasks, which can be explained, students' earlier high success rate in teaching (higher level of knowledge, ability to understand and remember the theory and its application in practice).
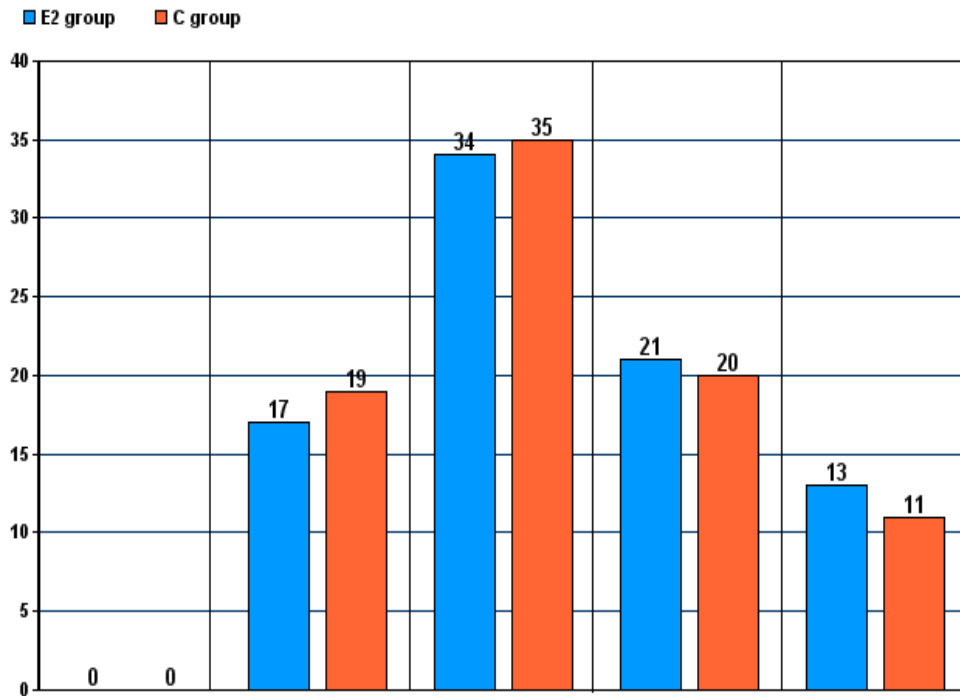
Figure/Diagram 6.9 Graphical representation of achievements at the initial test (Ti)
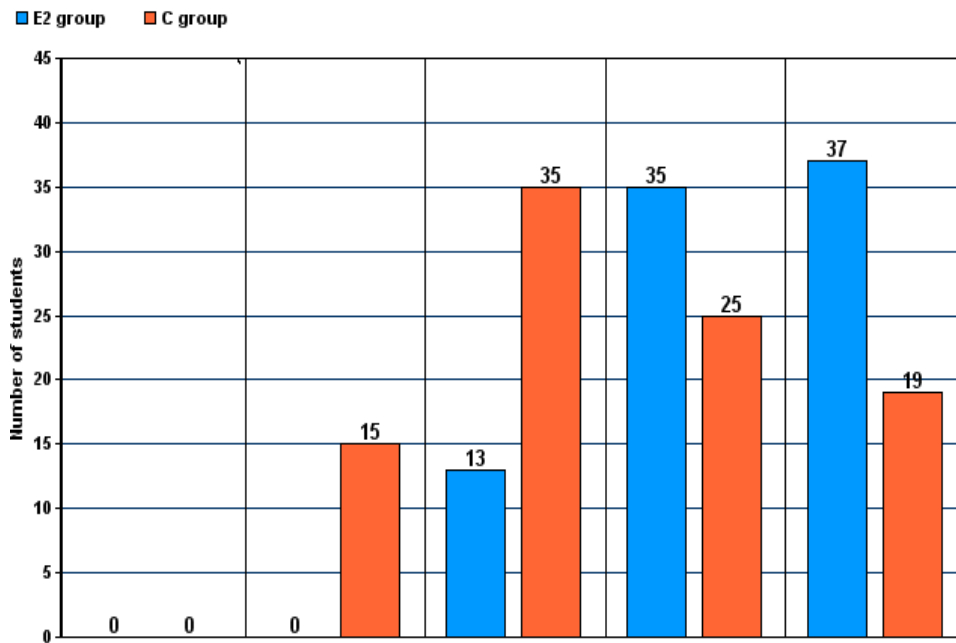
Figure/Diagram 6.9 A Graphical representation of achievements at the final test (Tf)

6.4.1. Development of student's internal motivation

Starting from the goals and research tasks, and hypotheses, strategy management, designed in education, the innovated model of distance learning with heuristic model of teaching is based on a larger and more diverse number of tasks - problems, and therefore the thinking process, which is the characteristic of a heuristic teaching model, that differs from direct exposure and explanation. Research results confirmed the expectations of the extreme effectiveness of internal motivation of students in the experimental group. This modern form of education as one of the highest forms of learning in the classroom, is directly related to the internal motivation of students, such as curiosity and other cognitive demand as students looked for ways to solve problems or heuristic task for new information, searching for the meaning of the learned through practical application and have also assembled new knowledge. Observing the course of the study it was noticed that the students in the experimental group internal motivation is more significant. The effort of students to come up with successful solutions caused new achievement and encouraging more efforts and faith in its own power. Compared with students in the control group, where handed over and transferred knowledge the student perceived as something that comes from outside, beyond his personality, internal motivation, and often against his will. Praise and awards in communication between the teacher - student and student - student, had their psychological and ethical value, because students got closer to knowing the true value of human work and creation. In the experimental group, on the students development of internal motivation influences choice of interesting teaching materials and teachers' skills of interpretation, which activates the intellectual motivation of students and gradually grows into an internal stimulus, i.e. the motive of activity. That's why we talk about learning as the inner need to satisfy the motive of curiosity, anticipation, tension and anxiety, as well as aspirations for expression and self-assertion which the acquired knowledge is transformed into ideas, attitudes and beliefs. Students in the control group based their activity on simultaneously work in direct contact with a teacher who has conducted didactic communication with the whole class. The questions were designed for the average student and are not respected individual potentials of students. The students did not come alone to the acquisition of knowledge. Starting from the above presented results of research and analyzed and reasoned opinions, it can be concluded that the innovated model of education distance learning with heuristic mode, more than a traditional, i.e. the normal modes, contributed to the development of internal motivation in students.

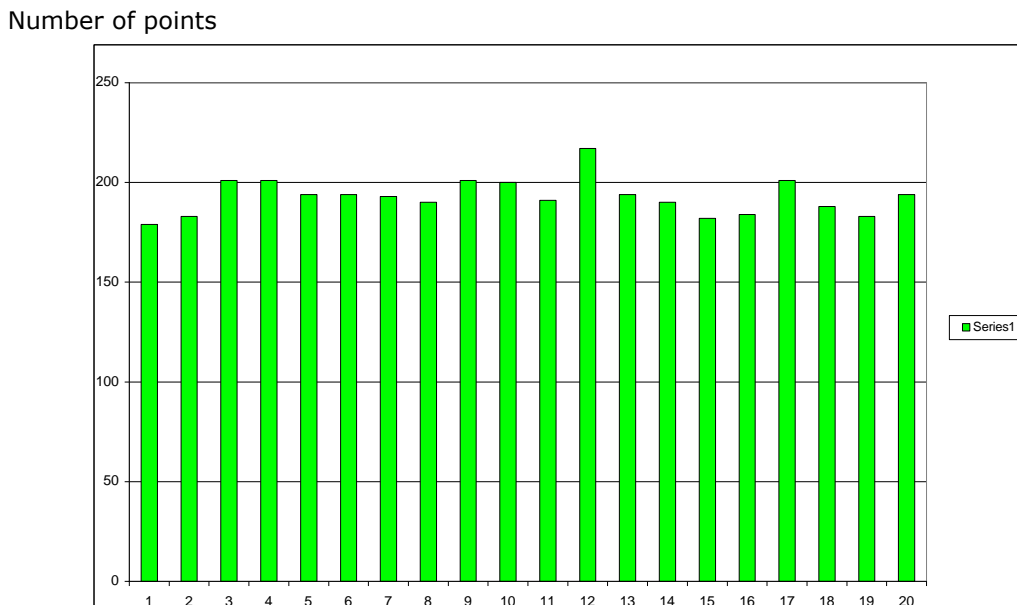| NUMBER QAM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1	4	2	2	5	4	4	3	2	5	5	5	4	4	4	4	2	2	5	4	4	74
2	4	5	5	3	4	5	4	5	4	4	5	5	4	3	4	5	5	3	4	5	86
3	1	5	4	4	4	3	3	3	2	2	1	5	4	3	1	5	4	4	4	3	65
4	2	4	4	2	3	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	65
5	2	3	3	3	4	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	64
6	4	1	5	5	1	4	2	4	3	3	3	3	4	2	4	1	5	5	1	4	64
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8	2	3	5	4	4	4	1	5	5	1	4	2	2	5	5	2	5	2	4	4	69
9	4	5	3	3	3	2	5	5	2	5	2	4	2	5	2	4	4	2	3	3	68
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22	3	2	1	4	5	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	62
23	4	1	5	5	1	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	67
24	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	1	63
25	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	3	1	5	4	4	66
26	4	2	4	3	3	3	3	4	2	4	1	5	5	1	4	2	4	3	3	3	63
27	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	4	81
28	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	2	4	5	4	4	66
29	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	2	2	5	5	5	70
30	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	5	82
31	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	2	4	5	4	1	63
32	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	2	2	5	5	5	70
33	4	5	3	3	3	2	5	5	2	5	2	4	4	2	3	3	3	4	2	4	68
34	4	2	2	5	4	4	3	2	5	5	5	4	4	4	1	5	5	1	4	3	72
35	4	5	3	3	3	2	5	5	2	5	2	4	4	2	3	3	3	4	2	3	67
36	4	2	2	5	4	4	3	2	5	5	5	4	4	4	1	5	5	1	4	2	71
37	4	5	5	3	4	5	4	5	4	4	5	5	4	3	4	4	4	3	5	4	84
38	1	5	4	4	4	3	3	3	2	2	1	5	4	3	2	1	4	5	3	2	61
39	2	4	4	2	3	3	3	4	2	3	5	4	4	4	1	5	5	1	4	2	65
40	2	3	3	3	4	2	3	1	5	4	4	4	4	5	3	3	3	2	5	2	65
41	4	1	5	5	1	4	2	4	3	3	3	3	4	2	2	5	4	4	3	4	66
42	3	4	4	4	3	5	4	5	3	4	4	4	4	5	5	3	4	5	4	5	82
43	3	2	1	4	5	3	2	4	5	4	3	2	1	5	4	4	4	3	3	3	65
44	4	1	5	5	1	4	2	2	5	5	2	5	2	4	4	2	3	3	3	3	65
45	2	5	5	2	5	2	4	2	5	2	4	4	2	3	3	3	4	2	3	2	64
46	4	3	2	5	5	5	4	5	5	5	4	4	4	1	5	5	1	4	2	4	77
47	5	4	5	4	4	5	5	4	4	5	5	4	3	4	4	4	3	5	4	5	86
48	3	3	3	2	2	1	5	2	2	1	5	4	3	2	1	4	5	3	2	3	56
49	3	3	4	2	3	5	4	2	3	5	4	4	1	5	5	1	4	2	2	4	68
50	2	5	5	2	5	2	4	4	2	5	2	5	2	4	4	2	3	3	3	2	66
51	4	3	2	5	5	5	4	4	4	4	2	2	5	4	4	3	2	5	5	5	77
52	5	4	5	4	4	5	5	4	3	4	5	5	3	4	5	4	5	4	4	5	87
53	3	3	3	2	2	1	5	4	3	1	5	4	4	4	3	3	3	2	2	1	58
54	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	5	67
55	5	4	5	4	4	5	5	4	4	5	5	4	3	4	4	4	2	1	4	4	80
TOTAL	179	183	201	201	194	194	193	190	201	200	191	217	194	190	182	184	201	188	183	194	3860

Table 6.10.Results of the initial measurement of the achievement motive E2 group (fifth grade)

QAM - Questions of achievement motivation;   The average grade point: 193
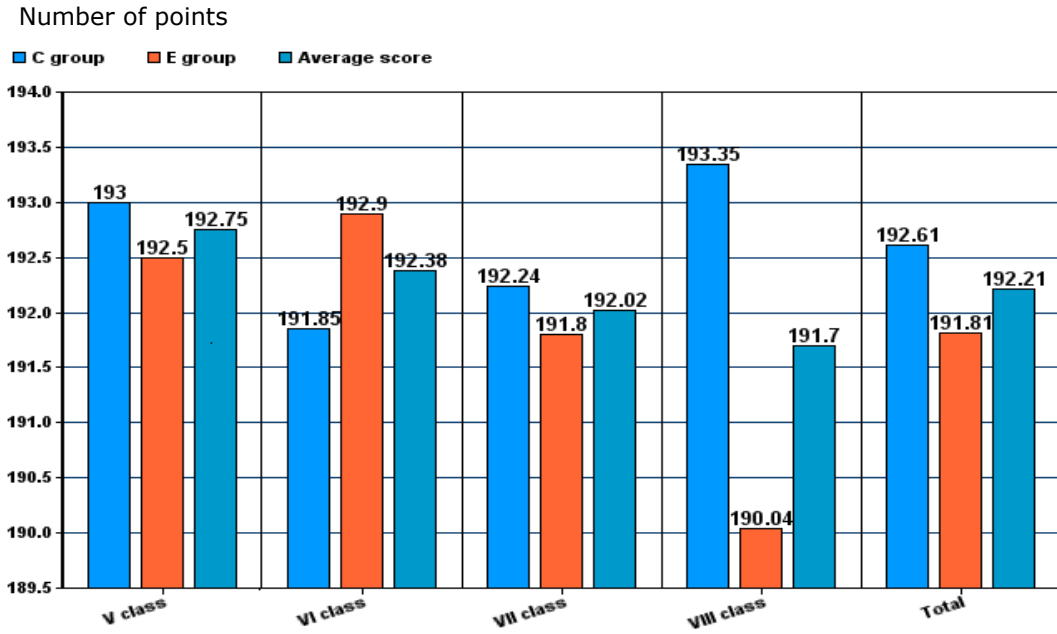
Number of points

Number of questions

Figure/Diagram 6.10 Graphical representation of achievement motivation C (number of points / question)

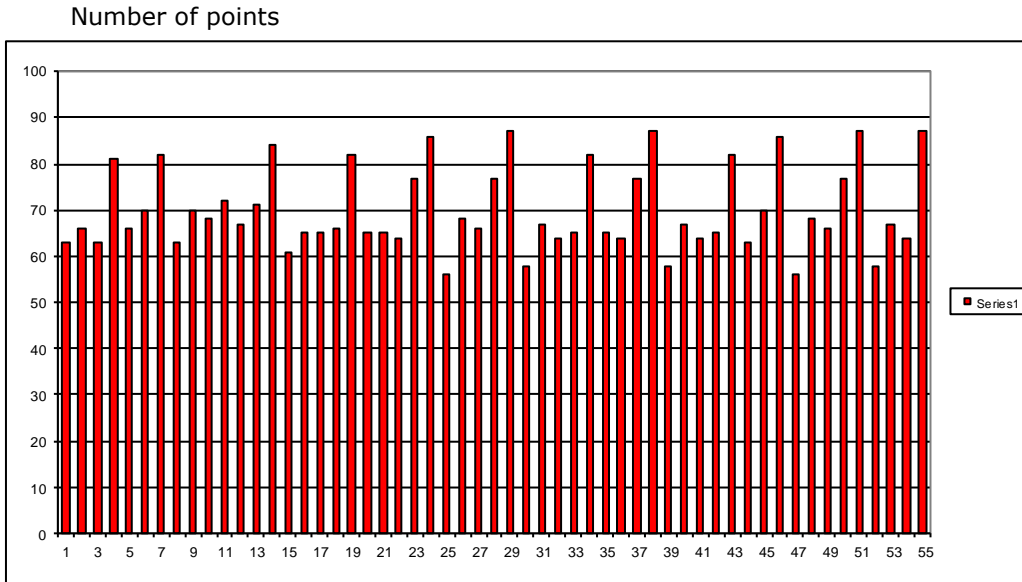Number of points

Number of students

Figure/Diagram 6.11 Graphical representation of achievement motive C (number of points / student)

NUMBER QAM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	1	63
2	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	3	1	5	4	4	66
3	4	2	4	3	3	3	3	4	2	4	1	5	5	1	4	2	4	3	3	3	63
4	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	4	81
5	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	2	4	5	4	4	66
6	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	2	2	5	5	5	70
7	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	5	82
8	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	2	4	5	4	1	63
9	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	2	2	5	5	5	70
10	4	5	3	3	3	2	5	5	2	5	2	4	4	2	3	3	3	4	2	4	68
11	4	2	2	5	4	4	3	2	5	5	5	4	4	4	1	5	5	1	4	3	72
12	4	5	3	3	3	2	5	5	2	5	2	4	4	2	3	3	3	4	2	3	67
13	4	2	2	5	4	4	3	2	5	5	5	4	4	4	1	5	5	1	4	2	71
14	4	5	5	3	4	5	4	5	4	4	5	5	4	3	4	4	4	3	5	4	84
15	1	5	4	4	4	3	3	3	2	2	1	5	4	3	2	1	4	5	3	2	61
16	2	4	4	2	3	3	3	4	2	3	5	4	4	4	1	5	5	1	4	2	65
17	2	3	3	3	4	2	3	1	5	4	4	4	4	5	3	3	3	2	5	2	65
18	4	1	5	5	1	4	2	4	3	3	3	3	4	2	2	5	4	4	3	4	66
19	3	4	4	4	3	5	4	5	3	4	4	4	4	5	5	3	4	5	4	5	82
20	3	2	1	4	5	3	2	4	5	4	3	2	1	5	4	4	4	3	3	3	65
21	4	1	5	5	1	4	2	2	5	5	2	5	2	4	4	2	3	3	3	3	65
22	2	5	5	2	5	2	4	2	5	2	4	4	2	3	3	3	4	2	3	2	64
23	4	3	2	5	5	5	4	5	5	5	4	4	4	1	5	5	1	4	2	4	77
24	5	4	5	4	4	5	5	4	4	5	5	4	3	4	4	4	3	5	4	5	86
25	3	3	3	2	2	1	5	2	2	1	5	4	3	2	1	4	5	3	2	3	56
26	3	3	4	2	3	5	4	2	3	5	4	4	1	5	5	1	4	2	4	4	68
27	2	5	5	2	5	2	4	4	2	5	2	5	2	4	4	2	3	3	3	2	66
28	4	3	2	5	5	5	4	4	4	4	2	2	5	4	4	3	2	5	5	5	77
29	5	4	5	4	4	5	5	4	3	4	5	5	3	4	5	4	5	4	4	5	87
30	3	3	3	2	2	1	5	4	3	1	5	4	4	4	3	3	3	2	2	1	58
31	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	5	67
32	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	3	1	5	4	2	64
33	4	2	4	3	3	3	3	4	2	4	1	5	5	1	4	2	4	3	3	5	65
34	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	4	82
35	4	1	5	5	1	4	2	2	5	5	2	5	2	4	4	2	3	3	3	3	65
36	2	5	5	2	5	2	4	2	5	2	4	4	2	3	3	3	4	2	3	2	64
37	4	3	2	5	5	5	4	4	4	4	2	2	5	4	4	3	2	5	5	5	77
38	5	4	5	4	4	5	5	4	3	4	5	5	3	4	5	4	5	4	4	5	87
39	3	3	3	2	2	1	5	4	3	1	5	4	4	4	3	3	3	2	2	1	58
40	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	5	67
41	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	3	1	5	4	2	64
42	4	2	4	3	3	3	3	4	2	4	1	5	5	1	4	2	4	3	3	5	65
43	5	4	5	3	4	4	4	4	5	3	4	4	4	3	5	4	5	3	4	5	82
44	3	2	4	5	4	3	2	1	5	3	2	1	4	5	3	2	4	5	4	1	63
45	4	2	2	5	5	2	5	2	4	4	1	5	5	1	4	2	2	5	5	5	70
46	5	4	5	4	4	5	5	4	4	5	5	4	3	4	4	4	3	5	4	5	86
47	3	3	3	2	2	1	5	2	2	1	5	4	3	2	1	4	5	3	2	3	56
48	3	3	4	2	3	5	4	2	3	5	4	4	1	5	5	1	4	2	4	4	68
49	2	5	5	2	5	2	4	4	2	5	2	5	2	4	4	2	3	3	3	2	66
50	4	3	2	5	5	5	4	4	4	4	2	2	5	4	4	3	2	5	5	5	77
51	5	4	5	4	4	5	5	4	3	4	5	5	3	4	5	4	5	4	4	5	87
52	3	3	3	2	2	1	5	4	3	1	5	4	4	4	3	3	3	2	2	1	58
53	3	3	4	2	3	5	4	4	4	2	4	4	2	3	3	3	4	2	3	5	67
54	2	3	1	5	4	4	4	4	5	2	3	3	3	4	2	3	1	5	4	2	64
55	5	4	4	5	5	4	3	4	4	5	3	4	5	4	5	4	4	5	5	4	87
TOTAL	191	175	196	197	201	193	212	186	209	188	182	213	196	177	190	178	187	194	193	192	3850

Table 6.11 Results of the initial measurement of the achievement motive group K (class V)
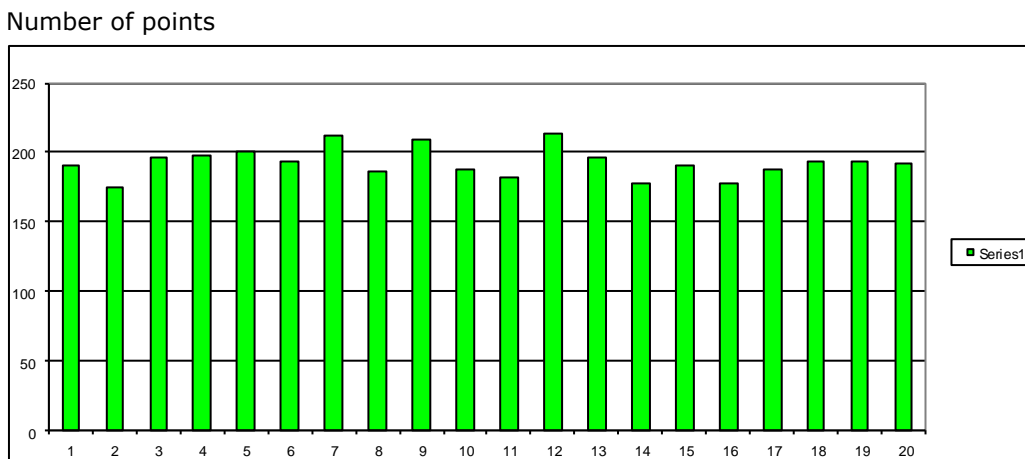QAM - Questions of achievement motive
The average grade point: 192.5

Number of points

Number of questions

Figure/Diagram 6.12 Graphical representation of achievement motive E2 (number of points / question)

Number of points

Number of students

Figure/Diagram 6.13 Graphical representation of achievement motive E2 (number of points / student)

In the same way we processed the data for all grades from fifth to eighth grade, how for control group C, and for experimental group E2:

Results of the initial measurement of achievement motive C and E2 groups (fifth grade):
 - QAM - Questions of achievement motive - The average grade point: 193 C groups.
- QAM - Questions of achievement motive - The average grade point: 192.5 E2 group.
Results of the initial measurement of achievement motive C and E2 groups (sixth grade):
- QAM - Questions of achievement motive - The average grade point: 191.85 C group.
- QAM - Questions of achievement motive - The average grade point: 192.9 E2 group.
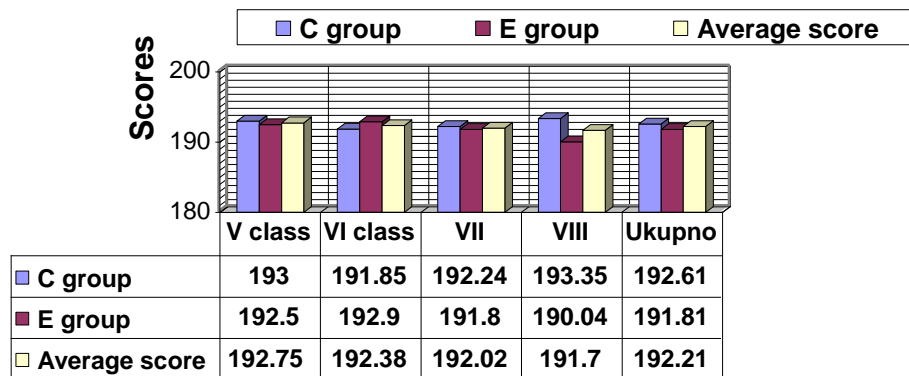Results of the initial measurement of achievement motive C and E2 groups (seventh grade):
- QAM - Questions of achievement motive - The average grade point: 192.24 C group.
- QAM - Questions of achievement motive - The average grade point: 191.8 E2 group.
Results of the initial measurement of achievement motive C and E2 groups (class VIII):
- QAM - Questions of achievement motive - The average grade point: 193.35 C group.
- QAM - Questions of achievement motive - The average grade point: 190.4 E2 group.
The mean value of the achievement motive amounts 192.21

	V class	VI class	VII	VIII	Ukupno
C group	193	191.85	192.24	193.35	192.61
E group	192.5	192.9	191.8	190.04	191.81
Average score	192.75	192.38	192.02	191.7	192.21

Figure/Diagram 6.14
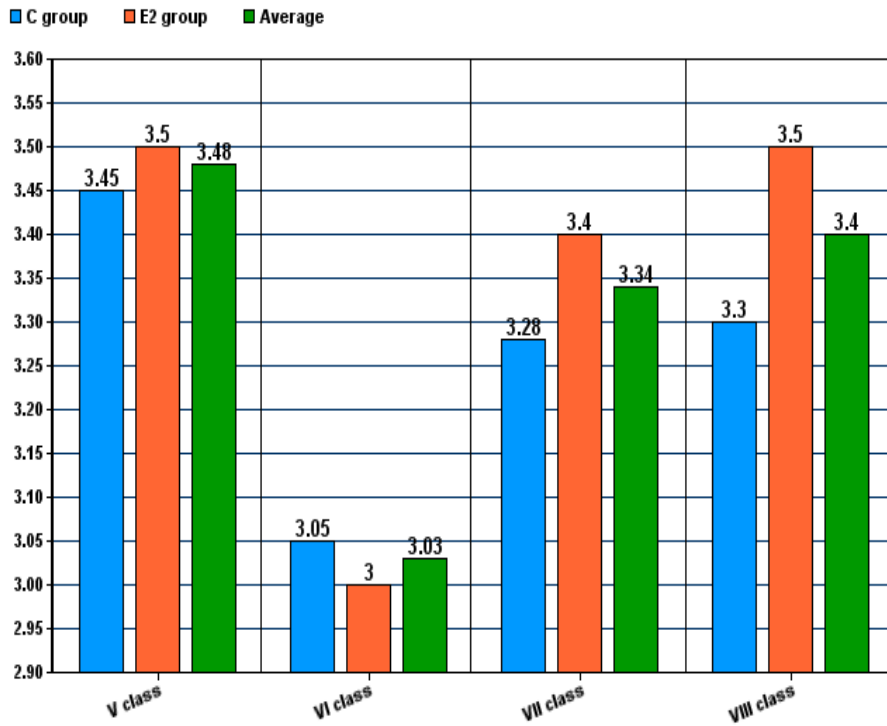
Figure/Diagram 6.15 Graf of initial measuring achievement motive (Test T-i)
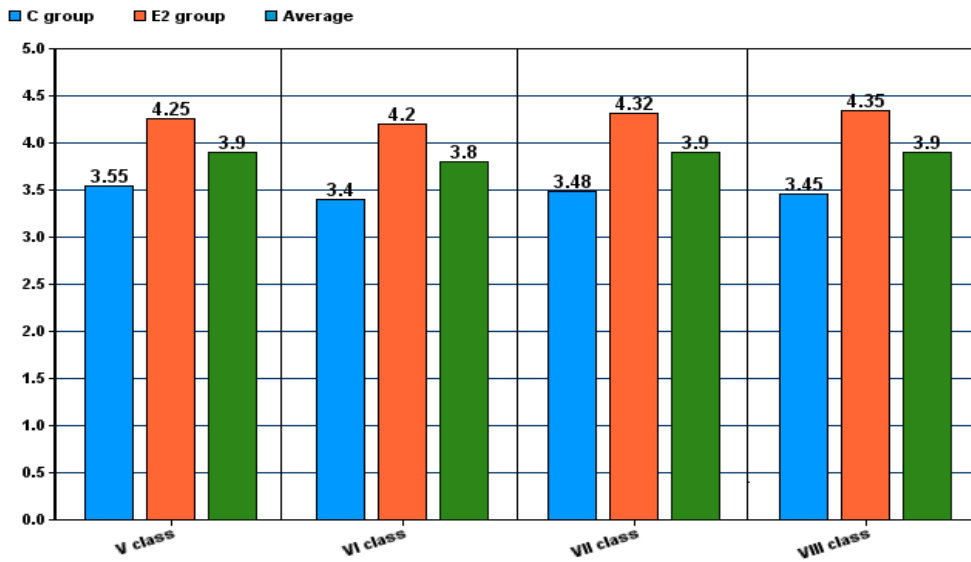
Figure/Diagram 6.16 Graf of final measuring achievement motive (Test T-f

7. FINAL CONSIDERATIONS

7.1. Overview of research and achieved results

Starting from an analysis of theoretical positions, the importance and relevance of modern education in the context of rapid social change in a world that is rapidly changing, and in which knowledge is expanding and becoming more complex every day, and sources of information are multiplying, and the data, information and facts can become irrelevant and obsolete before than they are used, we have pointed the need for education, which requires a new approach to the organization of teaching and learning in general. Such education exceeds the limits of declarative knowledge, enabling young people to functional and efficient communication, cooperation, teamwork and creativity, both teachers and students. In this regard, the most important element is emphasized by this paper is the work of the student, who must be aware of its importance, know and apply a specific methodology in teaching and feel satisfaction with the results. Distance learning and heuristic approach to the problems of teaching presented by this research are stated.

In reviewing the current theory and practice and setting up the research problem within the set target, objects, tasks and a hypothesis, this research aims to overcome the negative tradition, caused by stereotyping of thought and dogmatism in the opinion of young people. Distance learning and heuristic approach to the problems of teaching technical and IT education should enable students to acquire the knowledge creative process, to learn to think and develop the capacity for education in all conditions.

It is, therefore, an approach that is not based on a passive observation and imitation of phenomenon performed by the teacher, but also establishes an active relationship to cognitive phenomena and introduces students to independently research problems heuristically conceived, using the model of distance learning in all circumstances, even in emergency situations.

Experiment results were evaluated in two ways - through surveys and the comparison of student grades obtained before and after the experiment. At the beginning of the experiment, the initial survey was conducted with 254 students (ages from fifth to eighth grade elementary school) who participated in the experiment and 112 elementary school teachers trained to work on the updated model of distance learning in regular and emergency situations.

The results of the initial survey showed that the population of students generally uses computers for playing games, downloading music, watching movies, chatting and collecting information for their tasks, as well as on their own initiative and independently developing knowledge.

Final Results of the survey show that 88% of students tested are highly motivated to use computers in the experiment.

They find it more interesting to use a computer to learn than to learn only from books because they in that way are provided different information. The remaining 12% of the students are still intimidated by computers as they were before the experiment. They justify their opinion emphasizing that the individualization of the learning process leads to mutual segregation and alienation.

Approximately 85.22% of students believe that their computer skills significantly improved over the activities of the project, while the remaining 14.78% is not noticeable progress. The average time that student spends on the computer did not

change during the experiment, but it is mainly devoted to the activities of the experiment.

Comparison is made between the grades the students received before and after the completion of the experiment. It was found that in 8.87% of cases there was an improvement from the experimental group covered by the experiment in which innovated the model was applied. Recorded progress when it comes to grades, is not very significant, which may be due the inexperience of teachers in teaching and students learning in this way.

It is important that students have a favorable opinion of the applied mixed methods, 92% of them, while the remaining 8% have a negative opinion. More than half of the students (52%) stand out as very important that this method allows individual learning process and provide support to their individual interests and abilities.

At the beginning of the experiment, 69% of teachers believed that the use of computers will help them to establish better cooperation with their students, to increase students' creativity and improve information to parents about their children's success in school and to generally improve the interaction between students, teachers and parents.

At the end of the experiment, 81.65% of the teachers are very satisfied with the project because they think that the use of computers in education can improve operational efficiency, enhance their professional and personal potential of creativity. They generally believe if used rationally, computers can help students to learn faster. On the other hand, teachers fear that students can become antisocial or misuse the computer for fun instead of using it all the time for learning.

In addition, most of the teachers are convinced that the implementation of the updated model requires much more work than the conventional preparation for teaching. Both teachers and students are afraid of the health consequences caused by implementing too much time at the computer.

The experimental problem was implemented in selected teaching contents of the Technical and IT education, suitable for processing heuristic approach which caused adequate teaching methods, forms and means of the purpose of permanent learning. Realization of work in the experimental groups was carried out through intensive student conceptual work, compliance with certain phases of the work and increased cognitive effects in simulated emergency situations using models of learning.

To prove the success of the model of distance learning and teaching designed heuristic, and to confirm hypotheses and sub-hypotheses, was elected experiment with parallel groups E2 and K mutually consistent, while to determine the effect was elected an experiment with a group E1.

Teaching Technical and IT education has many problems, which can be heuristically conceptualized in order to students could study and solve these problems in a new way through the scientific method of thinking in combination with distance learning, also to exaggerated their knowledge.

Spirit of heuristic teaching, in general, is inconsistent with the dominance of traditional methods verbal presentations of ready true.

Heuristic teaching is based on the fact that the human ability to remember facts are limited, and the prospects for the development his various capabilities are virtually limitless.

Heuristically designed teaching aspires to promote the student as an active subject of the teaching process, as researcher who develops its own initiative, their creative thinking, their judgment, and that based on the established methods and models of distance learning independently come up with all possible solutions of heuristic

problem. Thus conceived teaching, allowing each student to achieve their best in accordance with their abilities, to understand the heuristics problem, and solve it at a rate that suits their individual differences. This represents the key of creativity in each student according to their abilities in all conditions, which is an objective of teaching.

Heuristic problem must correspond to psychological characteristics of each student, and thereby has more paths leading to provide a range of solutions and capabilities, to talented and weaker students in order to quickly, easily and more thoroughly adopt teaching contents. It is necessary to find the best way of its implementation in the teaching process a Technical and IT education, with respect to professional and highly didactic and methodological requirements.

The heuristic model of education requires special methodological preparation and commitment of teachers. Its function in heuristic teaching is changing, therefore it is less a lecturer and examiner, and more strategist, researcher and organizer. Design of of teaching topics or units in the form of heuristic problem initially slows down the work, but the motivation and effort of enthusiastic students to come up with a solution of the problem is irreparable price for the teacher's patience.

The problem of this study is the effectiveness of modern teaching technical and IT education, while the case studies represent a theoretical and empirical study achievements of students by applying innovative models of teaching technical and IT education.

The study included 254 primary school pupils (aged from fifth to eighth grade elementary school) who participated in the experiment and 112 elementary school teachers trained to work on the innovated model of distance learning in regular and emergency situations.

Within the sample, there are three sub samples that have been prepared for pedagogical experiment with one or two parallel groups: the first sub-sample included 84 students who formed the experimental group subjects (E1 group - an experiment with a group), the second sub-sample included 85 students who were represented the experimental group subjects (group E2). E2 group has been teaching according to elaborately designed experimental program work. The third sub-sample included 85 students, who formed the control group (C group) in which teaching technical and IT education conducted the usual lecturing mode. For research purposes was comprised an experimental program that included the teaching contents Technical and IT education, which are designed for innovative teaching model. The aim of this study was to determine the effects of an experimental program using innovative models of teaching technical and IT education to student success, using the method of pedagogical experiment with one or two parallel groups.

In the experimental part of the dissertation is organized distance learning over the Internet using a system dLearn, within which was performed testing and measuring relevant parameters influence to the efficiency of this type of learning. Measuring for relevant parameters and the analysis of the results was performed using standard statistical methods.

Analysis of the derived pedagogical experiment, made possible drawing the following conclusions:

- Initial checking conditions showed that the experimental and control groups are equal in relation to the basic computer literacy, as well as in relation to the predisposition toward distance learning. The results of the initial test of knowledge by which was checked learners' prior knowledge in the field of technical and IT

education showed no statistically significant difference between the experimental and control groups.

- Examining the significance of differences in achievement between the experimental and control groups at the initial and final test, we observed significant improvement in the experimental group compared to the control. Under the influence of the experimental program, which in the appropriate implementation of teaching acted as an experimental factor, there was a statistically significant increase in student achievement. From this is derived the conclusion that the chosen model of classical teaching in the control group does not prepare students sufficiently for the application of technical and IT education knowledge.

Conversely, it is possible to conclude that the experimental program and an innovative working model (Heuristic in combination with distance learning) contribute to developing the ability to apply knowledge from technical and IT education.

We can say that the experiment confirmed:

• Sub-hypothesis 1 - *innovated model of distance learning in teaching technical and IT education contributes to advancement of creative skills of students in solving real problems in this area* - it has been confirmed on the basis of empirical research, it can be concluded that the suggested model innovated in teaching technical and IT education, contributes to more efficient knowledge acquisition of students.

• Sub-hypothesis 2 - *innovated model of distance learning in teaching Technical and IT education provides a higher level of development of intellectual abilities and skills of students, i.e. provides for the same time, greater durability, and immediate students' knowledge compared to classical approach to learning.* Was confirmed by the results of repeated tests in a month, by which it was established that people who have worked through distance learning, more durable and in higher level, have adopted teaching material, than the control group. Multiple regression analysis examined the impact of the results of the initial test of knowledge, basic computer literacy and group, on the results the final test of knowledge. Standardized regression coefficients show that the largest contribution to the explanation of individual differences in the results achieved in the final knowledge test gives a result of the initial test and the lowest score basic computer literacy.

• Sub-hypothesis 3, which assume that the implementation of innovative models of learning in teaching technical and IT education, self-study, observation and reasoning, will enable the students to develop motivation for the research work and the desire for knowledge of technical and computer education. It is confirmed*. Teaching Technical and IT education based on the updated model of distance learning increases students' motivation in the learning process with respect to the classical approach to learning* - it has been confirmed in the survey, after the performed experiment, where the results show that users prefer the innovated model and distance learning. Positive views of a majority participants of the experimental group on such innovative models of work, have contributed significantly to the success of the final test, which proves that the selected models of learning enhance the positive effects of an experimental program on students achievement.

• On the basis of previous results have been confirmed the basic hypothesis: **an innovated model of distance learning in teaching technical and IT education has a statistically significant impact on the efficiency of the teaching process.**

The general conclusion of previous research is the proper application of innovative models of teaching technical and computer education, based on the updated model

of distance learning, heuristic model of teaching (based on learning through independent problem solving, learning through discovering, research directed learning, ...) leads to a significant increase in student achievement, and thus improve efficiency of teaching technical and IT education. The quality of students' knowledge is enhanced because of its emphasis on the improvement of professional knowledge in solving real problems in the Polytechnics.

Previous measurements have proved that the experimental and control groups were matched for many fields and, therefore, the real hope of success could be expected, in the conducted experiment.

The constructed conditions of the experiment were used to establish the assumed effect of education modeled by heuristic teaching and distance learning.

• Checking achieved results with the final flash-test Tf1, it was found that the pure effect of the experimental program in an experiment with a group E1 (0.84) or in percentage (17%).

• Checking achieved results in the final test T-f of the Technical and IT education, it was established that the experimental group E2 achieved greater success than the control group K, by 0.73 expressed as grades or (15%).

•The established difference between the arithmetic means of both groups is statistically significant, since t-value (2.21) exceeds the limit of significance of 0.05, where $t 0, 05 = 1.96$, and $t 0, 01 = 2.58$. It follows that $1.96 < t < 2.58$, which means that students from the E2 group are better than group K students.

• The results showed that the experimental factor, Innovative Model (Distance learning and heuristic model of teaching), significantly contributed to increasing knowledge on the final test T-f, compared to the initial test and T-i. Based on these results we can conclude that the problem solving a heuristic strategy conceptualized, motivated and encouraged students to do creative work, proper cognitive activity and acquire knowledge on their own contemplative activity.

• The obtained data confirmed the main hypothesis that the application of the Innovative Model in the realization of Polytechnic teaching content, enables achieving higher effects of teaching and learning.

• During the systematic presentation of the experimental program, it was found that the heuristic models of teaching and distance learning model, and claimed and managed to change the position of the student in the teaching process, to develop his own initiative, creative thinking, i.e. to place student in the position of the subject. The student is able to independently, creatively and responsibly participate in the learning process, to take part with other students in preparing the cabinet for Technical and IT education, in preparing teaching resources and learning materials, by making use value objects (models), and in the planning and selection of teaching contents, practice, performing experiments and evaluating their results. All these elements determine the quality of student activities in the heuristic teaching and the updated model of distance learning, favoring independence in work, research and creative work through solving heuristically conceived problems (selection methods, research, argument for opinions, perform the tasks of heuristic nature, etc).

Internal motivation expressed in interest, desire and need, that affects students' attitudes to work and the pace of work is an essential element of success. Difficulties and obstacles in the heuristically conceptualized problem, act motivational since the student is oriented toward goals (student felt inner need, a desire to solve a problem or task). Hence the conclusion that education by the updated model of distance learning heuristic teaching provide a significant advantage of the experimental factor, compared to the usual way of learning, which

was confirmed by the results of research on the initial and final test of achievement motivation.

• Summed results of research show that the set tasks are completed, the main hypothesis and sub-hypotheses are confirmed.

• The facts that have emerged over research: an experiment was designed and implemented in regular teaching programs, learning at a distance, and the heuristic teaching may find application in other subject areas; the heuristic teaching does not require special teaching aids; heuristic teaching success depends on the ability of teachers to the intellectual work, before class, prepare a project for a school class at the designated stages - a heuristic model incorporated in the model of distance learning; activity of teachers in the classroom would be reduced to coordination, multi-directional communication, and encouraging students to intellectual work and the mutual exchange of experiences in purpose of efficient solving heuristic problems.

• Will innovated model of distance learning be applied in teaching practice depends on many conditions: the teacher's general and specific ability and the incentive to improve the educational process. That is the ultimate chance for his creative activity. Such teacher should possess certain pedagogical features, such as to love his job, has a high degree of education, a broad general education and culture and has a constant education. Only prepared teacher can be a carrier of modernization and the acceptance and implementation of innovations in teaching, and thus innovated model of distance learning in regular and emergency situations.

• Each absolutization of the updated model with the heuristic teaching and application which would not evaluate the elements that define it, would damage her. Therefore, it is logical to assume that as a form of active learning and creative thinking in combination with other forms and methods contribute to the development of a sense of exploration and knowledge connecting with lifestyle practices in all conditions.

• Despite the significant results achieved with this doctoral dissertation, we can not say that the problems of teaching and methodological innovation solutions in the interpretation of programs of technical and IT education can be considered completed. On the contrary, this dissertation described a certain situation and provided initial and possible solutions that open a range of further research in this educational area.

• These results are used for designing suggestions curriculum for training students in elementary and high schools, in order to create continuity in monitoring, training future employees necessary for the reformed society, educated in accordance with new developments in Europe in regular and special situations. Comparative analysis of reformed educational systems of the neighboring countries that have joined or are waiting for admission to Euro-Atlantic integration, the system of the European Union and the proposed model reorganization of our educational system, has resulted in a desire to help in finding the best solution taking into account the specifics of the current education system, and experiences.

• The contribution of this dissertation to practice depends on ability to be available to teachers who teach technical and IT education and emergency situations management.

7.2. Scientific and social contribution of research

The main scientific contribution of this dissertation is a formal specification of a set of educational methods and information and communication technology for the

realization of the updated model of distance learning in teaching technical and IT education, where as a starting point were used the experiences of other countries, while ensuring all the specific characteristics of the elementary schools in Vojvodina and their environment that are considered in the implementation of e-learning; evidence of better qualitative and quantitative results in mastering the material. Practical contribution of the dissertation is the design and development of electronic materials in the form of text, images, video tutorials that are required for the selected subject areas. The results of previous development and implementation of the updated model of distance learning indicate advantages, but also some problems.

Perceived benefits:

- A place of learning can be chosen - depends on the media being used as a vehicle for learning (learning on the job, at home ...)
- Choosing their own way of learning - active or passive learning, different degrees of interaction, "classic" written material to conduct their own notes, interactive simulations, discussion with other participants (e-mail, teleconferencing, ...), more multimedia - graphics, animation , sound ...
- Own pace - the students go through the learning material as fast and as many times as they wish,
- Practical work with different technologies - gaining not only information about what is taught, but also additional knowledge and skills,
- Self-learning- teachers learn from students who independently look for resources.

Problems identified:

- For students who are V (fifth) grade of elementary school is possible temporary disorientation in the learning process,
- A solution to this problem may be more intense work of professors in the following activities - more clearly defining the direction of student learning, constant supervision of their work, and encouragement of active learning through the Internet, using different teaching techniques and assessment tests, intensive discussions through forums, clarifying the issues, dilemmas and questions regarding the past material.

The original contributions of this work are:

- Consideration of methodological procedures of the traditional educational process of teaching technical and IT education in order to develop the updated model for distance learning
- The implementation of the program dLearn for distance learning in teaching technical and IT education, and its application to other educational facilities (Chapter 5), 6.2.
- Designing electronic learning materials of teaching contents technical and IT education (Appendix CD)
- Creation of representative tasks in the field of technical and IT education (Appendix CD)
- Application of the updated models in real terms over the sample of elementary school students in Zrenjanin and the application of results.

Using interactive Internet classroom can be removed serious weakness of traditional teaching for providing equal access and equal requires of all participants in the learning process, although their knowledge, interests and mental potential and other characteristics are different. In Internet classroom teaching can be successfully differentiated, set on several levels of complexity and thus adjust it with the capabilities and needs of the students.

7.3. Options for further research

This study emphasizes the attempt to Innovative models of work, presented and experimentally validated, show a gradual transition from a traditional to a new vision of teaching technical and IT education. This by implication should point out that it is not everything bad in the current system of teaching, and that it should not be completely ruled out, but on the contrary on its grounds should create new, more efficient solutions that will work well in our schools.

Presented results can be used as a basis for easier guidance of future research. The results indicate the need for larger and more frequent application of the selected model of learning, and the possible effects that would have during their long and continuous use in the teaching of technical and IT education. The results of this study should complement the professional knowledge teachers, to encourage them to apply the given experimental program. Further work in this area is possible, primarily to improve the personalization of the proposed learning methods. Also, development of technological basis, as well as awareness of our society that we live in a turbulent era of science and technology, in the future it will be possible further development of educational software and electronic textbooks, as well as their applications in all areas of education.

The results of this study provide a basis for further research that would be directed to:
- Pupils / students as potential users of e-learning from the point of their needs, motivation to use such a form of education and their technical equipment,
- Application of the results to improve teaching activities in higher education institutions in Vojvodina,
- Considering the application of the results in the wider area of Serbia.

Also, there will be further work to improve courses, their development, better multimedia presentation, and especially, to fostering interactivity. Test model was implemented with the first year students at the Faculty "Mihajlo Pupin". This experience is a good example of the need for a multidisciplinary approach in teaching information technology and technical education, as well as opportunities to take high information technology application in the classroom. The introduction of interactive virtual Internet classroom in the education system with support of modern sophisticated educational telecommunication information systems, to create a nucleus for further expansion of modern teaching technology and teaching practices for raising it to a higher level. In this way, our educational system could be trained to effectively accepting scientific and technological development.

If education is understood as multilayered and multidirectional combination of ongoing interactions, there is no recipe for a guaranteed good result because the act of teaching is the creation of personal design. Therefore, it is impossible there is methodology that would itself solve the problems of each teacher (Pešikan, 2003). We believe that this study will increase teacher's commitment in the implementation of validated models of teaching and its use in practice.

Information technology in higher education can become a very powerful teaching tools to support lectures and exercises, because they encourage the learning and understanding of the presented teaching content and encourages a high level of motivation to work on designing own knowledge of pupils / students.

It should be pointed that this is the first experiment of implementing updated model (e-learning) in elementary schools in Serbia. There is a possibility that after the success of the experiment follows its application in other schools.

During the implementation of the updated model (e-learning) has shown that the telecommunications structure is not evenly distributed in our schools and

municipalities. So, unable to access LMS are not equal for all schools and for all students. On the other hand, it is good that the hardware and software needed for implementation of the innovated model are available.

Activities of the experiment have contributed to improve the computer literacy of teachers and re-define their teaching methods. After a significant investment in education of teachers in this experiment, it is clear that the true results of their work will be shown in the future.

Computer skills of students are systematically developed in elementary school and satisfy the needs of the experiment. It is necessary to continue improving computer literacy of teachers in order to qualify for using information and communication technologies in teaching. Teachers who created learning materials in the experiment can develop lessons to compatible high-quality content.

Having in mind that this is the first experiment application of the updated model (e-learning) in primary education, results undoubtedly shows that the population of teachers and students achieved significant improvement in practical skills in using the computers as a tool in the educational process.

Application of LMS as an educational tool in primary education, can significantly improve the quality and efficiency of the educational process, but it is necessary to continue the development of human and technical capacities. In order to enable students benefit from the updated model (e-learning) should be invested more effort and research.

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