

CREATING EDUCATIONAL GAMES FOR MATHEMATICS CLASSES USING INFORMATION TECHNOLOGY

Vilislav Radev

Abstract. *The article is devoted to the use of information technologies in the creation of educational games for the acquisition of new knowledge in primary school. Specialized Scratch software for introducing computer culture to children is reviewed. The basis for the developed animated module is the mathematics textbook for third grade, authored by Prof. Dr. Vladimira Angelova and Zhana Koleva, Prosveta Plus Publishing House, Sofia, 2017. The aim of this article is to strengthen the competences acquired by the student on the subject of “Subtraction of the numbers up to 1000 with transition” to perform the arithmetic operation of subtracting the numbers up to 1000 with a transition from the order of hundreds to the order of tens, to check the subtraction with addition and to find an unknown addendum.*

Key words: information technology, digital competence, mathematics, Scratch.

Modern education must create conditions for continuous learning process throughout a person’s life, for understanding and analyzing the processes of the world around us, for making a correct assessment of various situations and achieving the maximum positive result of one’s activity in these situations. One of the main tasks of the modern Bulgarian school is the creation of such creative personalities. For this purpose, the person is required to possess a wide range of competences with wide applicability to be able to adapt quickly to the changing reality.

Based on the European directives and materials published in our country related to education and training, the Ministry of Education and Science in Bulgaria indicates the following key competences that must be formed in the training process:

1. Communication skills for communicating in the native language;
2. Communication skills for communicating in a foreign language;

3. Mathematical competence and basic competences in the natural sciences;
4. Digital competences (Information and communication technologies);
5. Skills for independent learning and information gathering;
6. Public and civil competence;
7. Initiative and entrepreneurship;
8. Cultural awareness and creativity.

It is considered that all eight competences are equal and what they have in common is creative thinking, creative problem solving, decision making, initiative, individuality, etc. Each of the competencies is defined and the necessary knowledge and skills that must be acquired in the training process are defined.

The European Commission has developed a European Framework for Digital Competence of Citizens (DigComp). It defines the term “digitally literate”:

1. Information and data literacy – to be able to articulate information needs, to find and retrieve digital data, information and content. To assess the significance of the source and its content. To store, manage and organize digital data, information and content.
2. Communication and collaboration – to interact, communicate and collaborate through digital technologies. To participate in public life using public and private digital services. To manage its own digital identity and reputation.
3. Digital content creation – to create and edit digital content, improve and integrate information and content into existing knowledge management systems. To know how to give understandable instructions to a computer system.
4. Security – to protect digital devices, content, personal data and privacy in a digital environment. To know how to protect physical and mental health, and to know the possibilities of digital technologies to increase social well-being and social inclusion. To recognize the impact of digital technologies on the environment.

5. Problem solving – to identify needs and problems, and solve conceptual problems in a digital environment. To use digital means for creating innovative processes and products.

Digital literacy should “meet the current and future needs of learners and the community” and “provide students with the tools they need to meet today’s challenges” [1]. With the presented animated module “Picnic” and its use in mathematics classes, knowledge and skills for the correct application of information and communication technologies are expected to be formed. A similar approach with a proven positive impact and the use of dynamic and interactive electronic models for the presentation of learning content has also been applied in higher education levels [2, 3]. The results obtained by A. Nikolova are in accordance with the above who concluded that the application of IT in education “supports the construction of positive motivation among students, putting them in an active cognitive position” [4]. According to Hristov, “The primary teacher of “Computer Modeling” often solves tasks related to computer technology”, such situations when working with computer devices and software lead to the complication of the learning process and additional work by the teacher [8].

Educational content

Increasing digital literacy in students could also be done through gamification of part of the learning content in mathematics classes. Such an example is the game “Dogs” from the teaching content of the topic “Multiplication of a two- and three-digit number by a one-digit number”, page 54 of the textbook “Mathematics for third grade” (Vl. Angelova and Zh. Koleva). Its aim is strengthening the competencies acquired by the student:

- Multiplication of a two-digit and three-digit number by a single-digit number with passage to the hundreds;
- Solving compound word problems in straight form.

By solving the proposed task from the “Books” module, the aim is to develop the skill of modeling with numerical expressions of text tasks.

Scenario of the implementation of an animated module for the game “Dogs” in the Scratch electronic environment

The game is designed for third grade and is programmed as a comic

book with two characters. The characters are the animated character Annie, who sets the condition of the task as cues, and her dog Sharo. The student must read the cues as the time for reading and understanding is not exactly set. In this way, he has enough time to write down the main elements that are given in the condition of the task, to think and give an answer.

The animated heroine expresses positive support for a correct answer – “Bravo!”, and in case of mistake, communicates, giving the opportunity to correct the answers with the reply “Try again”. This makes the game dynamic and interesting for students. There is a help button in the upper right corner (a worried face emoticon and a question mark). Students can press it and the game redirects to a resource section.

In the text task, the goal is to find the value in leva that the heroine will save if she sews jackets for her two dogs herself. The price of one dog jacket if she buys it from the store, the fabric from which she can sew the two jackets and the cost of the other materials for the sewing are known. The only unknowns are the value of two jackets she can buy and the amount she would save if she sewed two jackets. The task is a composite text in a straight form and the students consolidate the knowledge of multiplying a two-digit number by a single-digit number by passing to the hundreds.

In the first level, the animated heroine introduces herself and her dog friend Sharo. The characters are selected from the available sprites in the Scratch gallery. They are located on the “Forest” decor, which is not available in the app’s gallery. It is selected from an image from Internet and integrated into the animation module for the purpose of the task.

After introducing herself, the heroine points out to the students that it is getting cold outside and her pets need warm clothes, in this case a jacket (see Fig. 1).

In the next level, the decor changes to “Shop Outside”. This decor is not available in the Scratch gallery, but an image from Internet that has been integrated into the animation module for the purpose of the task. The heroine turns to her dog and tells him that he must stay outside while she is in the store picking out clothes for him and his friend who stayed at home (see Fig. 2).

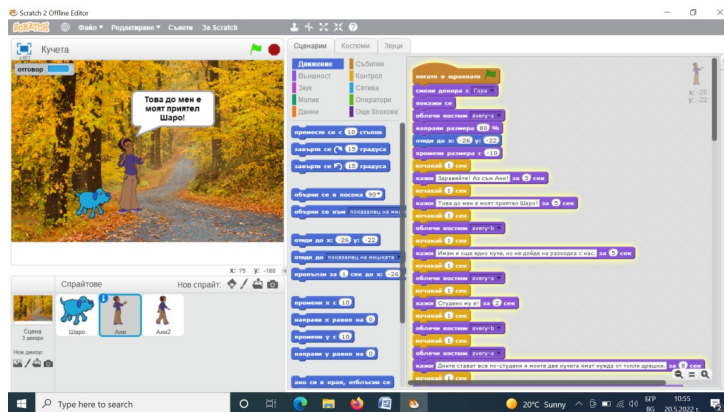


Figure 1. Module “Dogs”, level one

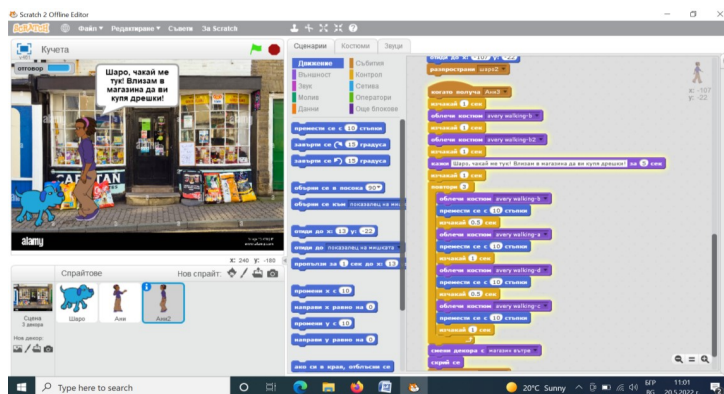


Figure 2. Module “Dogs”, level two

The game is entirely in monologue form and the heroine thinks by herself all the time and asks questions to the students. The animated heroine solves the problem with separate calculations. When performing the operation of multiplying the number of dogs there are and the amount of one jacket, the method of oral calculation is applied. Since the problem covers content that is studied in the third grade, the goal is to refresh the knowledge of multiplying a two-digit number by a one-digit number by going to the hundreds. The first calculation is done.

The heroine Ani directs the students’ attention to the other elements that are necessary to solve the task. She reveals the value of the fabric for sewing the two jackets – BGN 39 and the value of the other necessary materials – BGN 12. In the next calculation, she needs the help of the students. They are required to solve the problem on their own and write down with a single numerical expression the way in which the whole problem will be solved. This is done in the field with the flashing cursor and the command must be confirmed. When the answer is correct, the heroine

Annie stimulates the students with praise – “Bravo!”. And in the case of a wrong answer, it indicates this with a reply – “Try again” and gives the opportunity to correct the answer. The action is repeated until a correct answer is given and the limit of wrong answers is not set.

To successfully practice the action of multiplying a two-digit number by a one-digit number to the hundreds, students, in addition to writing down a numerical expression, are prompted by the animated character to write the correct answer in the field with the blinking cursor. For a correct answer, the heroine again stimulates the students with praise – “Bravo!”. And for a wrong answer, it indicates this with a reply – “Try again”, and gives the opportunity to correct the answer. Again, the action is repeated until a correct answer is given, and at the same time a limit of wrong answers is not set (see Fig. 3).

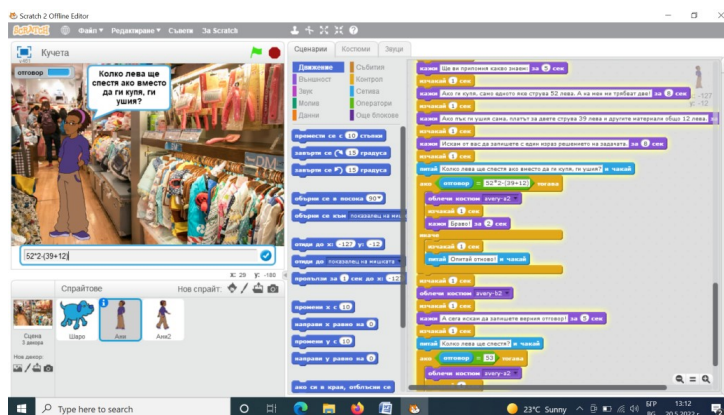


Figure 3. Module “Dogs”, level three

It is explained to the students in advance that when writing the numerical expression in the empty field with the blinking cursor, no spaces should be inserted.

The number is found and the problem is solved. The solution record of the problem is as follows:

It is known: – jacket for a dog 52 BGN;

fabric for sewing two jackets 39 BGN;

other materials for sewing 12 BGN.

Wanted: How much will Annie save if instead of buying clothes for her two dogs, she sews them for them?

Answer: With one numerical expression: $52 * 2 - (39 + 12) = 53$ BGN

With separate calculations:

$$52 * 2 = 104 \text{ BGN}$$

$$39 + 12 = 51 \text{ BGN}$$

$$104 - 51 = 53 \text{ BGN}$$

Answer: Annie will save 53 BGN.

The task provides a “Help” section (see Fig. 4), which can be activated at any moment by pressing the button on the worried face emoticon located in the upper right corner of the screen. The decor illustrates the pattern of multiplying a two-digit number by a single-digit number with a transition to the hundreds.

After viewing the help section screen, the game must be restarted. At any moment, the player can interrupt the game with the stop button. Anyway, restart it using the green flag button.

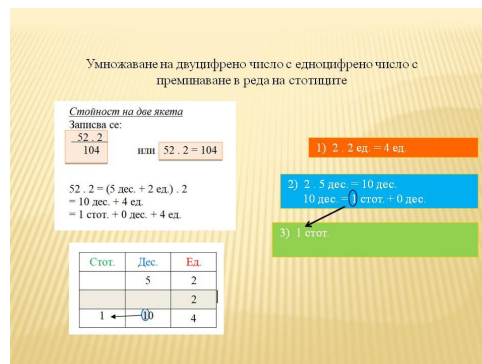


Figure 4. “Dogs” module, “Help” section

Conclusion

The modern student, placed at the threshold of numerous irritants through the smart devices at his disposal, is easily distracted. Digitizing learning content and introducing students to game scenarios is a proven way to capture and retain their attention. The use of appropriate methodology and tools creates a favorable environment for student motivation [6]. It enriches and diversifies the learning process, according to the children’s interests; create an emotional and fun atmosphere in which the child feels satisfaction from the educational activity, in accordance with the real needs of the children [5]. The proposed educational game model itself can be used both within the framework of familiarization with new knowledge

and within the framework of an exercise lesson, as well as for independent work.

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Vilislav Radev*

“Paisii Hilendarski” University of Plovdiv,
236 Bulgaria Blvd., 4003 Plovdiv, Bulgaria

Corresponding author: vradev@uni-plovdiv.bg