ANNOTATION OF THE SCIENTIFIC PAPERS AND SELF-ASSESSMENT OF THE CONTRIBUTIONS

to participate in the competition for the academic position of **"professor"**
area of higher education: **1. Pedagogical Sciences**,
professional field: **1.3. Pedagogy of Teaching**
(Methodology of Teaching in Informatics and Information Technology)

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For participation in this competition (see List of scientific papers for participation in the competition) are presented 44 scientific papers, including 1 monograph, 1 book, 41 scientific publications and 1 textbook. All of them were published after acquiring the academic position of „associate professor".

I. MONOGRAPHS AND BOOKS

1. **Terzieva, T**., *Educational means for teaching in a digital environment,* Paisii Hilendarski University Press, Plovdiv, p. 139, 2021, ISBN 978-619-202-631-8.

One of the main ways to increase the effectiveness of teaching and activate the actions of students is the use of modern teaching methods and tools. New educational technologies based on innovative ICT are one of the most important aspects of improving and optimizing the educational process. The relevance of the research follows from the need to change the learning model and the possibilities of modern ICT for the implementation of personalized e-learning. Another important aspect is the educational communication, the feedback of the learner - teacher, the engagement of the learners and their participation in a game-based educational process, which increases the activity and stimulates the development of creative thinking.

The monograph presents pedagogical strategies for activating the cognitive activity of students through the application of innovative digital technologies.

The monograph consists of five chapters divided into two parts. The first part is dedicated to didactic aspects and pedagogical strategies in the realiaztion of adaptive e-learning. Special attention is paid to the theoretical approaches to the application of adaptive learning. The given classification and description of the approaches for adaptive learning is based on the pedagogical strategy, which is the basis of the adaptive scenario. Emphasis is placed on ways to model and develop adaptive learning materials.

Different methodological approaches are considered for determining the parameters of the learner in order to personalize the learning content. The focus is on several main parameters: student preferences, learning style, level of knowledge, available learning time, specific goals, history of visits to individual learning sites, etc. To test the developed pedagogical strategies for adaptive learning, an example adaptive scenario is presented for training in "Information Technology" through DisPeL (Distributed Platform for e-Learning).

The second part is dedicated to modern didactic tools for learning in an electronic environment. Pedagogical strategies are analyzed for increasing motivation through modern teaching methods and creating a suitable learning environment. In order to implement the presented strategies, the emphasis is on game elements in the training and interdisciplinary integration. For the purposes of the training, a prototype of an educational game has been developed, which contains several interactive puzzles. It can be used to acquire new knowledge or to assess the acquired knowledge and skills in various subject areas.

The results of research and analysis are presented of some of the most commonly used digital educational platforms in the Bulgarian school. The environments are presented in terms of the opportunities they offer in the educational process: use of ready-made educational content or creating your own, opportunities for assessment and self-assessment, feedback on student achievement, availability of an interface in Bulgarian, focus on specific learning. subject or offering tools for creating and / or using teaching materials, regardless of the subject area.

Due to the fact that the methods and tools of informatics and IT have become widespread in many areas of human activity, the tasks solved in the classes in informatics and IT have a pronounced interdisciplinary nature. When studying the general principles of creating information models, information models from different subject areas are considered as examples - mathematics, physics, history, ecology, economics, biology, etc. The fifth chapter presents a pedagogical approach to provoke the interest and increase the motivation of students to study computer science disciplines through interdisciplinary integration with other subjects such as history and physics.

Didactic teaching aids in the e-learning environment transform the learning environment, thus achieving student engagement and the creation of self-learning skills. Another feature of the lesson through the application of modern means is in the increased emotional state, activation of interest and increase of the motivation of students. An important element in the educational process is the creation of conditions for cooperation and joint training, implementation of differentiated and personalized training, development of virtual learning spaces and others.

The monograph is intended for teachers, researches, PhD students and university students who are interested in the application of innovative pedagogical strategies for learning through modern didactic tools.

2. **Terzieva, T**., *Development of algorithmic thinking in the informatics education,* Paisii Hilendarski University Press, Plovdiv, p. 193, 2021, ISBN 978-619-202-622-6.

This book presents the results of an in-depth study of the concept of algorithmic thinking, classifies the main learning activities for the formation and development of algorithmic thinking in computer science education. The research presents a didactic model based on Bloom's expanded taxonomy of learning and developed for a formation of algorithmic thinking and implementation of developmental training in Computer Science for first-year students. The fundamental elements of this model of the learning process are the actions which occur during the course. An educational environment and teaching technology for formation of algorithmic thinking was created through a system of learning tasks. Emphasis was placed on the formation and development of skills for understanding and implementation of algorithms, skills for modeling and algorithm development, and skills for analyzing algorithms. An effective methodology for Development of variational thinking skills in Programming teaching is proposed as a quality of critical thinking. As the principle of clarity is realized, static and dynamic visualization is used with the participation of specially developed didactic software applications of methods for sorting arrays.

In order to obtain objective information about the accessibility of the educational content proposed in the research and the effectiveness of the developed teaching methodology, a pedagogical experiment was conducted. The proposed system of tasks and teaching methodology create conditions for in-depth and lasting acquisition of knowledge, understanding of their application in solving tasks in various subject areas. The proposed didactic approaches favor the active acquisition of knowledge, support the formation and development of skills for the development of algorithmic thinking of students in the basic courses of computer science education.

The developed model for the implementation of developmental training can enrich the existing pedagogical practice in computer science training. The subject of further research is the implementation and modeling of developmental learning through modern digital educational technologies and active learning methods.

The book is intended for researchers and PhD students dealing with the problems of computer science education. It could be useful for teachers who are interested in the theory and methodology of developmental education in computer science, as well as for training students, and others.

II. TEXTBOOKS

3. **Terzieva, T**., *Introduction to web programming*, Paisii Hilendarski University Press, Plovdiv, p. 216, 2021, ISBN 978-619-202-631-8.

This textbook is an introduction to web programming, the content is structured in 10 chapters. Basic web concepts such as browser, hypertext, HTTP protocol, client-server system, World Wide Web and web page development tools are discussed. Modern standards are studied for describing web content – HTML5, tools for dynamic content management and building functional user interfaces via CSS and JavaScript. Attention is paid to the ways of creating and using CSS styles, selectors and style definitions, as well as to CSS rules for presentation, positioning and visual layout of the elements of the web page. The basic principles of JavaScript are presented – working with embedded objects, defining your own objects and event handling. Emphasis is also placed on the Document Object Model (DOM) and additional JavaScript tools for creating dynamic pages using the DOM and accessing web page elements. Students are introduced both to the basics of web programming and the techniques for maintaining various browsers and devices.

The textbook reflects the lecture course on Introduction to Web Programming for first-year students, subjects ”Software Technology and Design“, „Mathematics, Informatics and Information Technology“ and „Information Technology, Mathematics and Educational Management“ at the Faculty of Mathematics and Informatics, University of Plovdiv „Paisii Hilendarski“. It can also be used by other students or learners who are beginning to study web technologies and are interested in the tools to create web applications. The aim of the course is to acquaint students with the main stages of the process of creating and maintaining websites and Internet-based applications.

III. SCIENTIFIC ARTICLES

4. Manev H., **T. Terzieva**. *Application of modern educational technology in Mathematics and IT for pharmaceutical students*, Journal: Computer Science and Education in Computer Science, Vol. 11, 2015, Issue No: 1, p. 78-84, Boston, MA, USA, ISSN 1313-8624.

The use of the information technologies in all spheres of life leads to demands for new forms of teaching, learning and appropriate examination and evaluation of acquired knowledge and skills of the students. In this work it is developed a methodological approach of a blended educational system in Mathematics and IT for pharmaceutical students at the Medical University – Plovdiv. The developed system aims to create an opportunity to conduct educational courses with the help of modern e-learning environments. We present a developed system for blended learning, attendance hours for lectures and exercises, combined with a remote implementation of the examination. The system allows the entire course to be held interactively. The relevance of e-learning environments nowadays and the need for modernization of the educational courses are the main reasons for the usage and the integration of this form of teaching more and more. In this work it is designed a model for an educational platform of a university discipline which can be applied in other teaching courses.

5. Stavrev S., **T. Terzieva**. *Virtual environment simulator for educational safety crossing*. Boston, MA, USA. Journal: Computer Science and Education in Computer Science, Vol. 11, 2015, Issue No: 1, p. 94-101, Boston, MA, USA, ISSN 1313-8624.

In this paper we present a Virtual Environment Simulator for Educational Safety Crossing. The virtual simulation is developed specifically for educating young children from 1st to 4th grade. The simulator's main purpose is to build voluntary and involuntary habits in the children in range of situation, such as: correctly crossing a street on the pathway, abiding traffic lights rules, learning and abiding road signs, safely walking on the sidewalk, safely riding a bicycle, correctly waiting for the bus at a bus stop and so on. Furthermore, the system gives feedback on the child's position and movements. Finally, the platform evaluates the overall performance of the child. The virtual platform uses Microsoft's Kinect sensor for taking gesture input. It then transfers this gesture into an interaction within the virtual environment. There are two types of interactions/gestures – the directional movement of a 3D avatar and manipulation of the in-game menu. Software that used is C# and Unity game engine.

6. Ivanova, V., **T. Terzieva.** *Criteria for the Construction of Tests for Language Assessment and Evaluation.* Proceedings of the Doctoral Conference in Mathematics and Informatics, Sofia, Bulgaria, "St. Kliment Ohridski University Press, 2016, pp. 58-66, ISBN 978-954-07-4186-4.

One of the major problems of both the theory and practice of didactic testing is determining the objectives and tasks of the educational work, the achievement of which is diagnosed with tests. Defining the objectives is an important stage of the overall planning, conducting, and result evaluation of the education. In this paper we suggest a set of criteria for evaluating the learning outcomes. For our teaching purposes we have used Bloom's taxonomy to devise five basic criteria for evaluating the learning outcomes. For each criterion we have defined several types of test questions. In addition, we have offered practical examples based on New Headway Academic Skills Level 2 Student's Book (Reading, Writing, and Study Skills).

7. Arnaudova, V., **Terzieva, T**., Rahnev, A. *A methodological approach for implementation of adaptive e-learning*. CBU International Conference Proceedings, Prague, Czech Republic, v. 4, p. 480-487, sep. 2016. Print ISSN 1805-997X, Online ISSN 1805-9961. (Indexed in Thomson Reuters Web of Science)

In this article we present a methodological approach for implementation of adaptive e-Learning on the course "Computer information systems in tourism" planned for students from program "Tourism" of Plovdiv University "Paisii Hilendarski" – affiliate Smolyan through the Distributed Platform for e-Learning DisPeL. In the process of realization of such an educational course, both the content and the tasks for individual work or group work can change. All components of the distance learning

form can be improved, the evaluation criteria can be adapted, etc. The creation of a profile of each student and the quick feedback of the teacher with the students provide an opportunity for an individualized approach and adaptation of the level of difficulty to the behavior of each student.

8. Staribratov, I., E. Angelova, T. Terzieva, V. Arnaudova. *E-learning for project management and program participation,* Scientific Works of the Union of Scientists in Bulgaria - Smolyan, Vol. 2, 2016, p. 243-248, ISSN: 1314-9490.

In this article we present an approach for e-learning through e-textbook Manage Projects and Programs participation. Our objectives are to enhance quality in the absorption of the material in this course through the introduction of new methods and approaches of teaching. Another purpose that we set is diagnosing the assimilation of knowledge and skills through the use of e-textbook. For the evaluation of the results it is important how this training leads to an increased training efficiency compared to traditional way of education. The electronic textbook has been tested with students students from majoring in „Information Technology, Mathematics and Educational Management“ at Plovdiv University “Paisii Hilendarski” – affiliate Smolyan. In the curriculum of this subject one of the main principles is the competitive start. That way we indirectly stimulate competition in education and create conditions for innovation. With this training we aim to prepare future teachers to improve their knowledge of planning, implementation and reporting projects and programs.

9. Angelova, E., O. Rahneva, **T. Terzieva**, V. Arnaudova. *Adaptive learning through electronic Javascript textbook in DisPeL*, Scientific Conference “Innovative ICT in Business and Education: Future Trends, Applications and Implementation”, Pamporovo, 24-25 November 2016, 143-152, ISBN: 978-954-8852-72-2.

Adaptive computer tests are one of the newest directions in the development of testing and diagnostics of learning outcomes. The article examines methodological approach for the implementation of adaptive e-learning on the course “Computer accounting.” Emphasis is on both structuring of learning content in lessons, in order to achieve adaptability and on creation of computer adaptive tests. For the purpose of greater precision in the assessment, we present an opportunity in order to adapt the complexity of issues according to the level of the tested student. Parametrization of test questions and exam tasks are explored so that students can be assessed through different but equivalent tests. In this article we present the applied methods for parameterization of test questions and the used software tools for full or partial automation of the following processes: generation of test questions; generating tests for each learner and conducting and evaluating the tests. Adaptive electronic tests provide the opportunity for greater accuracy in assessment.

10. **Terzieva, T.**, E. Angelova, V. Arnaudova. *Didactic problems in implementation of adaptive e-learning*. Scientific Works of the Union of Scientists in Bulgaria - Plovdiv, Series C. Technics and technologies, Vol. XIV, 2017, ISSN: 1311-9419 (Print), ISSN: 2534-9384 (On- line), c. 47-52.

The purpose of this paper is to study and analyze the didactic problems which occur with implementation of adaptive e-learning. Discussed are the nature and purpose of adaptive learning. The methodological approaches are described in depth for applying of adaptation in the learning process. Didactic problems are discussed which occur with implementation of adaptive e-learning where the accent falls on the fact that for a learning process to be successful it is necessary to build an individual trajectory of the learning process. Beside that didactic technologies and the developed educational materials have to be conformed to different characteristics of the student as specific purposes, preferences, level of knowledge, cognitive opportunities, etc. and according to all that to use a suitable didactic strategy. An extremely important task is to model the relationship between learning materials and resources, learning style, assessment and acquisition of new knowledge. In the process of information interaction in dynamic main adaptation there is a change in the content and the forms and manner of presentation of teaching materials and overall management of the adaptability of the system for each student.

11. Pavlov, P., **T. Terzieva**, A. Rahnev. *Interdisciplinary teaching between Computer science, Mathematics and IT*, Education and Technologies Journal, VOL. 8/2017, ISSUE 1, ISSN 1314 1791, p. 114-119.

Computer Science is one of the sciences that forms the understanding of the unified nature of information processes in the world around us. Information and communication technologies give us some new and powerful means of solving problems that are applicable in all scientific disciplines. Due to the fact that the methods and the tools of informatics and IT have become widely spread in many areas of human activity, the tasks solved during informatics and IT classes have a clearly defined interdisciplinary character. On the other hand, changes in the structure of motives in computer science studies over the last few years and the rapidly changing technologies both lead to the necessity of searching for different ways and pedagogical strategies to increase student motivation. The development of the cognitive motivation of the students is influenced by various factors, including the particularities of the various subjects. In this research, we present an approach for Interdisciplinary teaching between computer science, mathematics and Information technology.

12. **Terzieva, T**., A. Rahnev, V. Arnaudova. *Didactic features in developing a model for adaptive e-learning*. 8th World Conference on Learning, Teaching and Educational Leadership (WCLTA-2017), 26-28 October 2017, p. 61, Universidade Aberta, Lisbon, Portugal.

The purpose of this research is to study, analyze and present the didactic features and stages in developing a model for adaptive e-learning. The nature and purpose of adaptive e-learning are discussed. The methodological approaches are described in depth in the application of adaptation in the learning process. The model describes the individualization of the learning process on the basis of the creation of electronic courses, taking into account individual characteristics of students, including psychological characteristics, a level of initial knowledge, levels of perception, as individual goals and training tasks. An important task that we will consider is the modelling of the relationship between educational materials and resources, the styles of learning, the assessment and assimilation of new knowledge. The adaptive e-learning systems better determine the level of initial training and give information for the current status of the knowledge and skills of each student.

13. Pavlov, P., **T. Terzieva**, A. Rahnev. *Pedagogical strategies for increasing the motivation in the training in Informatics and IT*, Proceedings of the National Scientific Conference "Education and science – for personal and social development", 27-28 October, 2017, Smolyan, Book one, Section B: Training in Mathematics, Informatics and Information Technologies, University Press "Paisii Hilendarski", Plovdiv. 221-230, ISBN: 978-954-8767-65-1.

In this report we present a pedagogical approach to provoking interest and enhancing students' motivation to study computer science through integration with other subjects such as history and physics. The report provides an in-depth study of the nature and types of motivation, proposing several pedagogical strategies to increase motivation in computer science and IT training. Emphasis is placed on practical connection - students are offered tasks from other school subjects, but their solution is discovered with the help of methods and tools for computer science. The interdisciplinary integration is realized through the presented didactic approach. The aim is to provoke interest and increase the motivation of students to learn programming. On the other hand, the proposed tasks demonstrate the practical meaning and applicability of knowledge and skills in computer science.

14. Rahnev, A., **T. Terzieva,** E. Angelova, V. Arnaudova. *Adaptive e-learning systems*, Proceedings of the National Scientific Conference "Education and science – for personal and social development", 27-28 October, 2017, Smolyan, Book one, Section B: Training in Mathematics, Informatics and Information Technologies, University Press "Paisii Hilendarski", Plovdiv. 231-238, ISBN: 978-954-8767-65-1.

The purpose of this research is to study and analyze the adaptability of e-Learning systems. It is difficult to make a precise and unambiguous analysis of adaptive e-learning systems, but in the study we present a comparison of the main adaptability capabilities to certain criteria. The opportunities for adapting e-learning systems are addressed from the point of view of users – learners and trainers, not from the point of

view of software development. Adaptability is reflected in the individual performance of the courses for each learner, according to its specific preferences and skills, to the provision of learning content according to user behavior and depending on the results shown. Personalization involves the ability to model an individual path of learning and provide adaptive content to the test and evaluation results.

15. Karapeeva, V., **T. Terzieva**, A. Rahnev. *Research of the concept of non-standard task in Informatics and IT training*. Proceedings of the National Scientific Conference "Education and science – for personal and social development", 27-28 October, 2017, Smolyan, Book one, Section B: Training in Mathematics, Informatics and Information Technologies, University Press "Paisii Hilendarski", Plovdiv. 211-220, ISBN: 978-954-8767-65-1.

Tasks have a special role to play in computer science and IT training - they can be a learning tool. The subject of our research is the notion of a non-standard task in the Informatics and IT training of the secondary school, and its main features have been studied and presented. A comparative analysis of different points of view is made. Particular attention is paid to the stages of solving a non-standard task in Informatics and IT. An example of a non-standard task with several different solutions is described in detail. This methodical approach creates conditions for the formation and development of creative thinking, avoiding the template and the stereotypes in solving a task. In this way, skills are developed to look for different solutions and apply the acquired knowledge and skills to new situations that may be related to real life. On the other hand, it is possible to use different and original ways of solving, which show an unconventional way of thinking.

16. Terzieva, T., A. Rahnev, E. Angelova, V. Arnaudova, A. Karabov. *Methodological aspects of adaptive e-learning,* Proceedings of the Scientific Conference Innovative Software Tools and Technologies with Applications in Research in Mathematics, Informatics and Pedagogy of Education, Section B: Innovative Software Tools and Technologies in Education, Pamporovo, 23-24 November 2017, p. 167-174, ISBN: 978-619-202-343-0.

In this article we present the results of the study related to the methodological aspects of adaptive e-learning, in terms of pedagogical strategies for personalization. Special attention is paid to the methodology for creating and implementing adaptive and individualizing concepts in e-learning. Various theoretical approaches for the application of adaptability in education are presented and didactic possibilities for realization of adaptive scenarios are discussed. The creation of an adequate methodology for the implementation of adaptive e-learning is associated with two main problems - the use of pedagogical technology for planning an individual educational path and creating a technological model for student assessment, in accordance with his preferences, educational goals, learning style, level of knowledge, behavior in the system, etc.

17. **Terzieva, T**., O. Rahneva, V. Arnaudova, A. Karabov. *Application of DisPeL for Adaptivity and Individualization in the Training*, Proceedings of the Scientific Conference Innovative Software Tools and Technologies with Applications in Research in Mathematics, Informatics and Pedagogy of Education, Section B: Innovative Software Tools and Technologies in Education, Pamporovo, 23-24 November 2017, p. 175-182, ISBN: 978-619-202-343-0.

In this article we present some results from the application of the Distributed Platform for e-Learning DisPeL in the implementation of an adaptive e-learning course for students of the speciality "Tourism" at the Smolian Branch of the University of Plovdiv. Various pedagogical approaches have been analysed to apply adaptability and individualization in learning. We have discussed the possibilities on DisPeL for adaptive customized training and assessment. One of the functionalities of the system is the generation of statistical information about the exams. In this way, the teacher can make personal references to a particular student or group of students and reach out relevant conclusions about the extent of learning, difficulties encountered, etc.

18. **Terzieva, T.**, A. Golev, S. Stavrev. *Serious games – innovative educational mean,* Proceedings of the Scientific Conference Innovative Software Tools and Technologies with Applications in Research in Mathematics, Informatics and Pedagogy of Education, Section A: Development of Innovative Software Tools and Technologies, Pamporovo, 23-24 November 2017, p. 107-114, ISBN: 978-619-202-343-0.

This article introduces the basic concepts of Game Based Learning. The process of emerging and developing educational games, aimed at serious games and their application in education, is studied. The advantages they offer in the learning process are highlighted. Some exemplary apps about game-based education are being presented from leading universities and software companies. The number of serious educational games is constantly increasing. The challenge of developing educational computer game is the right symbiosis between software technologies and innovative concepts, pedagogical and game factors. Specialists from different fields are introduced in the development of a computer game - game designers, animators, graphic engineers, software developers, pedagogues. The key to a successful project is to include knowledge in the context of the game environment.

19. Rahnev, A., E. Angelova, I. Staribratov, **T. Terzieva**, A. Karabov. *Test theory through DisPeL*, Proceedings of the Scientific Conference Innovative Software Tools and Technologies with Applications in Research in Mathematics, Informatics and Pedagogy of Education, Section B: Innovative Software Tools and Technologies in Education, Pamporovo, 23-24 November 2017, p. 129-138, ISBN: 978-619-202-343-0.

This work introduces computer adaptive training and assessment through the electronic book on Test theory developed in the DisPeL (Distributed Platform for e-

Learning). Some features of adaptive testing are explored, focusing on the benefits of computer adaptive testing. The creation of tests, which diagnose the achievements of the students, is presented after each subject, as well as at the completion of the training course. The electronic textbook is intended for all participants in the educational process who are interested in computer-based test assessment and self-assessment, current teachers, students who are preparing for teachers and others.

20. Karabov, A., **T. Terzieva**, A. Rahnev. *Research results on the use and development of e-learning content*, Mathematics and Education in Mathematics, Proceedings of the Forty-seventh Spring Conference of the Union of Bulgarian Mathematicians, Borovets, April 2–6, 2018, 239 - 245, ISSN 1313-3330.

The requirements for new learning outcomes and competence development can be achieved by organizing learning activities in a modern information and educational environment and developing a methodology for creating e-learning content. In the framework of the research a survey was conducted with teachers from Smolyan region aiming to study the extent of use of e-learning content and Internet resources. In this survey took part 318 teachers from different schools most of them in secondary and primary schools. For the purposes of the study, it is important to identify teachers' attitudes towards e-learning education as well as the difficulties they encounter in creating and implementing e-learning content. Major deficits are identified to overcome difficulties in creating and implementing e-learning content.

21. Stavrev S., **T. Terzieva**, A. Golev, *Concepts for distributed input independent architecture for serious games*, CBU International Conference Proceedings 2018: Innovations in Science and Education, Prague, Czech Republic, Vol 6 (2018), Print ISSN 1805-997X, Online ISSN 1805-9961. p. 1166-1172. (Indexed in Thomson Reuters Web of Science)

Serious games (SG) allow us to learn even when we are relaxing. These games are called “serious” because they allow us to be trained at domain-specific knowledge level. That is the main reason SG are gathering an even increasing research interest in recent years. In contrast with traditional, purely entertainment games, SGs architectures and design principles are under active investigation by researchers. Recent work in that field attempts to define how SG are structured, built, used and extended. However, there is still a lot of debate which design techniques are adequate or which techniques can be borrowed from other fields – such as computer science or mainstream entertainment games. The main objective of our research is three-fold: investigate and analyze current architectural approaches; summarize the top characteristics of a modern serious game; and propose an architecture that is coherent with current approaches. Following these principles, we determine that the prevailing views in the SGs area are that they should be distributed and modular, service-based and easily extendible. We offer a concept for creating serious games that are independent of their input devices and propose two ways that independence can be achieved.

22. **Terzieva, T**., A. Rahnev, A. Karabov. *Methodological problems for development of adaptive e-learning content*, Education and Technologies Journal, VOL. 9/2018, ISSUE 1, ISSN 1314 1791, стр. 119-124.

In this research we present the results of a study related to the methodological problems on developing an adaptive e-learning content. Special attention is paid to the different opportunities for adaptation of learning content in e-Learning systems. An emphasis is put on the ways of modelling and developing adaptive learning materials by presenting didactic capabilities of adaptive e-Learning systems to achieve learning objectives. Various methodological approaches are discussed to determine the learner's parameters in order to customize the learning content. Several parameters are taken into account: learner's preferences, learning style, level of knowledge, available learning time, specific objectives, visit history, etc.

23. Stavrev, S., **T. Terzieva**, A. Golev, *Integrating third-party services using brokers in the serious games' domain*. TEM Journal Technology, Education, Management, Informatics, Volume 7, Issue 4, Pages 842-848, ISSN 2217-8309, DOI: 10.18421/TEM74-23, November 2018. (Web of Science, SCOPUS) SJR 2018 0.15.

Queues have been used inside games' logic for exchanging different event messages between in-game entities. Message queues, on the other hand, are used in various domains as data exchange mechanisms between heterogeneous or distributed applications. In this article, we explore opportunities to integrate third-party services into the architecture of serious gaming. We use message queue broker and micro-services in a publish/subscribe manner in order to use real-time 3rd party data into a serious game's logic. In this work, we discuss the benefits of service-oriented architecture. Special attention is paid to comparison and analysis different message queue brokers in terms of data latency, throughput, fail-tolerance, and scalability for the purpose of serious games. As a result, we apply those best practices from other domains in the field of Serious Games.

24. **Terzieva, T.,** A. Rahnev, A. Karabov. *Design and Development of Adaptive e-learning content*. Collection of scientific papers from Scientific and Practical Conference „Mathematics, Informatics, Information Technology, application in education", 10-12 October 2018, Pamporovo, ISBN: 978-619-202-437-6, 290-301.

Adaptive technology allows, with the help of specially developed learning materials and training tools to create self-learning conditions with an individual pace of development. This paper presents some didactic approaches for designing and developing adaptive learning content. Special attention is paid to the methodology in creating learning objects. Different types of electronic learning materials are classified as well. A generalized technological model for design and development of adaptive electronic content is presented. The aim is to design educational courses that are tailored

to different learner's characteristics such as specific goals, preferences, knowledge, style of learning, etc.

25. **Terzieva T.**, A. Rahnev, *Basic stages in developing an adaptive e-learning scenario,* IJISET – International Journal of Innovative Science, Engineering & Technology, Vol. 5 Issue 10, October 2018, ISSN 2348 – 7968, pp. 50-54. (Indexed in Thomson Reuters)

The aim of this study is to present the main stages in the development and implementation of adaptive e-learning through the DisPeL platform. Adaptation is presented as a two-way process – on the one hand adapting the educational environment to the personality of the learner. On the other hand, the student is actively involved in the design and construction of an individual educational trajectory. The modelling of adaptive e-learning is done by individualizing the learning process based on the creation of e-courses, taking into account the learner's individual characteristics, the level of the initial knowledge, the levels of perception, the individual objectives and the tasks of the training. The purpose of adapting eLearning systems is to ensure effective training by providing an opportunity for learners to communicate with an environment that meets their needs, behaviors and knowledge.

26. **Terzieva, T.**, A. Rahnev, P. Pavlov, *Activating Knowledge Motivation through practical tasks*, Scientific Works of the Union of Scientists in Bulgaria – Plovdiv. Series C. Technics and Technologies. Vol. XVII., ISSN 1311 -9419 (Print); ISSN 2534-9384 (Online), 2019, 145-151.

In recent years, it has been stressed the need to optimally combine different means that allow the new knowledge to be presented to the student as a problem. To the extent that the pupil participates in solving problems and seeking new paths to achieve a result, learning cognitive motives are also improved. In this report, we present some methodological approaches for activating the cognitive motivation of students to study computer disciplines by solving practical problems of interdisciplinary nature. Students are offered tasks from other school disciplines – mathematics and chemistry, and their solution is done using the methods and tools of informatics and information technologies. The aim of the study is to increase motivation to study programming and to develop integrative competencies through tasks of interdisciplinary nature.

27. Kyurkchiev, N., A. Iliev, A. Rahnev, **T. Terzieva**, *A New Analysis of Code Red And Witty Worms Behavior*, Communications in Applied Analysis, An International Journal for Theory and Applications, Volume 23, No. 2, 2019, pp. 267-285, ISSN 1083-2564. DOI: 10.12732/caa.v23i2.3, (SJR 2019: 0.156).

Some epidemiological models have been studied, which in some situations can be applied to the theory of the spread of computer viruses. In this work, we present an opportunity for a new accurate analysis of the situation with the spread of the Code Red worm, as well as the Witty worm. These worms were actively spread from 00:00 UTC

July 19, 2001 to 00:00 UTC July 20, 2001 and on March 19, 2004, at approximately 8:45 p.m. Pacific Standard Time (PST) respectively. We propose an approach to treat these epidemics using the sigmoidal Dagum-II function, which we test with real data.

28. Stavrev, S., **T. Terzieva**, A. Golev, *Some implementations of distributed architecture for developing video games*, International Electronic Journal of Pure and Applied Mathematics, Volume 13, No. 1, 2019, 81-91, ISSN: 1314-0744, doi: 10.12732/iejpam.v13i1.6.

The software architecture is an important part of the process of design and development of video games. Nowadays game developers strive to achieve a software architecture which enables reuse, porting, extension, etc. Those architectures are centered on several key principles, service-oriented games that use modular components and that can be independent of their inputs. In this paper, we briefly present the Distributed Architecture for Serious Games (DiAS) that abides by those principles. Furthermore, we demonstrate and discuss several concrete serious games that are implemented on the top of that architecture. The main research is related to ways both of these games can be extended to work with different input-devices, while keeping their internal logic (gameplay) intact.

29. Iliev, A., N. Kyurkchiev, A. Rahnev, **T. Terzieva.** *Some New Approaches for Modelling Large-scale Worm Spreading on the Internet. II*, Neural, Parallel, and Scientific Computations, 27, No. 1, 2019, 23-34, ISSN: 1061-5369.

The epidemic infection models that can be used to study the propagations of the worms as it infects Internet hosts are divided into two directions: discrete stochastic (time-stepped) and deterministic (using differential equations). For large enough populations it is common to approximate the stochastic model by the better continuous state continuous time deterministic model. Researchers make great efforts to describe the adequate situation used to spread worms, as it is difficult to use real traces of worm trafficking or realistic parameters for research. In this work, we explore some new approaches for Modelling Large-scale Worm Spreading on the Internet.

30. Kyurkchiev, N., A. Iliev, A. Rahnev, **T. Terzieva**, *A New Analysis of Cryptolocker Ransomware and Welchia Worm Propagation Behavior. Some Applications. III,* Communications in Applied Analysis, An International Journal for Theory and Applications, 23, No. 2 (2019), 359-382, ISSN: 1083-2564, doi: 10.12732/caa.v23i2.7, (SJR 2019: 0.156).

In this paper we receive new models that in some situations can be applied to model computer viruses propagation. Welchia worm and Cryptolocker ransomware have a long growing phase in contrast to many other threats. In September 2013 the CryptoLocker malware starting its invasion using mainly P2P ZeuS (aka Gameover ZeuS) malware. CryptoLocker' main aim was to receive money from the unsuspecting victims for decrypting their files. Welchia worm uses a vulnerability in the Microsoft

remote procedure call service. Welchia firstly checks for Blaster worm and if it is exists continues with Blaster deletion as well as takes care for computer to be immunised for Blaster worm. Also we modeled Malicious high–risk Android App volume growth; Malware evolution; Number of users attacked by Trojan-Ransom malware; Number of users attacked by crypto-ransomware; Number of unique users attacked by Trojan-Ransom.AndroidOS.Fusob; and ”Seasonal data”.

31. **Terzieva, T.,** V. Arnaudova, E. Angelova, *Methodological approaches for applying adaptation in the educational process through DisPeL*. Proceedings of the 12th National Conference „Education and Research in the Information Society” Plovdiv, 30-31 May 2019, 65-74. ISSN 2534-8663.

Different methodological approaches for applying adaptation to the learning process are considered in the work. We present results of adaptive e-Learning on the course “Information Technologies” of students at Plovdiv University “Paisii Hilendarski” – affiliate Smolyan through the Distributed Platform for e-Learning DisPeL. The content of the course is structured in 13 topics. There is an opportunity to obtain statistical information about the exams, and the teacher can make personal inquiries about a particular student or group of students, receive information about the assimilation of the material, the difficulties encountered on each topic, as well as comparisons of exam results on a particular discipline in different years. In this way it is possible to trace to what extent the change in the teaching methodology and the different didactic strategies reflect on the acquisition of knowledge and skills by the students.

32. **Terzieva, T.**, A. Iliev, A. Rahnev, N. Kyurkchiev. *The Lomax–D–Generalized–Weibull Cumulative Sigmoid with Applications to the Theory of Computer Viruses Propagation. IV*, Neural, Parallel and Scientific Computations, October 2019, 27(3&4):141-150, DOI: 10.12732/npsc.v27i3&4.1, ISSN: 1061-5369.

Welchia, also known as the "Nachi worm", is a computer worm that exploits a vulnerability in the Microsoft remote procedure call (RPC) service similar to the Blaster worm. In September 2003, the worm was discovered on the US State Department's computer network, causing them to shut down their network for 9 hours for remediation. In this work, we show that the proposed model can be successfully used with success in the field of analysis of Computer Viruses Propagation. We also analyze some experimental data: the cumulative number of Welchia attackers; data of Conficker propagation in 2008; the cumulative number of users attacked by Trojan-Ransom malware. The Numerical examples, illustrating our results are presented using programming environment CAS Mathematica.

33. **T. Terzieva**, A. Iliev, A. Rahnev, N. Kyurkchiev. *On a Powerful Transmuted Odd Log-Logistic-Gumbell Model with Applications to the Theory of Computer Viruses Propagation. V*, Communications in Applied Analysis, October 2019, 23(3), p. 441-451, ISSN: 1083-2564. (SJR 2019: 0.156).

This work continues the research on modeling the spread of computer viruses. We also analyze some experimental data: the cumulative number of Welchia attackers; data of Conficker propagation in 2008; the cumulative number of users attacked by Trojan-Ransom malware and data ”Blaster worm”. Numerical examples, illustrating our results are presented using programming environment CAS Mathematica. Finally, we note that the studied model produces extremely good results, generally when approximating specific ”cumulative data” from Computer Viruses Propagation.

34. **Terzieva, T**., A. Iliev, A. Rahnev, N. Kyurkchiev, *Comments on a New Hyperbolic Sine-Weibull Model with Applications to the Theory of Computer Viruses Propagation. VI*. International Journal of Differential Equations and Applications, Volume18, No. 1 (2019), pages: 137-146. ISSN (Print): 1311-2872; ISSN (Online): 1314-6084. (Zentralblatt MATH)

Continuation of research on emerging new classes of sigmoidal and model functions to solve problems in the field of Computer Viruses Propagation and the application they find especially for the recognition of "already known viruses". The purpose of this article is to make a theoretical and experimental study of a New Hyperbolic Sine-Weibull Model that can be successfully used in the field of analysis of Computer Viruses Propagation. We also analyze some experimental data: “data of Conficker propagation in 2008”, data “Blaster worm” and data “Witty worm”. Here we present a new analysis of Conficker propagation in 2008 and we explore the Network Telescope project’s daily dataset collected on November 21, 2008.

35. Kyurkchiev, N., A. Iliev, A. Rahnev, **T. Terzieva**, *Another look at a good approximation of data for the distribution of COVID-19 in Cuba*. Revista Habanera de Ciencias Médicas, 2020, 19(3):e3445, MAY-JUNE ISSN 1729 - 519X, (Scopus, Web of Science) (SJR 2019: 0.125)

In the article “Adjustment of population growth curve applied to Covid-19 in Cuba”, the authors propose six types of models to approximate data from the distribution of COVID-19 in Cuba, while giving a clear answer to the possible advantages of some considerations. In this paper, we study intrinsic properties of some models of growth with polynomial variable transfer that give a very good approximation of the specific data on the pandemics in Cuba by June 5, 2020. The models have the right to exist in the treatment of issues from different fields of scientific knowledge. Numerical examples are presented using CAS MATHEMATICA.

36. **Terzieva, T.,** V. Arnaudova, A. Rahnev, V. Ivanova, Technologies and tools for creating adaptive e-learning content, Mathematics and Informatics, Volume 63, Number 4, 2020, ISSN 1314–8532 (Online); ISSN 1310–2230, p. 382-390. (Print). (Web of Science).

The aim of adapting e-learning systems is to provide effective learning by supplying students with the opportunity to communicate with an environment that meets their needs, behaviour, and knowledge. The design and creation of learning materials is directly dependent on the learning objectives. Themore different groups of students a course is adapted to, the higher the degree of personalization of the learning process is. In this article we present the results of a study on the types of adaptive systems depending on the technological tools and methodological approaches for implementing adaptability and personalization in learning. Special attention is paid to the applied technologies in the development and delivery of adaptive learning content as well as to the ways of modeling an individual learning path.

37. **Terzieva, T**., A. Iliev, A. Rahnev, N. Kyurkchiev. *Comments on some modification of SUJA cumulative functions with applications to the theory of computer viruses propagation. VII*, International Journal of Differential Equations and Applications, Volume19, No. 1, 2020, pages: 83-95, ISSN (Print): 1311-2872; ISSN (Online): 1314-6084; doi:10.12732/ijdea.v19i1.6 (Zentralblatt MATH)

Various modifications of the famous Suja Distribution are considered. Relevant cumulative analogues have been shown to be well used in various fields in the study of the spread of computer viruses. We present examples with which we test the model and analyze the following data: the spread of Storm worm – one of the biggest cyber threats for 2008; Welchia worm data; version of MyDoom, which on July 26, 2004 attacked Google, AltaVista and Lycos and others. The article (Part VII) is a natural continuation of the authors' research in this area.

38. Gaydarova, M., **T. Terzieva**, A. Rahnev, *Teaching during distance learning – shared experience of bulgarian teachers*, Education and technologies, VOL. 11/2020, ISSUE 1, ISSN 1314 1791 (print), ISSN 2535 1214 (online), pp. 7-14.

ICT is increasingly used in education in order to improve student motivation and learning effectiveness. To access the impact of educational platforms and ICT on achieving state educational standards, we conducted a survey of teachers' opinions on the manner and effectiveness of distance learning, the advantages and disadvantages they report. In this article we present the results of a survey conducted through an online anonymous survey among 68 teachers from the city of Plovdiv who work in an innovative school approved by the Ministry of Education and Science. The subject of the research are professional experience, used resources, technologies, methods and pedagogical approaches during distance learning, the achieved efficiency, etc. This study shows what are the teachers' attitudes and practices in the use of ICT in the

Bulgarian school during training in a digital environment. Both advantages and some disadvantages are taken into account when the conducted training is only in distance form.

39. Golev, A., A. Rahnev, **T. Terzieva**, NSP „ICTinSES“– *Achieved Results from the FMI Team at PU. I,* Proceedings of the Anniversary International Scientific Conference “Synergetics and Reflection in Mathematics Education”, 16-18 October 2020, Pamporovo, Bulgaria, ISBN: 978-619-202-595-3, pp. 251-258.

This article presents summarized results from the implementation of scientific tasks within the National Research Program "Information and Communication Technologies for a Digital Single Market in Science, Education and Security" (NNP "ICTvNOS") by the FMI team at Plovdiv University. The implemented activities in two of the main components are indicated – Electronic infrastructure for open science and Digital technologies in teaching and learning, work with young talents and special target groups. Under the second component, the emphasis is on scientific tasks in several areas: creation of publicly available educational resources; modern means for digitalization in education and work with young talents; augmented virtual reality in learning and three-dimensional models for illustrating learning content. Training of students was conducted in the established Laboratory for 3D modeling, more than 10 experimental 3D models for training and qualification of students and teachers were developed.

40. Spirova, M., **T. Terzieva**, A. Rahnev, *Digital Learning Environments.* Proceedings of the Anniversary International Scientific Conference “Synergetics and Reflection in Mathematics Education”, 16-18 October 2020, Pamporovo, Bulgaria, ISBN: 978-619-202-595-3, pp. 301-310.

In this article we have studied and analyzed some of the most commonly used digital educational platforms in the Bulgarian school. The environments are presented in terms of the opportunities they offer in the educational process: usage of ready-made learning content or to create your own, possibility for assessment and self-assessment, feedback for the achievements of the students, an interface in Bulgarian, focus on a specific subject or offering of tools for creating and/or using teaching materials, regardless of the subject area. It is essential for the modern teacher in Bulgaria to know the main characteristics of educational platforms and digital environments, the possibilities for their integration in the learning process, as well as in extracurricular activities, taking into account the age characteristics and level of knowledge of students.

41. Todorova, E., S. Aneva and **T. Terzieva**, *Creating a reflection in the informatics teaching by applying adapted ALACT Model*., Proceedings of the Anniversary International Scientific Conference “Synergetics and Reflection in Mathematics Education”, 16-18 October 2020, Pamporovo, Bulgaria, ISBN: 978-619-202-595-3, pp. 311-318.

The aim of the present research is purposeful and active creating of reflexive skills in students and their acquisition of models for reflective analysis and self-assessment. Reflexive abilities, which contribute to increasing the activity in computer science education, are part of the competencies of the students. The process of reflection is realized with the adapted cyclic model ALACT. A concrete example from the education of informatics is considered, through which reflective skills are formed in the students.

42. Chukanska, Y., **T. Terzieva**, O. Rahneva and G. Koleva, *Design and development of 3D Music instruments for training children with special needs*, Proceedings of the Anniversary International Scientific Conference "Synergetics and Reflection in Mathematics Education", 16-18 October 2020, Pamporovo, Bulgaria, ISBN: 978-619-202-595-3, pp. 221-228.

When teaching children with special educational needs, an individual approach and adaptation of the educational content to a form suitable for perception is needed. The use of computer and information technology facilitates adaptation to specific individual needs. In this paper we research and represent how using computer technologies and 3D printers can facilitate the Music education for children with severely limited sight. We demonstrate a form of a circle of fifths, suitable for transliteration into Braille. A 3D model of the circle of fifths in Braille is designed. The developed topics provoke interest to carry out similar developments in other areas, not only in music education.

43. Gaydarova, M., **T. Terzieva**, A. Rahnev, *ICT Based Approaches to increase the efficiency of the educational process,* Proceedings of the Anniversary International Scientific Conference "Synergetics and Reflection in Mathematics Education", 16-18 October 2020, Pamporovo, Bulgaria, ISBN: 978-619-202-595-3, pp.229-234.

In this publication, we present a description of good practices of modern approaches to increase the effectiveness of ICT based learning. A study was conducted in five schools in the city of Plovdiv: Primary School "Raina Knyaginya", Secondary School "Chernorizets Hrabar", Primary School "Aleko Konstantinov", Primary School "Elin Pelin" and Primary School "P. R. Slaveykov ". Exemplary criteria for innovative change of the educational process are indicated, as the main accents are: the vision for success of the students and the skills they have to develop; the new role of teachers as organizers and mentors, and the application of digital learning resources combined with modern pedagogical strategies.

44. Terzieva, T. *Development of Cognitive Skills through Computer Educational Games*, Pedagogy, Bulgarian Journal of Educational Research and Practice, Vol. 7, 2021, "Az-buki" National Publishing House, Sofia, ISSN 1314–8540 (Online),

ISSN 0861–3982 (Print) (in Print) (letter of assurance, verifying that the article is reviewed and approved for print) (Web of Science)

This article presents the results of a study on the possibilities of computer educational games for the development of various cognitive skills for learners. The advantages they offer in the learning process are highlighted. Special emphasis is placed on the relationship between game-based learning and mental development of learners. Examples of game-based learning from leading educational institutions at different stages of the educational process are given. A prototype of an educational game with several interactive puzzles is presented. They are designed to teach students in mathematics and philology (learning a foreign language). The developed prototypes can be used to acquire new knowledge or to assess the acquisition of knowledge and skills in various subject areas.

Signature:

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