part, "Checking the Digital Competences of Bulgarian Students", the digital competences verification of Bulgarian students is presented, which has been held for four years, the last two of them – for all 10th-grade students. The final part – "Specific experiment" – describes a particular experiment in a Bulgarian school. Specific ways to apply different learning methods through innovative technologies are identified, in order to demonstrate the value of using them to enhance pupils' digital competences.

2. Digital Competences

With the development of information technology, an independent government agency, the National Commission on Libraries and Information Science (NCLIS), in the development of library and information needs, establishes in the US in 1970. It defines the policy framework for the development of information activities. The idea of information literacy emerges.The Association of College & Research Libraries (ACRL) formulates standards for information literacy.

In 2001, Australia and New Zealand developed a collaborative framework for information literacy and improved it in 2004 (Bundy, 2004). It includes principles, covering the six basic standards that underlie the acquisition, understanding and implementation of information literacy by a person. These standards establish that an information literate person: recognizes a need for information and determines the extent of the information needed; accesses information efficiently; critically evaluates information and its sources; classifies, stores, manipulates and redrafts information collected or generated; incorporates selected information into their knowledge base; uses information effectively to learn, creates new knowledge, solves problems and makes decisions; understands economic, legal, social, political and cultural issues in the use of information; accesses and uses information ethically and legally; uses information and knowledge for participative citizenship and social responsibility; experiences information literacy as part of independent learning and lifelong learning.

In 2013, the European Commission (EC) published a Framework for Developing and Understanding Digital Competence in Europe (Ferrari, 2013). In 2016, the Commission published DigComp 2.0: The Digital Competence Framework for Citizens (Vuorikari, Punie, Carretero & Van den Brande, 2016). In 2017 the Commission expanded it and published DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use (Carretero, Vuorikari & Punie, 2017). The European Framework for Digital Competence has set key components of digital competence in five basic areas:

1) *information and data literacy:*identifying of information needs;browsing, searching, filtering data, information and digital content;creating and updating personal search strategies;analyzing, comparing and critically evaluating the credibility and reliability of sources of data, information and digital content; organizing, storing and retrieving data, information and content in digital environments;

2) *communication and collaboration:* interacting, communicating and cooperating through appropriate digital technologies; participating in society through the use of public and private digital services; adapting communication strategies to the specific audience and realizing of cultural and generational diversity in digital environments; managing one or more digital identities; protecting of one's own reputation;

3) *digital content creation:* creating and editing digital content in different formats;modifying and integrating information and content into existing knowledge management systems while applying copyright and licenses; creating new, original and relevant content; settings and modifications of programs, software applications, software, devices; planning and developing a sequence of comprehensible computing system instructions to solve a problem or to perform a specific task;

4) *safety:* protection of digital devices, content, personal data and privacy in a digital environment; understanding the privacy of other people; protection from threats and cyberbullying; knowledge of the possibilities of digital technologies for enhancing social well-being and social inclusion; knowledge of the environmental impact of digital technologies and their use;

5) *problem solving:* identifying and solving technical problems when operating devices and using digital environments; assessing needs and identifying, evaluating, selecting and using digital tools and possible technological responses to solving them; adjusting and customizing digital environments to personal needs (e.g. accessibility); creative using of digital technologies to create knowledge and to innovate processes and products; solving conceptual problems in the digital environment; identifying omissions in digital competence; searching for self-improvement opportunities and keeping up-to-date with the digital evolution.

The conclusion in a report, published by the European Commission in early May 2017, is that digital skills are needed for every job. The research is titled "ICT for work: Digital skills in the workplace" and explores the impact of ICT on job and skills transformation[1)]. It is essential that basic digital competences are acquired during the training process and that they continue to develop in the workplace.

In 1998, a concept for information literacy of the population was created in Bulgaria in the form of a Strategy for the Development of the Information Society and a National Program for the Development of the Information Society in the Republic of Bulgaria. There are a number of requirements in the Strategy: information literacy, functional computer literacy, communication literacy, communication skills in the ICT environment, cognitive and intellectual skills, critical thinking skills, assessment of one's own work and its outcomes; analysis of one's own learning processes and ability to optimize learning strategies. The same idea is seen in the objectives of the National Strategy for ICT Implementation in Bulgarian Schools from 2002.

Digital competences are among the eight key competences recommended by the European Parliament[2] and refer to criticism and confidence in using the full range of digital technologies for information, communication and basic problem solving in all aspects of life.

3. Digital Competences Verification of Bulgarian Students

Online testing of the 10th-grade digital competences started in 2015 in 15 selected schools in the regions of Sofia-city, Smolyan, Rousse, Pazardjik and Gabrovo; 1001 students participate in it[3]. In 2016, a pilot national online assessment of digital competences took place, with pupils from all 28 regions of the country. The evaluation included 19536 students, which was 93.21% of the sampled students from different types of schools[4]. In 2017, the first national digital assessment of digital competences with 10th-grade students in all schools in the country was held[5]. This year the second such assessment took place[6].

Competences that match both the State Educational Standards for ICT and Informatics and the European Reference Framework for Digital Competence in the following areas are checked: information, communication, content creation, safety, problem solving.

National External Evaluation of Digital Competences involves solving a theoretical test (Module 1) for 30 minutes and a practical task (Module 2) for 60 minutes. Both modules have a maximum of 30 points. The maximum score count is 60.

Before the actual evaluation, a training session with the students is carried out, with an exemplary test and a sample practical task, which have the same requirements to the learners' knowledge. The training session allows students to become familiar with the platform, the way and the environment in which the exam is held.

Module 1 includes theoretical material in Information Technology and Informatics, studied from 5th to 10th grade. Each student's test during the assessment is randomly generated from a task bank by category, so that all pupils do not work on the same test, but on an equivalent one that is exemplary, with other tasks in different order. The number of options that are obtained is a 10-digit number. The assessment is done automatically, immediately after the test is finished[3), 4), 5)].

Module 2 consists of solving a practical task for creating an integrated document, with students having to use their knowledge of forming a text, working with a spreadsheet, making a presentation, creating and sharing PDF documents. They need to demonstrate their ability to assess, analyze, clarify, process and present available complex information. The practical task is obtained online by the student at random from 15 options, which are also similar to the exemplary practical task[3), 4), 5)].

Students who have 30 or more points on the National External Assessment of Digital Competences (50% or more of the maximum number of points) receive certificates for their results from the Ministry of Education and Science.

From the published statistics[3), 4), 5)] on the trial, pilot and national external evaluation of digital competences, it is clear that pupils are permanently experiencing

difficulties in the theoretical basis of information - tasks related to measurement of information and conversion from one measurement unit to another, as well as tasks, related to searching for information. There is an enhanced success in the field of content creation - tasks with spreadsheet calculations. The highest results are shown in the areas of communication and safety – tasks related to electronic communication, cloud technologies and work in a shared environment, as well as tasks related to antivirus protection.

4. Specific experiment

The article presents particular results obtained from the National External Evaluation (NEE) of Digital Competences (DC) at the Professional School of Food Technology (PSFT), Plovdiv during the two school years, in which it is held with students from the 10th grade in all Bulgarian schools.

The preparation of students for the NEE of DC is in the form of homework and during teacher counseling hours, without disturbing the thematic curriculum for the 10th grade class content.

In the school year 2016/2017, the students' preparation for NEE of DC at PSFT was carried out through classical methods of training – lessons for new knowledge, exercises, control tests.

During the school year 2017/2018, the preparation of the students for NEE of DC was done through the application of innovative technologies – cloud services, implemented in PSFT from November 2017. Emphasis was put on enhancing students' skills to solve practical tasks. They worked not only in computer cabinets and on their own home computers, but also through their personal mobile devices, at random locations and at any time they wanted.

Ways to increase the digital competence of students by applying different learning methods:

1. Assigning a homework to refresh their knowledge on:

1.1. Searching and analyzing information from the Internet on a given subject, in the field of information technology. Checking the authenticity of the sources. Systematization of the information found.

1.2. Text and document formatting. Following the rules for shaping a text document.

1.3. Working with spreadsheets on practical tasks encountered in the students' learning practice of the respective majors. Analysis of the information provided. Performing calculations according to the task. Summary of the obtained results through diagrams.

1.4.Creating presentations on a given topic related to school subjects from the students' current curriculum.

1.5. Working with documents in PDF format - creating PDF documents using word processing programs, spreadsheets and presentations.

Students self-assess their homework by teacher-defined criteria, assess their classmates' homework, and then provide them for a teacher's examination in a cloud environment. This way they increase their competences and develop logical and critical thinking. Homeworks increase in difficulty, with the last 6 of these being practical tasks for creating an integrated document given in NEE of DC in previous years, and similar tasks, created from the teacher.

2. Solving theoretical online tests created by the teacher, as well as ones given in NEE of DC in previous years. The tests include information technology and computer science topics, studied by pupils from 5th to 10th grade. Students solve tests through via their mobile devices.

3. Teamwork on projects in the field of Information technology. Students work together on shared documents.

In the actual NEE of DC, Module 1 is automatically assessed by the National Online External Evaluation System as soon as the test is completed. The average number of points for Module 1 in the 2016/2017 school year at PSFT is 15.75 points, and in 2017/2018 - 15.90 points out of the maximum 30. From this it can be concluded that the theoretical part of the material is acquired at an average level.

In the 2016/2017 school year, when assessing Module 2, an impression is left that students are experiencing difficulties due to gaps connected with formatting both text and layout document structure. The given chart shows an appropriate choice of type, suitable to the task condition, but there are gaps with the indication of a headline, values and legend, data analysis. The text-based analysis of the task is difficult for pupils and is absent as a conclusion drawn up in written text. The linguistic norms of the Bulgarian language have been respected, but unformed documents are observed.

During the 2017/2018 school year, when assessing Module 2, it was found that students had done well with the practical task. Almost all of them had successfully created an integrated document, but although they had chosen the appropriate chart type to fit the task condition, they had difficulties in using it for data analysis. Another difficulty is the creation of lists that require particular order type, depending on the calculations made. The highest number of points is observed in the examination of the linguistic norms of the Bulgarian language and the overall structure of a document.

Figure 1 presents the percentage distribution of PSFT students who obtained NEE of DC scores in 5 ranges: up to 19 points, between 20 and 29 points, between 30 and 39 points, between 40 and 50 points and between 51 and 60 points during the school years 2016/2017 and 2017/2018. There is no student with a maximum (60) or a minimum (0) number of points in both school years. The percentage of students who received less than 30 points has decreased and the percentage of students who have received 30 points or more has increased.

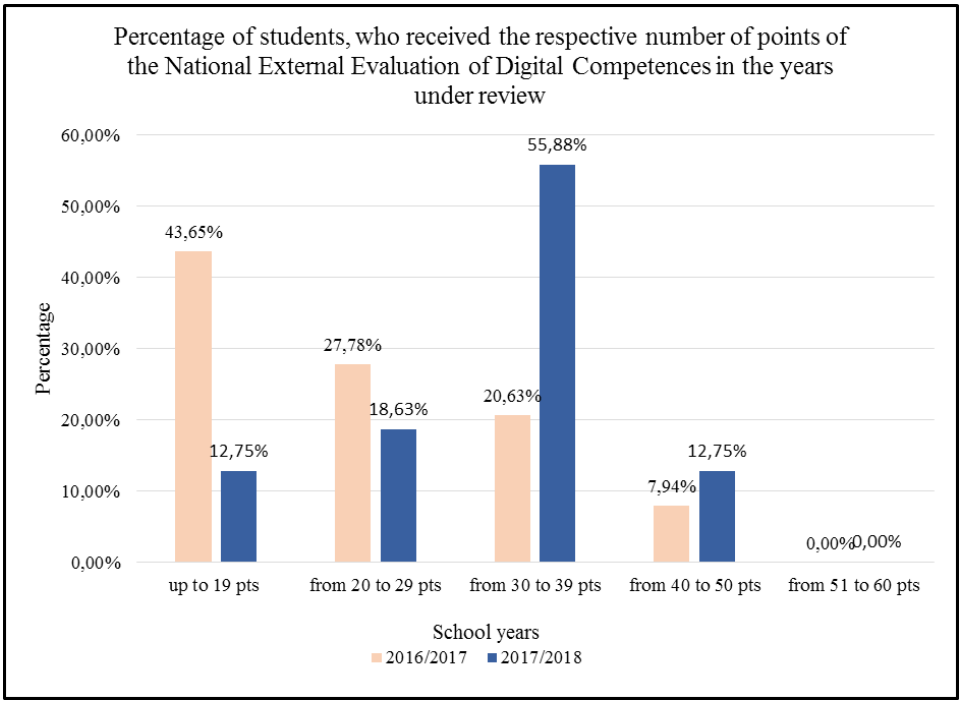

Figure 1. Results of students from the National External Evaluation of Digital Competences in 2016/2017 and 2017/2018 school years in percentage

The statistics presented in Figure 2 is important, because students who have 30 or more points in NEE of DC (50% or more of the maximum score) are presented; due to the receipt of certificates with the results of the evaluation by the Ministry of Education and Science, this is a criterion for a successful exam. In the 2016/2017 school year, the average number of points per student was 23.56, while certificates were received by 36 students out of 126, who had held the exam, which is 28.57%. In 2017/2018, the average number of points per pupil was 31.38. Certificates were given to 70 students out of 102, which is 68.62%.

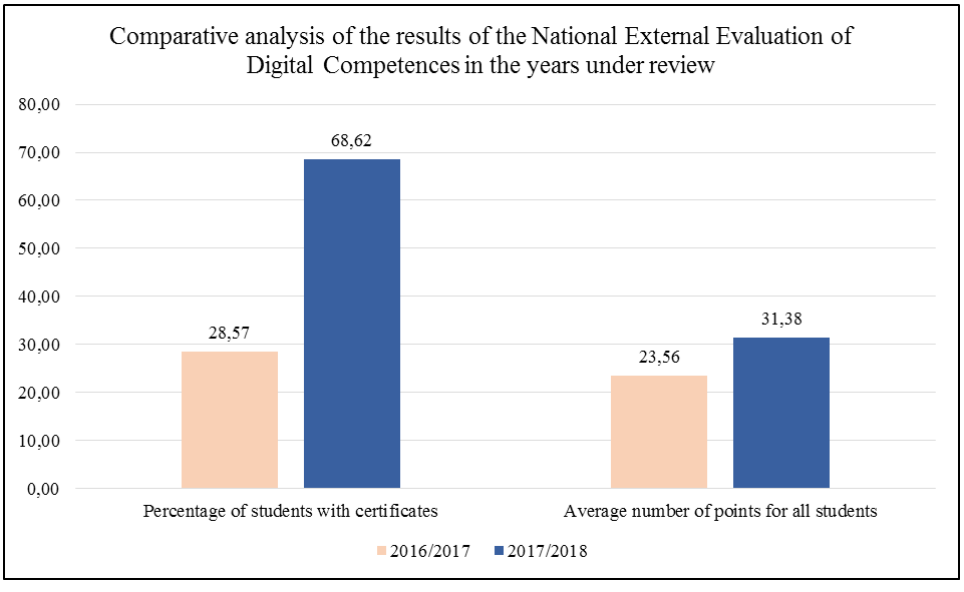

Figure 2. Comparative analysis of the percentage of students, who received certificates as well as the average number of points per student in 2016/2017 and 2017/2018 school years

As seen from the above statistics and Figure 2, there is an increase of 40.05% for students who have received certificates. Since the average number of points, received by students in the theoretical Module 1 over the two years, is slightly smaller than 0.15, the percentage is due to the higher success rate in the practical task.

Figure 3 shows the percentage distribution of PSFT students who obtained results from the Module 2 practical task (maximum 30 points) in 5 ranges: up to 14 points, between 15 and 18 points, between 19 and 22 points, between 23 and 26 points and between 27 and 30 points during the school years 2016/2017 and 2017/2018. The percentage of students who received less than half points has dropped, and the percentage of students who earned 15 points or more has increased.

This is the result of the above-mentioned ways of work that enhance the digital competences of students through different learning methods, applied with innovative technologies. The use of innovative technologies facilitates communication between teachers and students, and teamwork projects. Working in a cloud environment enhances the motivation of students, who are attracted to both new technologies and working through their own mobile devices from any location and at any desired time.

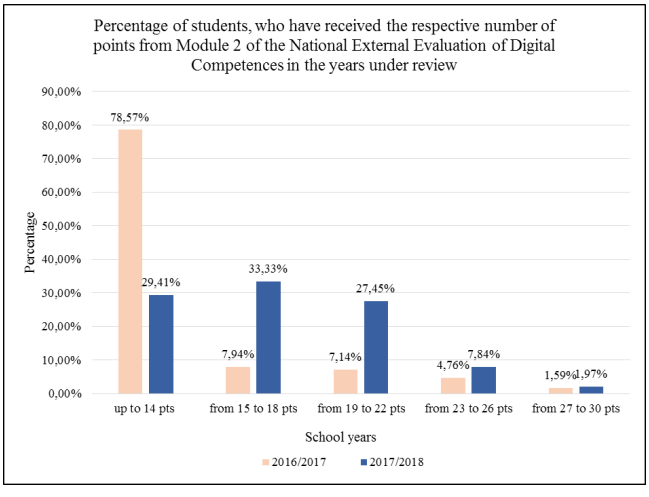

Figure 3. Results of students from Module 2 of the National External Evaluation of Digital Competences in 2016/2017 and 2017/2018 school years in percentage

5. Conclusion

The application of innovative cloud technologies provides an opportunity for enhancing students' digital competences by acquiring skills for the proper use of electronic means in learning, leisure activities and communication. The presented ways of using these technologies make it easier to retrieve, evaluate, store, create, integrate, present and share information, and communicate through the Internet easily. Students develop accurate and logical thinking, skills to process large amounts of information and acquire good communication skills. As a result, the level of digital competences of the new generation of citizens of the world is increasing.

NOTES

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Educational Technologies
Образователни технологии

СИСТЕМА ОТ ЗАДАЧИ В ОБУЧЕНИЕТО ПО МАТЕМАТИКА

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Резюме. Статията разглежда понятието „система от задачи“ като метод за обучение, което означава обучение чрез задачи. Тя покрива всички етапи на усвояване на новото знание – въвеждане, затвърждаване и приложение. Предложен е модел на система от задачи на различни равнища. Проектирането на системата е йерархично и включва: цел; очаквани резултати; подбор на задачите; организация, методи и средства при преподаването. Реализацията на системата е илюстрирана върху система от задачи първо равнище по темата „Сечение на многостен с равнина“ за свободноизбираема подготовка в XI клас. Методиката предполага използване на компютърни системи за визуализация и анимация.

Keywords: education in Mathematics; intersections; system of tasks; computer visualization and animation

1. Що е система от задачи

Задачите играят важна роля в обучението. Те могат да се разглеждат в два аспекта: като цел на обучението и като средство за обучение. Първият аспект е насочен към овладяване на методи за решаване на класове задачи. Вторият аспект се отнася до използване на задачите като метод за обучение.

Тази статия е посветена на втория аспект.

Обучение, което се осъществява с помощта на задачи, изисква специално разработена система. Разработването на система от задачи е въпрос, разглеждан в изследванията на редица математици от руската школа по методика на обучението по математика. Такива са работите на Dalinger V. A. (Dalinger, 1982), Kolyagin Y. M. (Kolyagin, 1977), Muravin K. S. (Muravin, 1966), Sarantsev G. S. (Sarantsev, 1982), Suvorova S. V. (Suvorova, 1982) и др. В България темата намира отражение в изследванията на Asenova P. (Asenova, 1990), Dureva D. (Dureva, 2001), Garov K. (Garov, 2004; Garov, 2006; Garov, 2010), и др.

Тук ще възприемем следното определение за ***система от задачи***: *това е методически обоснована съвкупност от задачи, която осигурява постигане на планирани резултати в обучението.*