ANNOTATION OF THE MATERIALS,
INCLUDIND SELF-ASSESSMENT OF CONTIRBUTIONS

of Assistant Professor Silvia Nikolaeva Gaftandzhieva, PhD,
for participation in the completion for Academic Position "Associate Professor"

For my participation in the announced competition for the academic position of Associate Professor in the field of higher education ***4. Natural sciences, mathematics and informatics***; professional field ***4.6. Informatics and computer science***; scientific speciality ***Informatics*** I present 30 scientific publications (11 of which are indexed in Web of Science and/or SCOPUS), 2 monographs, 1 book chapter, 1 textbook and 12 online courses. The presented materials do not repeat others used in the procedures for obtaining the educational and scientific degree PhD and for holding the academic position of Assistant Professor.

All materials are presented according to their numbering in the list of scientific works for participation in the competition.

According to their content, the scientific works submitted for participation in the competition can be classified in the following scientific fields:

I. Computer models and systems for dynamic quality evaluation– 10scientific publications and 1 monograph;
II. Learning analytics– 3 scientific publications and 1 monograph;
III. Models and systems for e-learning– 11 scientific publications;
IV. Pedagogical and social design of e-learning– 6 scientific publications, 2 monographs and 1 book chapter;
V. Textbooks and e-courses– 1 textbook and 12 e-courses.

I. Self-assessment of Contributions

I. Computer models and systems for dynamic quality evaluation

The main idea of the research in Scientific Field I. is related to the search for solutions for the automation of processes for quality evaluations of objects in different areas. Quality evaluation, regardless of the scope, needs and objectives for which it is carried out, is based on systems of respected criteria and procedures. Usually, such criteria systems include a large number of procedures and criteria for the evaluation of many objects and processes, which requires the processing of large data sets for the objective assessments. These systems require a quality evaluation to be performed periodically and to reflect the results of processes and states of objects in different periods, which leads to the need to pay special attention to the problem of ensuring dynamic quality evaluation. Dynamic quality evaluation requires the collection, analysis and interpretation of a huge amount of data on various aspects of the assessed area. Such automation is unthinkable without a well-functioning information infrastructure. In this sense, it poses a number of problems associated with the need to propose adequate models of processes for dynamic quality evaluation, including data extraction and processing of data from information systems based on different servers, operating systems, communication platforms, databases, etc. These problems are related to the need of creation and

exploration of conceptual and computer models of systems for dynamic quality evaluation, including tools for integration of various information systems and large datasets in relevant subject areas.

In relation to the need to evaluate the quality of various objects in education, basic concepts and definitions, standards, specifications and guidelines for quality evaluation in education, leading organizations and agencies in the field, are considered and presented in [A1] ("*Quality and evaluation of e-learning*"). Popular models for quality evaluation and software tools for automated quality evaluation of objects in the field of higher education are analysed.

Regardless of whether talking about traditional learning, blended learning or e-learning, the main modern mean for objective knowledge assessment is through conducting online tests, typically using a Learning Management System (LMS). Precisely because the assessment through online tests has become an integral part of modern educational testing activities in all forms of training, their quality assurance is of a prime importance for achieving a high level of educational services, offered by higher education institutions. As a result of the study in the field, software tools for automated collection and analysis of students' and experts' assessments of the quality of tests, e-courses and training in the study programme for the needs of internal quality systems have been developed.

In [E8] ("*Automated Evaluation of test Quality in E-Learning*") a hierarchical model for quality evaluation of test units and tests with 39 indicators is proposed. Based on the proposed model, a questionnaire was proposed by which students can evaluate the quality of the tests. To automatically process the results of the surveys among students, a software module for Moodle has been designed, developed and tested, which allows extracting, summarizing and automated analysis of survey results for the satisfaction of students from e-courses conducted in Moodle. The specialized module, developed on the basis of integration of a centralized system for generating reports and decision-making UBIS-Jaspersoft and Moodle, allows an authorized group of users (lecturers, members of university quality committees) to generate reports with summarized results of conducted surveys that help them to analyse and possibly make decisions to improve the quality of test units and tests, teaching and learning. The software module allows extraction and aggregation of data from other information sources - not only from the specific environment in which the e-learning was conducted.

[D2] ("*Automated Quality Assurance of Educational Testing*") presents the next stage of the study. Based on a review of known approaches to quality assurance of e-tests, a comprehensive approach to quality assurance of e-tests is proposed. This approach meets the needs of all stakeholders (authors of online tests, teachers, students, experts, quality managers, etc.), which has the following characteristics:

- it provides a possibility to obtain all the possible data of the evaluation of test items and tests as a whole on the basis of a statistical analysis of the test responses after the test probation among a representative group of students or after conducting it in real test situations and specially developed test quality models for evaluation by experts or students;
- it enables the process of assuring e-testing quality to be informed by input from representatives of all relevant stakeholders (test authors, teachers/assessors, methodologists and experts in the test subject area, students);
- it allows evaluation of the test quality during the complete lifecycle of a test (its design stage or usage stage, or even afterwards);
- it addresses the needs of quality-related information of all stakeholders (incl. educational quality managers and policymakers);

- it supports quality assurance activities in different levels of generalization in the level of separate online test items, of an online test as a whole, of online tests of an entire course, or of online tests of an academic specialty, etc.

To ensure the quality of the tests at the different stages of their lifecycle, 5 instruments (models) for educational test quality evaluation have been developed – two quality models for test evaluation by questionnaires from experts and students/testees, two quality models for evaluation of the basis of testees' responses of separate test items and educational tests as a whole, one quality model for evaluation of the quality assurance process itself of educational tests an entire course, an academic specialty, a professional field, or an area of higher education. The quality evaluation of the test according to the proposed models requires extraction and analysis of data from the system in which tests were conducted. An original software application named Test Quality Evaluation (TQE) is developed, according to the proposed approach, for the automation of the stakeholders' activities for quality assurance of educational tests throughout the whole lifecycle. The application retrieves and provides an analysis of data from online tests conducted and specially designed surveys for quality evaluation of educational tests by students and experts. It allows tracking and evaluating the quality of educational tests in real-time and provides the related quantitative data in different levels of generalization – in the level of a separate educational test, of educational tests of an entire course, or educational tests of a subject area. The software application has been put under real-time testing for quality evaluation of educational tests, included in e-learning courses from different subject areas that prove its applicability.

Another contribution in the field is related to the design and development of tools for the needs of the university's internal quality assurance systems, which allow conducting surveys and analysing the results using mobile technologies. In [E4] ("*Mobile Application for Quality Evaluation of Learning*") an analysis of the needs of internal university quality systems in conducting surveys as well as an overview of existing software tools for conducting mobile surveys have been made. After specifying the functional and non-functional requirements, an original mobile application for surveys has been developed. It meets the needs of internal quality assurance systems in higher education and includes tools for an authorized group of users, allowing monitoring of student activity in surveys and automated analysis of results. The application allows members of university quality commissions to generate summary reports, monitor the conduct of ongoing surveys and analyse interim data at any time. The developed mobile application was experimented at the University of Plovdiv for quality evaluation of courses and educational tests. The results of the conducted experiments prove the benefits of the developed application for the improvement of the quality assurance practices in higher education institutions. A study also supports the development of institutional quality assurance systems towards building a coherent European Higher Education Area.

In regards with the expanding field of applications and the need to multiply the results naturally, the following studies turn to design a comprehensive system for dynamic quality evaluation of higher education based on data extracted from university information systems.

In [D3] ("*Dynamic Quality Evaluation in Higher Education*") means for the automation of the processes for dynamic quality evaluation of objects in a given subject area are proposed. Based on a theoretical study, a set of conceptual and computer models of a process and a system for dynamic quality evaluation are developed. After an analysis of the objects, models, procedures and workflows of

activities related to the dynamic quality evaluation, architecture of a dynamic quality evaluation system is proposed. The architecture includes subsystems for conceptual modelling of methodologies; modelling of accumulating functions; computer modelling of methodologies within the information infrastructure of an institution; accumulation of information resources and reports for dynamic (self)evaluation of the quality; organization and management of tasks and procedures for quality evaluation; communication and interaction of users with the system. A corresponding software prototype has been developed on the existing university information infrastructure. The proposed general models are applied for dynamic evaluation of the quality of e-courses.

The dynamic monitoring of the procedures and activities related to the quality evaluation of higher education presupposes the collection (based on automated accumulation, aggregation, analysis and interpretation) of a huge amount of data from information and management systems (for the learning process, the development of the academic staff, etc.), learning management systems, digital repositories, etc. In [E9] ("*Automatic Accumulation and Aggregation of Data for Quality Evaluation in Higher Education*") the possibility for automated accumulation and aggregation of data for quality evaluation in higher education was explored. Based on the results achieved in [D3], a general model for dynamic accumulation and aggregation of data needed for quality evaluation in higher education is proposed. To apply the proposed model analysis of the NEAA criteria system and the information infrastructure of the assessed institution was performed. For each of the indicators at different levels (standards, criteria, the content of criteria), following their original numbering in the criteria systems is described: to which components of the evaluated object refers; what is the norm for its measurement; what documents may (possibly) be accumulated by university information systems. The analysis shows that about 92% of the recommended documents could be generated automatically, which in practice solves a major problem of accreditation procedures - the complexity of collecting and preparing documents and reports. Also, there is an opportunity for the implementation of a system for dynamic quality management in higher education, oriented towards meeting the NEAA criteria systems.

[D11] ("*Quality Evaluation in Higher Education: Dynamic Data Accumulation and Aggregation*") proposes a comprehensive approach for quality evaluation of higher education by accumulation and aggregation of data from different information systems. The proposed approach is tested for accumulation and aggregation of supporting documents necessary for the preparation of a self-evaluation report on the NEAA criteria system for institutional accreditation. For the need of the experiment, a digital repository and templates of supporting documents were created, on the basis of which supporting documents with data extracted from the university information systems were generated. The developed repository contains both the documents created by the expert in the process of monitoring the assessed object and the automatically generated documents. The proposed approach solves the main problem of accreditation procedures (the complexity of collecting and preparing supporting documents). It allows increasing the efficiency of the evaluation process and the reliability of the results obtained. The conducted experiment proves the benefits of the application of the developed model for dynamic data accumulation and aggregation for quality evaluation in higher education, specified in the case of institutional accreditation of higher education institutions in Bulgaria. On the one hand, the proposed approach is applicable for quality evaluation of each higher education institution in Bulgaria (after some changes related to the information systems used in the institution). On the other hand, because the model is tested with NEAA Criteria system developed following ESG, the proposed

approach can be easily adapted to evaluate the quality according to quality criteria of all other members of ENQA.

Most modern universities have not implemented tools for modelling, modification, virtualization and process support in their information systems. To solve the problem for e-management of activities in higher education in full degree, the idea presented in [G3] has to be developed by offering and implementing tools that allow adequate modelling, virtual implementation, visual representation and interface provision of processes (including the integration of functionalities of existing information systems and big data). In [D14] ("*Conceptual and Computer Modelling of Processes with Accumulation and Synthesis of Data in Higher Education*") after an analysis of objects, subjects and processes in higher education, the architecture of software system for modelling, virtualization and dynamic management of workflows in the corporate information infrastructure is proposed. A software prototype with which real business processes can be modelled is also presented. Models of complex business processes created through the software prototype are presented as a set of relatively separate processes - each with its lifecycle and rules for their interaction, synchronization and coexistence. Each business process is modelled as a flow structure of activities (steps) in which different information objects and subjects can participate. The software prototype also supports digital repositories of information resources for various purposes.

The models of dynamic quality assessment processes presented in [D3] are further developed in [A1] ("*Quality and Evaluation of E-Learning*"). The new formal model of a system for dynamic quality evaluation includes processes for modelling the organization and management of activities for the accumulation of information resources for specific institutions, according to a given methodology. Based on the analysis of the objects, models, procedures and workflows of activities related to dynamic quality evaluation and the created conceptual and computer models, architecture of an automated system for dynamic quality evaluation is proposed, which includes subsystems for: conceptual modelling of methodologies; dynamic (self)evaluation of the quality of processes and/or their elements (sub processes, activities, subjects, objects); modelling of accumulating functions; computer modelling of methodologies within the information infrastructure of the institution; accumulation of information resources and reports for dynamic (self)evaluation of quality; organization and management of tasks and procedures for quality evaluation of processes and/or their elements; communication and interaction of users with the system. The functional and non-functional requirements to each of the subsystems included in the proposed architecture are formulated. The created theoretical models provide a basis and provide opportunities for successful implementation of similar projects in various subject areas.

Ensuring the quality of services in the field of higher education is directly related to the technologies used, software and the degree of digitalization of the services offered by the higher education institution. In recent years, digital technologies have led to the need to digitize in education. To respond to the social and economic needs, contemporary higher education institutions have to adapt to new challenges, to maintain standards of excellence and be competitive in international educational markets. In the digital age, modern higher education institutions use more and more digital technologies to automate their activities for different user groups (librarians, faculty, students, local and global communities, researchers, administrative staff, etc.) – student information systems, library systems, digital archives, planning and management systems, human resources, learning management systems,

etc. In [A1] ("*Quality and Evaluation of E-Learning*") after an analysis of well-known digital maturity models, a model for assessing the degree of digitalization of Bulgarian universities is proposed. The model contains 88 indicators, grouped in 10 key elements according to ESG standards. The systematic approach adopted in its creation (it follows the European quality assurance standards) allows the model to be used to measure the digital maturity level of each educational institution in Europe (evaluated by ESG standards) and to compare the levels of digitalization of institutions. The proposed model can easily be adapted and used to measure the digital maturity level of educational institutions in any country and any educational level.

Other research in the field is related to the design of software for monitoring components and elements of corporate infrastructure and the quality evaluation of software products.

[E17] ("*Model and Monitoring System of Corporate Infostructure*") presents a model and architecture of a software system for tracking, analysis and monitoring of various components and elements of corporate infrastructure. The general model requires the creation and use of libraries with "accumulative processes", which have "access" to activities and elements typical for all parts of the corporate infostructure. In general, the system allows modelling, virtualization and management of segments of corporate information structure; processes of different nature (from "monitoring" to accumulation and aggregation of electronic resources); digital repositories with e-resources of the infostructure. The proposed architecture includes subsystems for modelling of infostructures for monitoring; modelling of processes as workflows; modelling of digital repositories of corporate infostructures; accumulation and aggregation of information resources in digital repositories in the result of virtualized processes; virtualization of infostructures, processes, repositories and data - models of elements of the corporate infostructure; maintaining the lifecycle of virtual models of elements of the corporate infrastructure; communication and interaction of users; management and synchronization of the system and its subsystems. The main functional characteristics of the designed system are process modelling, visualization methods and digital repositories for e-resources; dynamic management and control of user access in various roles to services; accumulation, aggregation and generation of information resources depending on the respective process; management and control of the exchange of e-resources at different levels within the virtualized processes; automatic generation of standard documents and files (including letters, reports and decisions for starting, conducting and finalizing processes and procedures); maintaining an electronic archive of documents, procedures and methodologies typical for institutional activities and inquiries via the Internet (for upcoming, current and completed virtual procedures); providing user access to information about the status and results of corporate processes, etc.

Since the appearance of the software quality assurance as a field in the software engineering, researchers have been looking for ways to automatically assess and manage the quality of software systems. In [E1] ("*Software Quality Assessment Tool Based on Meta-Models*") the research is directed to finding the answer to the question "Is it possible to automatically assess the software quality following the model defined by the standard ISO/IEC 9126 and using of appropriate metrics?". The main requirements for a system that automates the process of software quality assessment based on standards and metrics are: to enable automated quality assessment, based on formalized patterns of the participating items with a high degree of objectivity, reliability and portability where the formalized patterns are based on standards, metrics and best practices; to provide the opportunity for modelling of

different assessment tools/elements; to offer a maintenance of meta-models for definition and application of hierarchical software quality models; to offer a maintenance of meta-models for definition and application of software quality metrics; to offer a maintenance of meta-models for definition and application of procedures, related to software quality assessment; to allow flexible user management. Meta-models that are supported by the conceptualized software system have to allow modelling of assessment instruments for definition and interpretation of models, with the help of specific standards. Based on the analyses of the functional requirements in terms of the designed software system and following the proposed meta-models (software quality model, software quality metrics, procedure related to software quality assessment), a conceptual design of the concrete software system (a complete solution for automating the software quality assessment process) is proposed. In accordance with the selected meta-models and the specified functionality, the software application logic consists of three sub-systems: Maintenance of meta-model for hierarchical software quality models; Maintenance of meta-model for software quality metrics; Maintenance of meta-model for the model of procedure (workflow). As means of definition and implementation each subsystem includes: tools for definition of models (editor), an internal presentation and storage of defined models (in a database), and an interpretation engine (for configuration, implementation, tracking, etc.) of the built models of software quality/metric/procedure. The results of the study form well both a theoretical and a practical basis for the further development of a user-friendly software instrument that offers a rich set of tools for automation of the software quality assessment process. Amongst them there are tools for modelling of SQMo and corresponding metrics, which are applicable in the assessment, analysis and improvement of various software products. The development of such a product would objectify similar activities and would increase the efficiency (in the terms of time and resources).

The main contributions in Science Field I. are:

- a hierarchical model for quality assessment of electronic tests and test units is proposed;
- a software module has been designed and implemented, which allows automated analysis of results from conducted surveys in Moodle;
- a comprehensive approach to ensuring the quality of educational tests is proposed;
- models for quality evaluation of educational tests at different stages of their lifecycle are created;
- a software application for quality evaluation of educational tests has been designed;
- a mobile app for conducting and summarizing the results of the survey for the needs of the university quality assurance systems has been designed and developed;
- a general model for dynamic accumulation and aggregation of data for quality evaluation in higher education is proposed;
- an approach for quality evaluation in higher education by accumulation and aggregation of data from various information systems is proposed;
- an architecture of software system for modelling, virtualization and dynamic management of workflows in the corporate information infostructure is proposed;
- a software prototype of the system for modelling, virtualization and process management are developed;
- a formal model of a software system for dynamic quality evaluation of objects in any subject area is proposed;
- an architecture of a software system for dynamic quality evaluation of objects in any subject area is proposed;

- a model for measurements the digital maturity level in higher education institutions is proposed;
- a model and architecture of a software system for tracking, analysis and monitoring of components and elements of corporate information structure are proposed;
- a conceptual design of a software system for automating the software quality assessment process is proposed.

II. Learning Analytics

The theme of the study is in a scientific field known in the world research area as Learning Analytics, which is still in a relatively early stage of study (and in Bulgaria it is explored to a very little degree). Learning Analytics combines approaches, methods and results from different scientific fields such as intelligent data analysis and business intelligence, predictive modelling and pedagogy. Nowadays, the rapid development of digital technologies and the fact that higher education institutions (almost without exception) integrate e-learning into the learning process (in the form of distance learning, blended learning, problem-based learning, etc.), use a large number of software systems to automate their activities, simultaneously enforces and stimulates research in the field of Learning Analytics. When users apply these systems, they leave the so-called "digital footprint", and generate large amounts of data every day. Namely, methods, techniques and tools designed for automated retrieval and analysis of big data from repositories are the subjects of research in the field of Learning Analytics.

The first result of the study in the field of Learning Analytics is the mobile app Mobile LAP presented in [D7] ("*Mobile Learning Analytics Application: Using Students' Big Data to Improve Student Success*"), which aims to improve the learning outcomes of students. The application allows students to track the values of a set of indicators (for student activity, for control of the schedule and student success), which can help them achieve their goals during the training and improve their success. The set of indicators is determined based on the analysis of the data generated by the participants in the learning process (students and teachers) in Moodle. With the help of Mobile LAP, students can track their activity and success and compare them with the average level of activity and success of other students, as well as monitor whether they follow the schedule.

[D4] ("*Toward a Learning Analytics System in Bulgarian Higher Education*") presents a study, which aims to offer, develop and test software tools for Learning Analytics that will improve the learning outcomes in higher education. Using data mining methods for the analysis of data produced in the learning process (extracted from different data sources), Learning Analytics tools will be developed to improve the quality of outcomes in different elements of the learning process (learning, teaching, monitoring, etc.), and for the needs of different stakeholder groups. As a result of the study models, methods and software tools for intelligent data analysis to improve the learning and teaching outcomes in higher education will be proposed. In particular, software solutions will be introduced in the institutional information infrastructure for data analysis to improve learning outcomes. The developed software will be tested by stakeholders (students, teachers, program managers, members of quality committees and governing bodies, external experts) to monitor the training in real-time, to improve quality and promote of activities to achieve higher results.

In [E18] ("*Learning Analytics for Improving the Results of Training: State of Research in the Field*") an overview of research in the field is made.

In [A1] ("*Quality and Evaluation of E-Learning*") the areas of application of intelligent data analysis for different stakeholders (students, teachers, heads of educational institutions, etc.), software tools and best practices for using Learning Analytics in higher education are considered and analysed. Based on analyses of research and trends in the field and opportunities for extraction and intelligent analysis of data from typical university information systems, 7 models with a set of indicators are proposed, allowing tracking of learning outcomes for the needs of different stakeholders:

- a model with a set of indicators for students – allow students to substantially improve their learning outcomes (before completing the course) and compare the results they achieve with the average level of the course;
- a model with a set of indicators for teachers – allows teachers to track students' progress and identify students who do not show satisfactory results at as the earliest stage, or identify components that would help to improve course quality;
- a model with a set of indicators for programme managers – allows monitoring and quality evaluation of the training and the results achieved by the students in all courses of the bachelor/master programme;
- a model with a set of indicators for members of quality committees – allows monitoring and quality evaluation of the training and the results achieved by students and teachers in all courses from all bachelor/master programmes in the faculty;
- a model with a set of indicators for faculty leadership – allows monitoring and quality evaluation of the training and the results achieved by students and teachers, in all courses from all bachelor/master programmes in the faculty;
- a model with a set of indicators for university leadership – allows monitoring and quality evaluation of the training and the results achieved by the students and by the teachers, in all courses from all bachelor/master programmes in the higher education institution and comparing results across faculties;
- a model with a set of indicators for external experts – allows monitoring and quality evaluation of the training and the results achieved by students and teachers, in all courses from all bachelor/master programmes in the evaluated faculty.

The models are built on a hierarchical principle, and each one contains measurable indicators at three levels. For each indicator from the proposed models are identified data that can be extracted from the information systems used at the university. Some of the data for the indicators are generated by students during their training (number of reviews of teaching materials and activities, submitted assignments, quiz results, etc.) and teachers when evaluating students' activeness (tasks, quizzes, etc.) in the learning management system. Another part of data is generated by the administrative staff (e.g. inspectors from the academic department) when entering data about the students and grades in the studied disciplines in the student information system.

The main contributions to Scientific Field II. are:

- a mobile app for improving student results is developed;
- analysis of the used information systems to determine the appropriate data sources that can be used for the improvement of learning outcomes is done;
- models with a set of indicators, allowing tracking of learning outcomes (for the needs of different stakeholders) are created.

III. Models and systems for e-learning

High educational institutions use different information systems to automate management, operations and processes, decision making and educational services provided. Student information systems, e-Learning systems, library systems, etc. are such examples. Same data usually is entered manually into multiple systems, which could lead to errors. This imposes the need of examining the methods used for integration of heterogenic software systems.

Following the new trends in the development of e-learning, the possibilities for integration of the system with external systems, such as digital repositories, information systems, popular web technologies, have been studied and presented. The paper [E7] ("*Integration of a University Information System and LMS Moodle*") explores the possibilities for integration of a university information system with Moodle in order to avoid duplication and multiple entries of student personal data. It presents an experiment for the integration of an information system of the University of Plovdiv "PaisiiHilendarski" and Moodle. The experiment aims to achieve automation of the process of registration of students in Moodle by using the formed data of students in the student information system when they are admitted to the university. As a result, there is an opportunity for direct registration of students when conducting e-learning in Moodle without the intervention of a system administrator.

The possibilities for integration of contemporary web technologies and e-learning environments are the subject of research in [E5] ("*Integration of Web 2.0 tools in Moodle*"). After analysing the applicability of popular web technologies in 30 foreign universities and colleges, the paper examines the possibilities for integrating some of the most common and useful for education contemporary web technologies in Moodle. Various Web 2.0 tools are integrated with Moodle to implement the ideas of e-Learning 2.0 for the course, as follows:

- Blogs - to present additional information, to allow collaboration work on projects, to conduct discussions;
- RSS - for compliance with the schedule, timely information, control by the teacher;
- Social networks and social bookmarking - for the formation of interest groups, additional information, feedback, learning new concepts, mastering the methods of generalization and classification;
- Podcast - for presenting audio/video lectures, illustrations, individual work;
- Tools for sharing files and multimedia content - for presenting learning content and projects, collaboration, assessment by other participants and the teacher, etc.

During the learning process, students are overwhelmed by information. Providing in-depth and lasting knowledge and skills in the studied disciplines requires the use of technologies, methods and teaching aids that facilitate the assimilation of educational material, systematization of the learning content, concepts and connections between them. A known approach to achieving lasting and in-depth knowledge is to use frame-based learning methods. The use of frame representations in teaching has a long history. In 1974 M. Minsky have suggested frames to be used as a mean for presenting knowledge in artificial intelligence. The general nature of frame representations determines their application in various fields. They are used in the theory and practice of e-learning (in Physics, Mathematics, English, etc.) as a mean for classifying and cataloguing of learning units in the text. In [D10] ("*Accumulative Frame Models in E-Learning*") the term "accumulative frame model" is introduced. In comparison with classic frame models, slots of accumulative frame model can contain not only procedures (performed

after filling frame slots) or daemons (to calculate slot values) but the so-called "accumulative functions'. Accumulative functions allow the accumulation of additional data in the e-learning process. This data can be used to automate learning tasks. The advantages of the proposed model are the possibility for its non-standard applications in e-learning such as the automated generation of metadata and test elements to learning materials, segmentation of text to learning units, data extraction from text and others. The stages of research are presented, as a result of which a software system for design, creation and use of accumulative frame models in e-learning will be developed.

[E11] ("*Frame Representations and Applications*") presents part of a study introduced in [D10], devoted to the theoretical study of frame models and the analysis of their known applications in areas such as design, knowledge representation, computer modelling of semantic networks, extraction of information from text and web portals, decision-making systems, etc.

[D8] ("*Frame Representations in e-Learning - Applications and New Developments*") presents an innovative modification of frame models, called accumulative frame model. The accumulative frame model is a development of the classical understanding of a frame model. Therefore, it has all its typical features, but besides the possibilities for knowledge representation, it adds to the model means for knowledge accumulation. This provides particular flexibility in the implementation of the processes for automated extraction and aggregation of data and knowledge for training needs. A model of a system with accumulative frame models is introduced, with the purpose of conceptual knowledge representation in separate subject domains. The proposed models are approbated for conceptual modelling of a particular subject domain of study – the domain of computer programming.

Based on the proposed accumulative frame model [D8], the next paper [E12] ("*Framework Models in Programming Training*") introduces a system of accumulative frame models in "Programming" subject area, in the context "C++ programming Language" for the aspect "Learning the syntax of the language". The system consists of 20 accumulative frame models for studying the syntax of C ++ programming language operators. Based on the created system for studying simple and composite operators in C ++ programming language, a set of tasks has been created, divided into four main groups: Group 1. Analysis of unknown program code to find operators in C++ language and creation of frame-instances based on frame-prototypes of the operators in the program code; Group 2. Detection of syntactic errors in program code; Group 3. Creating syntactically correct program code based on a completed frame-instance; Group 4. Modification of unknown program code using the slot values of frame-instance.

[D9] ("*Verification of Accumulative Frame System in Programming Training*") presents results of the experiments performed on the applicability of a system of 36 accumulative frame models for programming training. The system was experimented among full-time students studying C++ programming language. The system is put to verification to be checked whether it fulfils the intended purpose to provide a formalism for conceptual modelling in the subject domain. The verification of the system relies on the comparison of the results of students (divided into three groups) who solve tasks with the same conditions (in two of the groups using the system of accumulative frame models and in one of the groups using traditional approaches to solving). The results of the verification proved that the proposed system of accumulative frame models provides an appropriate formalism for conceptual modelling and is applicable in training and facilitates the assimilation and understanding of the learning material.

[E15] ("*Computer Modelling Environment for Accumulative Framework Models for E-Learning")* presents a software environment for designing frame-prototypes and frame-instances with slots of various types, called CumuFormo. CumuFormo supports databases and facilitates the modelling of pedagogical scenarios as e-learning workflows. The main functionalities of CumuFormo are designing frame-prototypes with slots of various "built-in" type; creation of frame-instances based on existing frame-prototype; maintenance of frame-prototypes and frame-instances databases; modelling and realization of pedagogical scenarios for sets of frame-prototypes and frame-instance.

The accumulative frame model proposed in [D8] serves as a basis for automating e-learning by applying tools for extracting, summarizing and accumulating data and knowledge for educational purposes. Based on the proposed accumulative frame model, the information and computer models presented in [D10] ("*A Software Tool for Programming Training Trough Accumulative Frame System*") and a software tool for data extraction and aggregation have been created. The software tool has been developed as a web and mobile application. It allows automation of some learning activities, including filling in frame-instances, accumulating created instances in a database with good and bad examples, generating tasks, assessing students' knowledge. The tool allows teachers to create systems of accumulative frame models, declare frame-prototypes, create frame-instances of already declared frame-prototypes, create tasks in six categories (defined in [D9]), approve frame-instances created by students and store them in a database, to generate new tasks for the next training course. Additional categories of tasks can be implemented in the tool, which will allow students to define the elements of the algorithm used to solve the task, define and invoke multiple test scenarios for automated testing of the task they solve, define test scenario as a set of test items, test task solution based on the test scenarios.

[E19] ("Accumulative Frame Models for Extraction and Aggregation of Data on Knowledge and Processes in Learning") presents the results of a study conducted within the scientific project. The Project proposes, researches and tests tools (based on an accumulative frame model) for conceptual description and methodology for data extraction and aggregation, which are suitable for preparation and implementation of e-learning. The main result is the creation of methodology and software tools for extracting and aggregating data on knowledge and processes related to the automation of teaching activities. Several significant results have been achieved, including:

- comparative analysis of known frame models, modern methods, tools (including automated) and practices for the application of frame representations in the field of training and analytical review of typical training tasks (in particular for preparation and implementation of e-training), suitable for automation with an application of frame representations;
- an accumulative frame model has been introduced;
- information and computer models for data extraction and aggregation and automation of e-learning tasks have been developed.

[D5] ("*Business Process Modelling & Execution Application in Work Education Domain*") presents a workplace-based approach towards work-place education. Proprietary workflow description and execution environments are used to create a certain application. To overcome existing difficulties and functional deficiency in reviewed systems and approaches, the approach uses a specific modular structure, which contains six modules. Thus, multiple process engines utilization features are proposed. Future development in the field of Adaptive Learning Process Generation is envisioned as well.

The main contributions to Scientific Field III. are:

- analysis of the possibilities for integration of web technologies and Moodle is done;
- a successful experiment was conducted to integrate Moodle with a university information system;
- an innovative accumulative frame model is proposed;
- a system of 36 accumulative frame models for learning the syntax of the C++ programming language is created;
- information and computer models for data extraction and aggregation and automation of e-learning tasks are developed;
- a software tool for programming training using accumulative frame models is developed.

IV. Pedagogical and social design of e-learning

There are two different approaches to organize, conduct and manage the learning process in practice - conditionally called traditional learning and open learning. The majority of trainees and teachers have experience in traditional training. In this type of training, students spend much of their time attending lectures, seminars and consultations led by lecturers, at a pre-specified place and at a specific time. The local and closed nature of traditional education has a negative impact on its quality and accessibility. The dynamic development of modern technologies has contributed to the creation of new organizational structures and educational forms. Traditional teaching methods have become the basis for the development of others - modern and flexible educational forms based on e-learning and distance learning.

[A1] ("*Quality and evaluation of e-learning*") addresses issues related to the organization and conduct of e-learning. The monograph presents various forms of education in the information society. It discusses 10 aspects of e-learning (Philosophical, Socio-economic, Methodological, Technological, Cognitive-psychological, Information, Technical, Ergonomic, Legal, Organizational) and indicate how each of them is affected in the monograph. Special attention is paid to the main stages of e-learning and the activities that take place at each stage.

Special attention is paid to the main differences between distance and traditional learning, the target groups of distance learning are indicated, the basic concepts, elements and principles of distance learning are derived, and the definitions of the term distance learning are systematized.

Best practices and the positive experience of the authors in creating documentation for e-learning are presented in the form of recommendations - documentation for e-courses, e-resources and activities (Technology Card, Cards for e-course and e-resource, E-course schedule, Cards for multimedia elements), accompanying documents and a specialized guide. The recommendations made are also useful for creating training documentation for distance learning.

The main types of teaching materials and resources for e-learning are considered and in the form of recommendations to authors/teachers of resources for e-learning are presented best practices for creating e-resources, e-courses and e-textbooks.

For each of the main components of the e-learning process (teaching, learning and assessment), best practices are presented that help teachers to organize e-learning.

Models of documents, cards of e-courses and e-resources, questionnaires for quality evaluation and accompanying documents are offered.

Special attention is paid to issues related to the organization of distance learning in Bulgarian universities. Special attention is paid to main issues related to the accreditation of distance learning, preparation of educational documentation, organization, conduct, evaluation, management and administration of distance learning.

The organization of contemporary education is carried out through the increasingly active implementation of e-learning. Therefore, there is a growing need to develop and use intelligent technological solutions suitable for training at all education levels.

There are different types of software and software licenses that have advantages when used in the education system. Free software is an alternative to commercial software, so it is often used in education. [B1] ("*Free software in e-learning*") discusses software types and licenses, popular software products distributed as free software in Bulgarian education - operating systems, browsers, office suites, systems for learning management and creation of learning content, digital repositories, tools for prevention of plagiarism, etc.

Contemporary web technologies are increasingly used in training courses. In recent years, teachers face the challenge to successfully introduce the use of these technologies in the learning process. In this regard, in [B1] ("*Free software in e-learning*") special attention is paid to freely and widely used modern technologies for collaboration, communication, conferencing and sharing, for social activities and personal training. For each of the considered technologies, an analysis of possible applications in the field of education is made from two stakeholders' points of view - trainees and teachers. Special attention is paid to the most popular software tools which Google provides to teachers and students.

In recent years with the development of modern web technologies and their use in all spheres of human activity, software tools for teaching, learning, assessment and management have become widespread. Among them, Moodle is widely used in the educational systems of many countries (including Bulgaria). [B1] discusses the main features of Moodle.

The results of the study for the integration of innovative educational technologies are applied in the practical development of the "Spreadsheets" e-course (http://pdu.uni-plovdiv.bg/) and presented in [E2] ("*Social Networking in the Information Technology Training*"), [E6] ("*Web 2.0 Technologies in Learning*") and [B1] ("*Free Software in e-Learning*"). [E2] presents a part of the study, which shows how social networks can improve the results of learning activities (assessment of the knowledge, individual work, presentation of learning resources, etc.) in an e-course "Spreadsheets". [D6] focuses on the possibilities for using social bookmarking sites. The final result (presented in [B1]) is a complete (20 thematic modules, 398 tasks and cases for self-assessment and knowledge testing) e-course "Spreadsheets", showing the implementation of ideas of e-Learning 2.0 (including 31 ways for the integration of 11 web tools in 47 learning activities). Another distinctive feature of the created e-course is the systematic application (in the theoretical part) of the so-called 'invariant principle' of teaching. The essence of this principle is to present the teaching material in a way that is not limited and does not refer to the current state (company, version, etc.) of the software that illustrates the topic.

[B1] presents two other e-courses - "Free software in education" and "Moodle", which can be especially useful for teachers who prepare e-learning resources for disciplines in traditional and distance learning forms, developed with the use of free software (Moodle and web tools).

In recent years, there has been significant academic and research interest in the use of social networks for educational purposes. There is also a tendency towards a more formal acceptance of their role in higher education from participants in the educational process. Within the study for the application of social networks in education, a survey among students and teachers is conducted. The study aims to explore the attitude of teachers and students towards the use of social networks in the learning process. For the collection of primary data, a questionnaire that contains 18 question in a 5-point Likert scale is developed. The questionnaires have been prepared in such a way that without being time-consuming to complete, to give a clear and accurate picture of attitudes towards the extent and scope of the use of social networks by teachers and students for teaching and learning. The results of this study are presented in [E3], [D1], [D6] and [C1].

[E3] ("*Towards Formal Acceptance of Using Social Networking in Higher Education*") presents the summarized results of the study conducted in Bulgaria with 60 teachers and 128 students. Results show that in Bulgaria, the tendency to use social networks in education is towards official acceptance by the academic community. Although only 60% of the surveyed teachers use social networks and mostly for communication with their students, 80% of them believe that social networks are useful for educational purposes and their role will become more significant in the coming years. Quite logically, students show is a high degree of positive attitude in this regard. The reason for this is the fact that students use social networks in their daily lives with enthusiasm. For them, social networks are a natural way for communication, information sharing and discussions on various topics.

Detailed results of the survey on the attitude to social networks by teachers and students in Bulgaria are presented in [D1] ("*Social Media in Bulgarian Higher Education: An Exploratory Survey*"). The answers are analysed according to the academic position of teachers/educational degree of students and their age. The results show that most assistants in the age groups 25-34 and 45-54, associate professors in the age group 35-44 and professors in the age group over 55 have a positive attitude towards the use of social networks in their educational practice (average grades above 3). Most teachers, regardless of their academic position and age, believe that social networks could be useful for education and their role will increase in the coming years. In general, the attitude of students is positive - only students from bachelor programs in the age groups 25-34 and 35-44 years and from master programs in the age group 25-34 years are not willing to use social networks for communication with their teachers. Master students in the age group 25-34 are reluctant to use social networks to contact with people with similar interests.

[D6] ("*The Attitude Towards and the Use of Social Networking in European Higher Education: An Exploratory Survey*") presents results of the survey among 5,907 teachers from 37 European countries. The study seeks answers to 3 research questions: whether the use of social networks by teachers is related to their awareness of social networks (Question 1), their participation in interest groups and research on the use of social networks in education (Question 2). and whether the summarized results of the survey vary in different European countries (Question 3). In general, teachers do not use social networks in their teaching practice (average grade 2.63), but they have a positive attitude towards the use of social networks for educational purposes. Statistical hypotheses are tested to answer the research questions. The results show that there is a relationship between awareness of social networks and their use in teaching practice, participation in interest groups and the extent of the use of social networks in teaching practice.

[C1] ("*Chapter 26. Human Attitude Towards the Use of IT in Education: Academy and Social Media*") presents the results of a large-scale study among 19,987 teachers from 75 countries. The survey aims to investigate to what extent and for what purposes teachers from different countries around the world use social networks in their teaching practice. Globally, as in Europe [G6], teachers do not use social networks in their teaching practice (average grade 2.58) but have a positive attitude towards the use of social networks for educational purposes. The results are compared with the results of the study conducted in Bulgaria [E3, D1]. The results of the comparison show that teachers in Bulgaria use more social networks to communicate with students, share information, conduct discussions and organize training compared to their colleagues. On the other hand, teachers use more social networks during lessons and participate more actively in groups for the application of social networks for educational purposes than their counterparts in Bulgaria. The results of an in-depth analysis show that teachers who are familiar with social networks and participate in interest groups for the application of social networks for educational purposes use more social networks in their teaching practice than their colleagues. All results are also analysed by continent.

[E13] ("*An Attempt of Project-based Learning in e-Learning*") presents an attempt to conduct project-based training in a course in a master programme. A pedagogical approach is proposed in which the individual tasks of projects are combined with collaborative activities or assignments. The planned individual and collaborative activities are performed every week during the training course. The course is carried out with students from the University of Plovdiv. The obtained results are analysed, and some measures for improving the quality of training are formulated.

The main contributions in Scientific Field IV. are:

- a package of models of documents for organizing and conducting e-learning and distance learning is proposed;
- best practices for creating e-resources, e-courses and e-textbooks are suggested;
- best practices for the organization of the learning process are offered.
- an analysis of the applications of contemporary technologies in training - for the needs of teachers and students;
- an e-course for training in "Spreadsheets" was developed, presenting the realization of the ideas of e-Learning 2.0 with integrated 11 web tools in 47 learning activities;
- the results of a large-scale study on the application of social networks for educational purposes with 19,987 participants from 75 countries were analysed.

V. Textbooks and e-courses

F1. R. Doneva, **S. Gaftandzhieva**, *Object-oriented design and programming (with C++ examples)*, University Press "PaisiiHilendarski", ISBN 978-619-202-520-5, 325 p., 2020, https://plus.bg.cobiss.net/opac7/bib/38435848.

This textbook is intended for use in the study of disciplines related to the application of the object-oriented approach to creating software systems by students of the University of Plovdiv "Paisii Hilendarski" in all study programmes for which the curriculum requires it. The textbook could be used in other universities, as well as for self-study of the discipline. It would be useful for system designers who will find recommendations for the transition from the initial specifications of the task to its program implementation using the methods of object-oriented analysis and design. It can also be used by

programmers who will find recommendations for the effective use of object-oriented concepts and programming languages in solving practical tasks.

Readers gain knowledge that allows them to study the theory and practice of developing software systems with the application of object-oriented principles. As a result of the in-depth study of the topics included in the textbook, students will be able to use and apply the basic concepts, tools and methods of object-oriented design and programming in creating or evaluating specific object-oriented program systems.

The textbook consists of an Introduction, 9 Chapters and 10 Appendices. Each topic is related to one of the seven basic principles of Object-oriented programming, the formulation of which is a definite contribution to the practice of designing complex software systems. It is important to note that in the theoretical examination of the principles of the Object-oriented programming and related concepts, an attempt has been made to clarify them in general, beyond their dependence on specific programming languages.

The material is supported with examples and solved tasks for design and programming of C++. Each chapter ends with questions, tasks and projects for self-work.

G1. G. Totkov, **S. Gaftandzhieva**, R.**Doneva***, E-Learning Systems*, https://e-learning.uni-plovdiv.bg/course/view.php?id=243

The e-course is intended for Master students from E-learning study programme. It introduces students to e-learning systems and virtual universities and presents their architecture and components. Special attention is paid on users, groups and roles in e-learning systems and types of typical learning activities and resources. The possibilities for personalization of the trainees' learning path through conditional activities and tools for automation offered by the e-learning environments are presented in detail. The presentation is in line with the necessary competencies that experts in the field must-have.

G2. G. Totkov, R.Doneva**, S. Gaftandzhieva**, *E-learning methodology*, https://e-learning.uni-plovdiv.bg/course/view.php?id=242

The e-course is intended for Master students from E-learning study programme. It introduces students to the methodology of e-learning. The specific requirements of e-learning in the following aspects are considered: teaching materials and resources for self-preparation, training documentation, conducting, providing and maintaining training. The practical classes include acquaintance and consideration of examples of teaching materials, learning resources, courses, training documentation, etc., developed according to the methodology of e-learning.

The presentation is in line with the necessary competencies that experts in the field must have. It includes tasks that stimulate students to analyse and synthesize methodological approaches to e-learning in different situations (context), as well as to conduct research and analysis of good practices with an indication of digital learning activities.

G3. G. Totkov, R.Doneva**, S. Gaftandzhieva**, *E-learning management*, https://e-learning.uni-plovdiv.bg/course/view.php?id=241

The e-course is intended for Master students from E-learning study programmes. It aims to acquaint students with ways to organize and manage e-learning. The following aspects are considered:

normative and educational documentation, identification of the trainees, creation of a business plan, organization of the training in the different stages, application and enrolment, necessary team for organizing and conducting the e-learning, training and providing learning content, maintenance of the learning process, assessment of trainees, dealing with plagiarism and attempted fraud, communication, technical and administrative services, issuance of a diploma/certificate and evaluation of the quality of the training.

G4. R. Doneva**, S. Gaftandzhieva**, *ICT in the education*, https://e-learning.uni-plovdiv.bg/course/view.php?id=212

The e-course is intended for Master students from E-learning study programme. It acquaints the trainees with the stages in the development of ICT for education, with the European initiatives and state policy in this direction, with the different forms of learning in the information society and types of educational software. Special attention is paid to information and communication technologies (ICT) and systems useful for education - preparation of text documents, graphics, tables, data organization and automatic processing, creation of multimedia documents and Web -pages. The most popular and useful information and communication services and means for publishing and exchange on a network are considered. An examination of modern technologies and software tools in the context of new educational trends is included.

G5. **S. Gaftandzhieva**, *Contemporary web technologies and applications*, https://e-learning.uni-plovdiv.bg/course/view.php?id=268

The e-course is intended for students from the Faculty of Mathematics and Informatics. It introduces students to contemporary web technologies, which represent the next fundamental change in how websites are created and how people interact with them. Central to the study are technologies related to Web 2.0 and Web 3.0 (semantic Web). Web accessibility issues are also covered. Particular attention is paid to web technologies and relevant applications for collaboration on e-resources; group work; development of blogs, wikis, podcasts, e-portfolio; semantic search; marking, social bookmarking, etc.

G6. G. Totkov, **S. Gaftandzhieva**, *Project management*, https://e-learning.uni-plovdiv.bg/course/view.php?id=97

The e-course is intended for students at the Faculty of Mathematics and Informatics, Informatics study programmes. The e-course introduces students to the main stages of project development and management. It presents the logical phases of the design process, teamwork, resource management, cost optimization, etc. Special attention is paid to the methods and means for preparation, development, presentation, defence and project management. It presents European initiatives for financing projects in priority areas, especially those related to the development of the information society.

The e-course discusses the possibilities of the project management software Project. Students gain knowledge that allows them to create a project work plan, tasks, to add resources (human, material, cost), to assign tasks to human resources, to format and share a project work plan, to monitor project implementation. In addition to the main topics listed above, the manual also discusses the possibilities

of Project for additional allocation of tasks, precise adjustment of the task implementation and resources, detailed organization of the project plan, data export to other programs.

G7. R.Doneva,**S. Gaftandzhieva**, *Open software for Education*, https://e-learning.uni-plovdiv.bg/course/view.php?id=112

The e-course is intended for Master students from E-learning study programme. It acquaints students with a wide range of software tools and contemporary information and communication technologies (including how to work with them), which can be used in various forms of training and at different stages of its implementation and provision, in the context of new educational trends.

Special attention is paid to free software systems for the preparation of e-learning materials and resources (text, graphics, spreadsheets, multimedia, interactive, etc.), in conducting and providing e-learning (including assessment), when working in teams, etc.

Central to the study are Web 2.0 and 3.0 technologies, which represent the next fundamental change in how websites are created and, more importantly, how people interact with them. The trainees in the course have the opportunity to deepen and expand their knowledge and skills for practical work with the studied tools for creating e-resources and conducting training by working on course assignments.

G8. S**. Gaftandzhieva**, *Introduction to Computer Science (Exercises)*, https://e-learning.uni-plovdiv.bg/course/view.php?id=270

The e-course is intended for students from the bachelor's programs "Informatics" and "Business Information Technology" at the Faculty of Mathematics and Informatics. It aims to help students to acquire practical skills for designing, implementing and testing elementary algorithms in a modern programming environment. The emphasis is on basic algorithms using simple data types and representing cyclic processes.

G9. R.Doneva**, S. Gaftandzhieva**, *Algorithms and Data structures*, https://e-learning.uni-plovdiv.bg/course/view.php?id=272

The e-course aims to acquaint students with basic algorithms and data structures. The most common and useful algorithms (search, sorting, recursion, iteration, work with the studied data structures) are considered. Particular attention is paid to data structures (stacks, queues, linked lists, hash tables, trees and graphs), their presentation, operations on them and the algorithms that implement them. Approaches to analysis and compilation of algorithms, strategies for selection of abstract data types and for increasing the efficiency in the implementation of specific algorithms are considered.

The theoretical material is illustrated with many examples that support the practical mastery of the studied principles and concepts by programming in a specific programming language.

G10. R.Doneva**, S. Gaftandzhieva**, *Programming technology*, https://e-learning.uni-plovdiv.bg/course/view.php?id=153

The e-course aims to familiarize students with the basic concepts of programming. Special attention is paid to the methods of structural programming and in particular to control structures

(sequence, selection, repetition), procedural and data abstraction (data types and structures and their representation). One of the most common modern paradigms for the design and implementation of software systems - object-oriented programming - is presented in depth.

G11. R.Doneva*,* **S. Gaftandzhieva,***Client-side web programming*, https://e-learning.uni-plovdiv.bg/course/view.php?id=285

The e-course "Client-side web programming" provides the trainees with the knowledge and practical skills for developing modern websites with HTML 5, CSS 3 and JavaScript technologies. The e-course is suitable for both beginners and advanced trainees who are interested in web design and website development. The guide includes topics for introduction to the Internet, TCP/IP, client-server systems, WWW, and web application development languages. Themes related to the basic concepts and elements of HTML, text content, tabular and multimedia content, JavaScript scripts, CSS styles, dynamic web pages, etc. are discussed in detail.

G12. **S. Gaftandzhieva**, *Object-Oriented Design and Programming (with C++ examples)*, https://e-learning.uni-plovdiv.bg/course/view.php?id=302

The e-course is intended for students in bachelor's programs at the Faculty of Mathematics and Informatics. It aims to familiarize students with the object-oriented paradigm for the design and implementation of software systems, the principles of object-oriented programming and basic concepts of the object-oriented approach. Special attention is paid to the main methods of object-oriented analysis and design, as well as tools for presenting object-oriented models. The object-oriented possibilities of the C++ language are considered in detail. As a result of the in-depth study of the included topics, students will be able to use and apply the basic concepts, tools and methods of object-oriented design and programming in creating or evaluating specific object-oriented programs. The learning content is richly illustrated with examples of C++.

The main contributions in Scientific Field V. are:

- 1 textbook for students, system designers and application programmers has been created;
- 12 e-courses for online learning in disciplines E-learning system, E-learning methodology, E-learning management, ICT in education, Contemporary web technologies and applications, Project management, Open software for Education, Introduction to Computer Science (Exercises), Algorithms and Data structures, Programming technology, Client-side web programming, Object-Oriented Design and Programming (with C++ examples) have been developed.

II. Abstracts

Monographs and book chapters

A1. **S. Gaftandzhieva**, G. Totkov, R. Doneva, *Quality and evaluation of e-learning*, University Press "PaisiiHilendarski", ISBN 978-619-202-538-0, 2020, 425 p.

The monograph aims to support different stakeholders at different stages of the e-learning lifecycle, providing recommendations and good practices for preparing training documentation, for designing and conducting e-learning and for quality assurance and evaluation of the training.

The application of innovative educational technologies does not guarantee a quality educational process, as well as a convincing result. To provide opportunities for ensuring and improving the quality

and effectiveness of teaching and learning, the monograph proposes an approach to intelligent analysis of e-learning data. In this regard, stakeholders in the field of higher education have been identified and relevant models with a set of indicators for each of them have been proposed. Special attention is paid to the development of tools for quality monitoring and assessment of the degree of institutional digitalization. A formal model and architecture of an automated system for dynamic quality assessment are proposed, and functional and non-functional requirements to it are formulated. The monograph presents models of documents, standards, questionnaires, etc., developed by the authors and implemented in the University of Plovdiv "PaisiiHilendarski", which accompany the e-learning lifecycle.

The monograph is useful for e-course authors, teachers, e-learning organizers and quality assurance managers working in educational institutions of all educational levels.

B1. G. Totkov, G. Kiryakova, N. Angelova, R. Doneva, **S. Gaftandzhieva**, *Free software in e-learning*, Rakursi Ltd., ISBN: 978-954-8852-44-9, 2014 (co-author of all chapters without Chapter 4).

In recent years with the development of modern web technologies and their use in all spheres of human activity, software tools for teaching, learning, assessment and management have become widespread. The monograph discusses software types and licenses, popular software products distributed as free software in Bulgarian education - operating systems, browsers, office suites, systems for learning management and creation of learning content, digital repositories, tools for prevention of plagiarism, etc. Special attention is paid to freely and widely used modern technologies for collaboration, communication, conferencing and sharing, for social activities and personal training. For each of the considered technologies, an analysis of possible applications in the field of education is made from two stakeholders' points of view - trainees and teachers. The main features of Moodle are discussed. Following the new trends in the development of e-learning, the possibilities for integration of the system with external systems, such as digital repositories, information systems, popular web technologies, have been studied and presented. The results of the study for the integration of innovative educational technologies have been applied in the practical development of an e-course "Spreadsheets" for training in information technology. The final result is complete (20 thematic modules, 398 tasks and cases for self-assessment and knowledge testing) e-course "Spreadsheets", presenting the implementation of ideas of e-Learning 2.0 (including 31 ways to integrate 11 web tools in 47 learning activities). Another distinctive feature of the created e-course is the systematic application (in the theoretical part) of the so-called 'invariant principle' of teaching, the essence of which is to present the teaching material in a way that is not limited and does not refer to the current state (company version, version, etc.) of the software that illustrates the topic. The monograph also presents two other e-courses - "Free software in education" and "Learning Management System Moodle". This courses can be especially useful for teachers who prepare e-learning resources for disciplines with similar learning content in traditional and distance learning forms developed using free software (Moodle and web tools).

C1. **S. Gaftandzhieva**, R. Doneva, *Chapter 26. Human Attitude Towards the Use of IT in Education: Academy and Social Media*, Handbook of Research on the Role of Human Factors in IT Project Management (ed. Sanjay Misra and AdewoleAdewumi), ISBN: 9781799812791, DOI: 10.4018/978-1-7998-1279-1.ch026, pp. 501-523, 2020.

This chapter aims to explore the human attitude towards the use of IT in education, especially teacher attitudes towards the use of social media in teaching practice. The study is based on a survey questionnaire, which aims to investigate to what extent and for what purposes teachers from different countries from all over the world use social networking in their teaching practice. The chapter presents the method (an exploratory survey using questionnaire for data collection), organization of the study, and thorough analyses of the results in accordance with the study objectives. Finally, summarized results of the survey are presented, depending on the continent where the countries of the participants are located. The analysis of the survey results is presented on the basis of valid responses of 19,987 teachers from 75 countries around the world who participated in the survey.

Scientific publications

D1. R. Doneva, **S. Gaftandzhieva**, *Social Media in Bulgarian Higher Education: An Exploratory Survey*, International Journal of Human Capital and Information Technology Professionals (IJHCITP), ISSN: 1947-3478, Vol. 8, Iss. 4, pp.67-83, 2017, SCOPUS, SJR = 0.28.

Although many teachers are sceptical and think that the use of social media can disengage students and lead to lower results, we have witnessed increasingly widespread use of social networks in the educational environment. In recent years, there is also a trend towards more formal acceptance of the role of these networks in higher education by participants in the educational process. The study presented in this paper is intended to seek clarity on the development of this trend in Bulgaria. On the one hand, it aims to assess the extent to which the use of social networking for educational purposes shall be formally accepted by the two main groups of participants in the educational process (students and teachers) and to what degree it is still informal. On the other hand, the study explores specific areas of the use of social networking in higher education, with an emphasis on their efficacy.

D2. R. Doneva, **S. Gaftandzhieva**, G. Totkov, *Automated Quality Assurance of Educational Testing*, The Turkish Online Journal of Distance Education (TOJDE), ISSN 1302-6488, Vol. 19, No. 3, pp. 71- 92, 2018, SCOPUS, SJR = 0.223.

This paper presents a study on known approaches for quality assurance of educational test and test items. On its basis a comprehensive approach to the quality assurance of online educational testing is proposed to address the needs of all stakeholders (authors of online tests, teachers, students, experts, quality managers, etc.). According to the proposed approach is developed an original software application Test Quality Evaluation (TQE) for the automation of the stakeholders' activities for quality assurance of educational tests throughout the whole lifecycle. The application retrieves and provides analysis of data from online tests conducted and specially designed surveys for quality evaluation of educational tests by students and experts. It allows tracking and evaluating the quality of educational tests in real time and provides the related quantitative data in different levels of generalization – in the level of a separate educational test, of educational tests of an entire course, or educational tests of a subject area. The software application has been put under real-time testing for quality evaluation of educational tests, included in e-learning courses from different subject areas that prove its applicability.

D3. **S. Gaftandzhieva**, R. Doneva, G. Totkov, *Dynamic Quality Evaluation in Higher Education*, TEM Journal, ISSN: 2217-8309, Vol.7, No.3, pp. 526-542, 2018, SCOPUS, SJR=0.148.

The paper aims to propose, investigate and test suitable means for automation of the processes for dynamic quality evaluation of objects in a given subject area. On the basis of the theoretical study a number of conceptual and computational models are proposed. In consequence, the architecture of a software system for dynamic quality evaluation is defined and a corresponding software prototype is built over an existing university information infrastructure. General models are applied for dynamic quality evaluation of different objects in the field of higher education.

D4. **S. Gaftandzhieva**, R. Doneva, *Toward a Learning Analytics System in Bulgarian Higher Education Institutions*, TEM Journal, ISSN: 2217-8309, Vol.8, No.3, pp. 1058-1062, 2019, SCOPUS, SJR=0.148.

The paper presents a study in the area of Learning Analytics – a scientific field that is still in a relatively early stage of study in Bulgaria. The study aims to offer, develop and test software tools for Learning Analytics that will improve the learning outcomes in the field of higher education. Using data mining methods for analysis the data produced in the learning process (extracted from different data sources), intelligent software tools will be developed to improve the quality of outcomes in different elements of the learning process (learning, teaching, monitoring, etc.), and for the needs of different stakeholder groups.

D5. G. Pashev, L. Rusenova, G. Totkov, **S. Gaftandzhieva**, *Business Process Modelling & Execution Application in Work Education Domain*, TEM Journal, ISSN: 2217-8309, Vol.8, No.3, pp. 992-997, 2019, SCOPUS, SJR=0.148.

This paper describes a workflow based approach towards work-place education. Proprietary workflow description and execution environments are used to create a certain application. In order to overcome existing difficulties and functional deficiency in reviewed systems and approaches, we designed a specific modular structure, which contains six modules. Thus, a multiple process engines utilization feature is proposed. Future development in the field of Adaptive Learning Process Generation is envisioned as well.

D6. **S. Gaftandzhieva**, R. Doneva, *The Attitude Towards and the Use of Social Networking in European Higher Education: An Exploratory Survey*, International Journal of Virtual and Personal Learning Environments, ISSN: 1947-8518, Vol. 10, Iss. 1, pp. 51-69, 2020, SCOPUS, SJR=0.112.

Nowadays, social networking is becoming a more and more powerful tool for students for communication, sharing of information and discussions on various topics. The study presented in this article investigates the extent to which teachers from different European countries use social networking sites in their teaching practice for different purposes and what their attitude is towards the use of social networking in higher education in general. The analysis of the survey results is presented on the basis of valid responses of 5907 teachers from 37 European countries. The study is intended to seek clarity on the issues, whether the use of social networks is related to teacher information about social networking sites; their participation in interest groups and research for the use of social networks in education; and whether the results obtained from the survey vary according to the country. For this

purpose, the statistical software IBM SPSS Statistics is used. On the other hand, the study explores specific areas of the use of social networking in higher education, with an emphasis on their efficacy.

D7.**S. Gaftandzhieva**, R. Doneva, S. Petrov, G. Totkov, *Mobile Learning Analytics Application: Using Students' Big Data to Improve Student Success*, International Journal on Information Technologies & Security, ISSN 1313-8251, Vol. 10, No. 3, pp. 53-64, 2018, Web of Science.

Nowadays, big data is becoming more and more important in the field of education. The huge amounts of data generated by the participants in the learning processes led to increased interest in the collection and analysis of student data to support and obtain insight into the students' learning activities. This formed a new research field, known as Learning Analytics. The paper focuses on solutions of some problems related to technological considerations in Learning Analytics. It proposes a set of indicators that Learning Analytics should provide to help students to meet their learning goals and to improve their success. The mobile application Mobile LAP that allows students to trace out the values of the indicators during training is developed. Using Mobile LAP students are able to keep track on their own activity, success rate, adherence to the learning schedule.

D8. R.Doneva, **S. Gaftandzhieva**, G. Totkov, *Frame Representations in e-Learning – Applications and New Developments*, International Journal on Information Technologies & Security, ISSN 1313-8251, Vol. 10, No 2, pp. 23-32, 2018, Web of Science.

The use of frame-based knowledge representations in training methods has a long history. The paper presents a part of a study on the application of frame-based computer representations of knowledge for the needs of e-learning. It proposes an innovative modification of frame models, called accumulative frame model (AFM). The AFM is a development of the classical understanding of a frame model, and therefore has all its typical features, but beside the possibilities for knowledge representation, it also adds to the model the means for knowledge accumulation. This provides a particular flexibility in the implementation of processes for automated extraction and aggregation of data and knowledge for training needs. In addition, a model of a system of AFM is introduced, with the purpose of conceptual representation of knowledge in separate subject domains. The proposed models are approbated for conceptual modelling of a particular subject domain of study – the domain of computer programming.

D9. **S. Gaftandzhieva**, R. Doneva, *Verification of Accumulative Frame System in Programming Training*, Pedagogy, ISSN 0861 – 3982, Vol. 91, No. 7, pp. 982-993, 2019, Web of Science.

The paper presents a part of a study conducted for the needs of e-learning on the application of frames for representation of knowledge and processes in training on a particular subject domain. As a result of the study the classical notion of the frame models is developed further and the so-called accumulative frame model is proposed. The main rationales for the introduction of the accumulative frame model are: (1) to provide a formalism for conceptual modelling in subject domains and (2) to serve as a basis for automation of e-learning and e-training activities by implementation of intelligent tools for extraction, aggregation and accumulation of data and knowledge for educational needs. A system of 36 accumulative frame models and its verification for fulfilment of the intended purpose in the rationale (1) are presented.

D10. R. Doneva, **S. Gaftandzhieva**, G. Pashev, G. Totkov, *A Software Tool for Programming Training Trough Accumulative Frame System*, International Journal of Scientific & Technology Research, Vol. 9, Iss. 2, pp. 1389-1393, 2020, SCOPUS.

The paper presents a part of a study on the application of frames for the representation of knowledge and processes in programming training. The proposed accumulative frame model serves as a basis for automation of e-learning and e-training activities by the implementation of tools for extraction, aggregation and accumulation of data and knowledge for educational needs. The created on its basis information and computer models and a software tool for data extraction and aggregation are depicted.

D11. **S. Gaftandzhieva**, R. Doneva, G. Totkov, *Quality Evaluation in Higher Education: Dynamic Data Accumulation and Aggregation*, International Journal of Scientific & Technology Research, Vol. 9, Iss. 2, pp. 3275-3279, 2020, SCOPUS.

The paper presents a comprehensive approach for quality evaluation of higher education through data accumulation and aggregation. The proposed approach is tested for data accumulation and aggregation for NEAA criteria systems in Bulgaria. For this purpose, the criteria systems that this agency applies for quality evaluation in higher education are analysed. The possibilities for automated data accumulation and aggregation from different university information systems are explored. Experiments have been carried out to automate evaluation and accreditation procedures in a Bulgarian higher education institution.

E1. R. Doneva, **S. Gaftandzhieva**, Zh. Doneva, N. Staevsky, *Software Quality Assessment Tool Based on Meta-Models*, International Journal of Computer Science and Mobile Computing, ISSN 2320–088X, Vol.4, Iss. 5, pp. 574-590, 2015.

In the software industry it is indisputably essential to control the quality of produced software systems in terms of capabilities for easy maintenance, reuse, portability and others in order to ensure reliability in the software development. But it is also clear that it is very difficult to achieve such a control through a 'manual' management of quality. There are a number of approaches for software quality assurance based typically on software quality models (e.g. ISO 9126, McCall's, Boehm's and Dormey's models) and software quality metrics (e.g. LOC, McCabe's cyclomatic complexity, Halstead's metric, Object-oriented metrics) for assessment of various quality characteristics. Since the appearance of the software quality assurance as a field in the software engineering, researchers have been looking for ways to automatically assess and manage the quality of the software systems. This paper presents a conceptual design of a comprehensive solution, referring to the automation of the software quality assessment process. The designed software tool allows the definition of software quality models, based on standards, and enable the setting of matching between criteria of a software quality model and appropriate software quality metrics. The automatic definition and application of software quality models and software quality metrics is based on relevant supported by the software tool meta-models proposed in the paper.

E2. R. Doneva, **S. Gaftandzhieva**, *Social Networking in the Information Technology Training*, e-Learning'15 Proceedings of the International Conference on e-Learning, ISSN 2376-6698, pp. 190-196, 2015.

The paper is related to exploration of a didactical model that relies on the new Web technologies to realise the idea of e-Learning 2.0 for training in the field of Information Technology. For the exploration of the didactical model a specially designed e-learning course in Spreadsheets is developed and Web technology tools are integrated to support increasing the learning effects of different training activities. The paper presents a part of the study that shows how the social networking sites can be used to improve different learning effects of different training activities (knowledge assessment, individual work, presentation of primary and supplementary learning resources, etc.) in the Spreadsheet e-learning course.

E3. R. Doneva, **S. Gaftandzhieva**, *Towards Formal Acceptance of Using Social Networking in Higher Education*, e-Learning'16 Proceedings of the International Conference on e-Learning, ISSN 2376-6698, pp. 176-181, 2016.

In recent years there has been extensive academic and research interest in the use of social networking for educational purposes. There is also a trend towards more formal acceptance of their role in higher education by participants in the educational process. The article presents the results of a survey on attitudes towards (in the direction from informal to formal use) the extent and scope of application of social networking in teaching and learning by teachers and students in Bulgaria.

E4. **S. Gaftandzhieva**, N. Kasakliev, R. Doneva, *Mobile Application for Quality Evaluation of Learning*, QED'16: Technology Advanced Quality Learning for ALL, ISBN 978-619-185-261-1, pp. 32-49, 2016.

The paper proposes an alternative to the traditional way of conducting surveys within internal university systems for quality assurance using mobile technologies in order to increase the students' activity. An analysis of the needs of internal university quality systems in conducting surveys as well as an overview of existing software tools for conducting mobile surveys have been made. After specifying the functional and non-functional requirements the mobile application for conducting surveys for the purposes of internal systems for quality assurance of higher education has been developed. The developed mobile application allows conducting surveys within university systems for quality assurance and tools for authorized group of users that allow monitoring of the students' activity in surveys and automated analysis of the results. A solution relating to automation of the process of interviewing and summarizing the data in conducting surveys that are an integral part of the institutional quality assurance systems of universities is proposed. Thus the study supports the development of these systems in the direction of building a coherent European Higher Education Area. The results of the study would certainly have a positive influence on the improvement of practices for quality assurance in higher education institutions. The developed and probated at Plovdiv University mobile application for conducting surveys is probably the first of its kind in the country. Its means for automated monitoring of the students' activeness as survey participants and for subsequent analysis of the survey results allow members of university quality committees to generate summary reports. But moreover they could monitor ongoing surveys and analyse intermediate data at any time. The results of the presented research promise to be useful for the other educational institutions as well.

E5. R. Donevs, **S. Gaftandzhieva**, *Integration of Web 2.0 tools in Moodle*, Proceeding of the 5-th National Conference "Education in the information society" (eds. G. Totkovand I.Koychev), ISSN 1314-0752, 137-145, 2012.

The contemporary WEB 2.0 technologies are more and more widely used nowadays in the training courses conduction. It is a challenge for the teachers to introduce successfully the use of these technologies in educational process. Possibilities for integration of some of the most disseminated and useful in the training WEB 2.0 tools in Moodle are presented in the work. The results of the study are applied in the development of an e-learning course Spreadsheets to realize the ideas of e-Learning 2.0 for training in the field of information technology.

E6. R. Doneva, **S. Gaftandzhieva**, Web 2.0 technologies in e-learning, Scientific Research of the Union of Scientists in Bulgaria - Plovdiv, Series B. Natural Sciences and the Humanities, vol. XV, ISSN 1311-9192, pp. 93-96, 2012.

The paper presents "Spreadsheets" e-course based on the principle of invariance in presenting the learning content. It describes how specific Web 2.0 tools are integrated into the Learning Management System Moodle for the course, as well as the various learning activities for which they are used (knowledge testing, self-work, presentation of learning content, etc.). Specific examples of the application of technology during the training course are given.

E7. R. Doneva, **S. Gaftandzhieva**, Integration of a university information system and LMS Moodle, Scientific Research of the Union of Scientists in Bulgaria - Plovdiv, Series B. Natural Sciences and the Humanities, vol. XV, ISSN 1311-9192, pp. 89-92, 2014.

The paper explores the possibility of integrating a university information system with a learning management system to avoid duplication and multiple entries of student personal data. It presents an experiment for such integration of an information system of the 'e-student' type at the University of Plovdiv "P. Hilendarski" (PU) and the open-source LMS Moodle. As a result, there is an opportunity for direct registration of PU students when conducting e-learning in Moodle.

E8. **S. Gaftandzhieva**, G. Totkov, R. Doneva, *Automatised Evaluation of Test Quality in e-Leaning*, Proceedings of the VI-the National Conference on e-Learning in Higher Education Institutions, University Press "St. Kl. Ohridski", ISBN 978-954-07-4114-7, pp. 333 – 338, 2016.

The paper presents a model for quality evaluation of test items (TI) and tests used in various forms of e-learning in higher education. The model is based on surveys among students and experts concerning the design, development, implementation and evaluation of TI and tests in e-learning. The software module has been developed and experimented in order to process the surveys. It allows extracting and summarizing of data from other university data sources, not only from the system where the e-learning has been conducted.

E9. G. Totkov, R. Doneva, **S. Gaftandzhieva**, G. Pashev. Automated Accumulation and Aggregation of Data for Quality Evaluation in Higher Education, 10th National Conference "Education and Research in the Information Society", Rakursi Ltd., pp. 79- 88, 2017.

The paper explores the possibility for automated accumulation and aggregation of data for quality evaluation of higher education. A model for automated accumulation and aggregation of data specified

for institutional accreditation by the NEAA criteria system is proposed. An analysis of the possibilities for automated data accumulation for evaluation of the criteria from the Criteria system for institutional accreditation of higher schools of NEAA has been made. Experiments are performed for data accumulation from university information systems.

E10. G. Totkov, **S. Gaftandzhieva**, R. Doneva, *Accumulative Frame Models in e-Learning*, Scientific Works of the Union of Scientists in Bulgaria – Plovdiv, Series C. Technics and technologies, Vol. XV, pp. 17-20, 2017.

The use of frames as a mean of presenting knowledge in artificial intelligence has been suggested by M. Minsky in 1974. Frames are used in the theory and practice of e-learning (in Physics, Mathematics, English, etc.) as a mean for classifying and cataloguing of learning units in the text. The relevant methodology is based on the students' solution of the task "reading with comprehension of the learning text", coupled with frames creation. The paper introduces the term "accumulative frame model". The advantages of the proposed model are the possibility of its non-standard applications in e-learning such as automated generation of metadata and test items to learning materials, segmentation of text to learning units, data extraction of text, etc. The paper presents stages of a study for development of a software system for designing, creating and using accumulative frame models in the e-learning.

E11. ***S. Gaftandzhieva***, R. Doneva, G. Totkov, *Frame Representations and Applications*, Scientific researches of the Union of Scientists in Bulgaria-Plovdiv, series B. Natural Sciences and the Humanities, Vol. XVIII,ISSN 1311-9192, pp. 96-99, 2018.

The generality of the frame representations determines their broad application in a lot of diverse areas. The article introduces a part of a research on the implementation of the frame representations in e-learning, which is devoted to theoretical study of frame models and analysis of their known applications.

E12. R. Doneva, **S. Gaftandzhieva**, G. Totkov, *Frame Models in Programming Training*, 11th National Conference with International Participation "Education and Research in the Information Society", Rakursi Ltd., ISSN 1314-0752, pp. 170-180, 2018.

The use of frame-based representations in training methods has a long history. The paper presents a part of a study on the application of frame-based representations of knowledge for the needs of e-learning. On the basis of the proposed accumulative frame model for knowledge representation and accumulation, a system of 20 accumulative frame models for conceptual knowledge presentation in the field of programming has been developed. Four types of tasks for studying C ++ programming language syntax are suggested.

E13. E. Somova, **S. Gaftandzhieva**, R. Doneva, *An Attempt of Project-based Learning in e-Learning*, Proceeding of 7th National Conference "E-learning in Higher Education Institutions", University Press "St. K. Ohridski", ISBN 078-954-07-4509179-188, pp. 55-68, 2018.

The paper presents an attempt to realize active learning in a distance education course through project-based learning. The authors propose a pedagogical approach where individual project assignments are combined with collaborative activities or assignments. Individual and collaborative activities are placed in each learning week, continuously throughout the whole course. The e-learning

course is carried out with students from the University of Plovdiv. The obtained results are analysed and some measures for improvement of the quality of the learning are given.

E14. G. Totkov, **S. Gaftandzhieva**, G. Pashev, S. Atanasov, *Conceptual and Computer Modeling of Processes with Accumulation and Synthesis of Data in Higher Education*, Proceeding of 7th National Conference "E-learning in Higher Education Institutions", University Press "St. K. Ohridski", ISBN 078-954-07-4509179-188, pp. 134-142, 2018.

A significant part of the contemporary university information systems lack the tools for modelling, modification, virtualization and accompanying of processes. The paper introduces a software prototype, based on process virtualization tools in different spheres of higher education. A major role among them is played by tools for modelling and dynamic management of processes in corporate information infrastructures. Processes are modelled as workflows of activities. They are accompanied by visualization methods of related information resources stored in digital repositories (available for personal use or collaboration).

E15. G. Pashev, **S. Gaftandzhieva**, G. Totkov, *A System for Computer Modeling of Accumulative Frame Models for e-Learning*, Scientific Works of the Union of Scientists in Bulgaria – Plovdiv, Series C. Technics and technologies, Vol. XVII, ISSN 1311-9419, pp. 88-91, 2019.

A software environment CumuFormo for designing prototypes of frames and instances of frames with slots of different types is introduced. CumuFormo supports different databases and facilitates modeling of pedagogical scenarios in the form of e-learning workflows. The software tool Alpaca and a workflow interpreter, named EMS, are used in the development of CumuFormo.

E16. M. Docheva, **S. Gaftandzhieva**, G. Totkov, *Automatised Quality Evaluation in Secondary Education*, Scientific Works of the Union of Scientists in Bulgaria – Plovdiv, Series C. Technics and technologies, Vol. XVII, ISSN 1311-9419, pp. 96-99, 2019.

Each educational institution faces the challenge of improving the quality of education. In recent years, more attention has been paid to the quality assessment in secondary education. The quality of education in secondary schools is defined by a set of indicators that characterise different aspects of the learning process: learning content, training methods, pedagogical staff and factors that ensure the development of competence of the pupils. In order to be objective and in line with current trends and normative documents, the quality assessment should take into account school conditions, training content and the organisation of the learning process in which these results are obtained. The document presents approaches, normative documents and methodologies for quality assurance and assessment in secondary education.

E17. S. Atanassov, E. Alendarova, **S. Gaftandzhieva**, G. Totkov, *Model and Monitoring System of Corporative Infostructure*, Scientific Works of the Union of Scientists in Bulgaria – Plovdiv, Series C. Technics and technologies, Vol. XVII, ISSN 1311-9419, pp. 125-128, 2019.

The paper presents a model, architecture and software system COMPAS-M for tracking, analysis and monitoring of various components and elements of a corporative infrastructure. In general, COMPAS-M allows modelling, virtualization (i.e. start-up and maintenance of a life cycle) and management of: a) specific information structures – segments of corporative information infrastructure;

b) processes with different nature (monitoring, data gathering, synthesis of documents, etc.) and c) digital repositories with e-resources. Compass-M includes a library of data retrieval functions from the 3 parts of the corporative infrastructure (system, hardware and information), incl. with the participation of users.

E18. **S. Gaftandzhieva**, R. Doneva, S. Bandeva, *Learning Analytics for Improving the Results of Training: State of Research in the Field*, Proceedings of the 12th National Conference "Education and Research in the Information Society", Rakursi Ltd., ISSN 1314-0752, pp. 55-64, 2019.

In recent years there has seen an increase in the level of importance in the gathering and analysing of data related to the training. The new educational system/paradigm has seen some challenges in regards to providing the best quality education through the use of learning analytics. Even though this area of study is still to be explored and emphasized, it is nonetheless the key driver for the aforementioned study. The paper proposes a review of basic research in this field within the study that will provide models, methods and software tools for learning analytics to improve the learning outcomes of higher education.

E19. R. Doneva, **S. Gaftandzhieva**, G. Shivacheva, *Accumulative frame models for extraction and aggregation of data for knowledge and processes in education*, Proceeding of Science Forum 2017/2018, University Press "Paisii Hilendarski", ISBN 978-619-202-525-0, pp. 88-107, 2019.

The paper presents the results of a study conducted within the scientific project "Accumulative frame models for extraction and aggregation of data for knowledge and processes in education" ranked by the 2017/2018 competitive research session at the University of Plovdiv (competition "Young scientists and doctoral students"). The study is related to the application of frame structures for representation of knowledge and processes in e-learning.

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Plovdiv /Assoc. Prof. Silvia Gaftandzhieva, PhD/