

REZUMATUL TEZEI DE DOCTORAT CU TEMA - THESIS SUMMARY OF THEME

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

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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.

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.

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.

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.

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.

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.